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Argumentative Reasoning and the Sunk Cost Fallacy

The influence of reason-based choice and the confirmation bias on investments in failing endeavours in financial decision making

verfasst von / submitted by

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Abstract

Objective: This study aimed to investigate the social environment triggering psychological mechanisms at the origin of the Sunk Cost Fallacy. The hypothesis was that an argumentative context favouring reason-based choice leads people to be more affected by a confirmation bias which in turn causes this cognitive bias. ***Method:*** Eighty participants in the role of managers took two financial investment decisions of which the first one always resulted in negative outcomes. The Sunk Cost Fallacy was measured by the propensity in the second round to invest in the same department as in the first round. In a between-group design participants either anonymously submitted their decisions in voting boxes or justified their decisions to an audience. ***Results:*** Many participants in the audience condition either invested nothing to the failing department ("I made a mistake") or allocated equal amounts (rewarding and fair behaviour, hope of a turnaround), whereas in the anonymous condition allocations of five or fifteen million dollars out of twenty were preferred. Participants in the audience condition decided on salient points of investments more often and specific reasons underlay their investments. Although there was no significant difference between second investments in the two conditions, correlations between questionnaire answers and second investments indicated a relationship between the failure to update beliefs and second investments in the audience condition only. ***Conclusions:*** In an argumentative context participants take justifiable decisions. Results on the role of the confirmation bias are ambiguous. A follow-up experiment on decision making in hierarchical versus egalitarian groups is recommended.

Kurzfassung

Zielsetzung: Der Fokus der Studie lag auf dem Einfluss des sozialen Umfelds auf psychologische Mechanismen, welche der Sunk Cost Fallacy zu Grunde liegen. Die Hypothese war, dass ein argumentativer Kontext die Wahl rechtfertigbarer Entscheidungen begünstigt was zu einem Bestätigungsfehler führt. Dieser verursacht die kognitive Verzerrung. ***Methode:*** Achtzig TeilnehmerInnen in der Rolle von Managern trafen zwei finanzielle Investitionsentscheidungen, wobei die erste immer zu negative Resultaten führte. Die Sunk Cost Fallacy wurde an der Neigung gemessen in der zweiten Runde in die gleiche Abteilung zu investieren wie in der ersten. TeilnehmerInnen reichten ihre Entscheidungen entweder anonym in Wahlboxen ein (*anonymous condition*) oder rechtfertigten sie gegenüber einem Publikum (*audience condition*). ***Resultate:*** Viele TeilnehmerInnen in der *audience condition* investierten nichts in die scheiternde Abteilung („Ich habe einen Fehler gemacht“) oder ließen beiden Abteilungen gleich hohe Anteile zukommen (belohnendes und faires Verhalten, Hoffnung auf positive Umkehr). In der *anonymous condition* hingegen wurden Allokationen von fünf oder fünfzehn von insgesamt zwanzig Millionen Dollar präferiert. Zudem entschieden sich TeilnehmerInnen in der *audience condition* öfter für Investitionspunkte welche die Aufmerksamkeit auf sich zogen. Bestimmte Gründe standen hinter ihren Investitionsentscheidungen. Obgleich es keine signifikante Differenz zwischen den Investitionen in den beiden Konditionen gab, deuteten Korrelationen zwischen Fragebogen-Antworten und Investitionsentscheidungen daraufhin, dass nur in der *audience condition* zweite Investitionsentscheidungen und das Misslingen eigene Überzeugungen zu verändern in einer Beziehung zueinander standen. ***Schlussfolgerungen:*** In einem argumentativen Kontext treffen TeilnehmerInnen rechtfertigbare Entscheidungen. Resultate betreffend der Rolle des Bestätigungsfehlers sind nicht eindeutig. Ein Folge-Experiment über Entscheidungsfindung in hierarchischen versus egalitären Gruppen wird empfohlen.

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List of Abbreviations

An.	Anonymous condition
Aud.	Audience condition
B	Regression coefficient (unstandardized)
SE B	Standard error of *B*
β	Standardized regression coefficient
CP	Consumer products department
D	Test value of the Kolmogorov-Smirnov test for normality
EDE	Experimenter Demand Effect
F	*F*-ratio (regression model)
IP	Industrial products department
K-S Z	Two-sample Kolmogorov-Smirnov Z test value
M	Mean
Mdn	Median
Mio.	Million
n	Number of participants in subsample
N	Total number of participants in sample
ns	Not significant
p	Probability value (significance value of a test)
r	Effect size estimate
r_s	Spearman's rank correlation coefficient
R^2	Coefficient of determination
RMS	Root mean square
R&D	Research and development
SCF	Sunk Cost Fallacy
SD	Standard deviation
sig.	Significant
SP	Salient point of investment

t	Test value of a *t*-test (regression model)
T	Test value of the Wilcoxon's signed-ranks matched-pairs test
U	Test value of the Mann-Whitney U test
€	Euros
$	US dollars
%	Percentage
<	Less-than sign

1. Introduction

1.1 The Sunk Cost Fallacy as a cognitive bias

Neoclassical economic theory has depictured the individual actor as a “homo economicus”, characterized by being “self-interested” and “outcome-oriented”, having “exogenously given and determinate preferences” and “a rate of time preference that allows him to allocate consumption over time in a consistent manner” (Gintis, 2000, p. 312). Experimental Economists, applying for instance game theory, laboratory experiments, and field observations as tools (Gintis, 2000), have proven the limitations of this model: Human decision making “violates the axioms of decision theory” as humans are “hyperbolic rather than exponential discounters of benefits and costs” and show cooperative rather than solely self-regarding behaviour (Gintis, 2000, p. 313). Standard economic theory was built on the assumption of perfect use of information, but as Herbert Simon pointed out, an organism only possesses “limited information and limited computational facilities” (Simon, 1956, p. 129). Bounded rationality is not necessarily “an inferior form of rationality” and the application of “so-called fallacies” can be seen as “reasonable strategy under plausible assumptions about the environment” (Gigerenzer & Selten, 2002, p. 6). Nonetheless, much experimental evidence has been gathered (e.g., Kahneman, 2003b) suggesting that deviance from rational behaviour in the neoclassical sense in human decision making can also lead to biases which can result in negative outcomes for an individual.

The Sunk Cost Fallacy (SCF) forms such a class of irrational decisions. This cognitive bias has been defined by Arkes and Blumer:

> This effect is manifested in a greater tendency to continue an endeavor once an investment in money, effort, or time has been made. The prior investment, which is motivating the present decision to continue, does so despite the fact that it objectively should not influence the decision. (Arkes & Blumer, 1985, p. 124)

Instances of the SCF can be encountered in everyday situations: Lewis Broad, a student of Thaler, for example measured that more food was consumed in an all-you-can-eat pizza restaurant by customers who had to pay for their food in comparison to those who got it free of charge (Thaler, 1980). In this experiment, the refund and the non-refund group were composed of customers who had already taken the decision of entering the restaurant. Therefore, the cost of the lunch should not have been considered anymore in deciding on the amount of food to consume since they represented sunk costs. Eating more slices in the non-refund group to get a good value for the money only led to overeating, not to a recovery of the sunk costs as Frank pointed out (Frank, 2008). Being a seemingly trivial example, serious problems emerge out of the SCF if it occurs in the context of management or governmental decision making in which big quantities of resources or even lives are at stake. An illustrative example is the argument of supporters of the

Vietnam War. They claimed that the war should not end before the "total victory" because this "would have meant the waste of those lives already lost" (Arkes & Blumer, 1985, p. 126).

1.2 Debated determinants of the Sunk Cost Fallacy

Under various names, as for example "sunk cost effect" (Thaler, 1980, p. 47), "escalation of commitment" (Staw, 1976, p. 41), "entrapment" (Brockner, Rubin, & Lang, 1981, p. 68), "too much invested to quit" (Teger, 1980, p. 1), this phenomenon has been studied for more than 35 years with the goal to understand its cognitive foundations. As I will discuss in this section, the theories offer valuable information on the determinants of the Sunk Cost Fallacy, but questions remain open.

In 1980 Thaler argued that the SCF could be explained through Prospect Theory (Thaler, 1980), which had been developed earlier by Kahneman and Tversky (Kahneman & Tversky, 1979). The value function of Prospect Theory depicts that, once an investment has been made which resulted in negative outcomes, the "pain", as Thaler termed it, of further loosing is smaller than the "pleasure" of comparable gains (Thaler, 1980, p. 48). Therefore, a person, who has already made an investment which led to negative outcomes, is more likely to choose a risky option than a person who did not invest yet. In addition, a "certainty effect" is at work: If there is a possibility that an investment becomes less negative in the future, this long-term option will be preferred over a certain loss as "certain losses are particularly aversive" (Arkes & Blumer, 1985, p. 132). Left open is the question why people remain hopeful that an endeavour, which resulted in negative outcomes in the past, could lead to positive outcomes eventually. Even if future investments would lead to gains, the sunk costs would remain irrecoverable.

Arkes and Blumer focused on another aspect of the SCF which Prospect Theory failed to answer: They argued that Prospect Theory described the fact that "sure losses are so aversive and sunk costs are so difficult to ignore" but not why this is the case (Arkes & Blumer, 1985, p. 132). They hypothesized that people are irrationally taking sunk costs into consideration because otherwise the lost money would be rendered wasted (Arkes & Blumer, 1985). They gathered evidences for this theory of wastefulness through experiments with college students from Ohio and Oregon, which became standard scenarios used for a variety of consecutive experiments on the SCF (e.g., Garland, 1990; Soman & Cheema, 2001; Putten, Zeelenberg, & Dijk, 2010). In one of their experiments, to give an example, they sold different types of theatre tickets to students wanting to buy a season ticket for the Ohio University theatre: The first type provided a two dollars discount, the second one a seven dollars discount and the last type was sold at the normal price of fifteen dollars. Results showed that those students who did not get a refund went to the theatre significantly more often than both refund groups during the first half of the season (Arkes & Blumer, 1985). Researchers continue to study wastefulness as a determinant of the SCF to date. One example is a study by Haller and Schwabe who applied functional magnetic resonance imaging to examine the role of wastefulness. The desire not to appear wasteful (based on the answers of participants provided on their desire not to appear wasteful) was shown to be associated

with increased activation of the dorsolateral prefrontal cortex (dlPFC) which plays a role in rule- and norm-based decision making, of the amygdala, associated with emotions and framing effects, and of the anterior cingulate cortex (ACC), which is linked to conflict processing. Brain imaging results depictured a decreased activation of the ventromedial prefrontal cortex (vmPFC), and the nucleus accumbens if participants had made a prior investment. Both areas had been shown to be involved in the integration of costs and potential gains. The activation of the dlPFC was negatively correlated to vmPFC activation. The authors interpreted from the data that the rule not to waste resources, associated with the activation of the dlPFC, can override the activity of the vmPFC, which is linked to costs and benefits calculations (Haller & Schwabe, 2014).[1] Although the theory of wastefulness added valuable insights to the theory of loss aversion it cannot answer under which circumstances concerns about wastefulness appear and lead to the SCF. The question when a misapplication of the rule occurs is left open.

Staw, who published his work almost at the same time as Arkes and Blumer, introduced self-justification as an alternative theory aiming to clarify the determinants of the SCF. Staw claimed that "only self-justification would predict an interaction of personal responsibility and decision consequences such that increases in commitment would be even greater than the additive effect of these two separate factors" (Staw, 1976, p. 30). Using a 2 x 2 factorial design he manipulated both of these factors. In a financial decision case subjects had to decide on the allocation of research and development funds for the hypothetical "Adams and Smith Company". For the first decision half of the participants were asked to decide whether to invest ten million dollars in the industrial products department or the consumer products department (high personal responsibility condition). The other half was told that another financial officer has made the decision (low personal responsibility condition). In each of the two conditions, half of the participants obtained data depicting the negative consequences and the other half data showing the positive results of the initial decision. For the second decision they were asked to make another investment choice, but were provided with 20 million dollars which they could divide in any way they wished among the departments. The dependent variable was the amount of money spent in the second decision on the initially chosen, failing department. Staw obtained results providing evidence that self-justification indeed plays a major role for the SCF: Investments of participants in the high personal responsibility and negative consequence condition (with an average investment of 13.07 million dollars) were significantly higher than those of participants in the other three conditions (with average investments between 8 and 9.50 million dollars) (Staw, 1976). Nonetheless, the study by Staw does not explain why people do not choose rational arguments to justify themselves. Instead of investing more, participants could argue that under conditions of uncertainty they could not have predicted that their decision would lead to negative outcomes.

An interdisciplinary study supported both the theory of wastefulness and self-justification. Arkes and Ayton first researched upon decision making in animals: In the realm of Cognitive Biology

[1] The study by Haller and Schwabe (Haller & Schwabe, 2014) also illustrated how the Sunk Cost Fallacy can be studied in different disciplines relevant for Cognitive Science, in this case Neuroscience.

the SCF was studied under the name "Concorde Effect" but mostly independently from other fields. As Arkes and Ayton pointed out, there is much literature on both the Concorde Fallacy and the SCF, but both fields seemed to be rather ignorant of the existence of the other:

> Researchers have used the term *Concorde fallacy* to refer to the tendency of lower animals to commit the sunk cost effect. We have found no published paper in the human judgment/decision-making literature that cites any of the extensive literature on the Concorde fallacy, and we have found no published paper in the animal literature that cites the sunk cost effect. (Arkes & Ayton, 1999, p. 591)

Based on the study of literature published on the Concorde Effect, Arkes and Ayton claimed that there is no unambiguous evidence for the existence of the phenomenon in animals.[2] In the second step, they looked into studies on children. As a result of their analysis and comparisons of studies by Kahneman and Tversky (Tversky & Kahneman, 1981), and Baron et al. (Baron, Granato, Spranca, & Teubal, 1993) on the SCF as well as Krouse (Krouse, 1986) and Webley and Plaisier (Webley & Plaisier, 1998) on mental accounting, they concluded that adults commit the SCF more often than children. Arkes and Ayton presented two explanations for adults committing the SCF more often than both animals and children: First, adults are more likely to use abstract rules. Children and animals are not aware of the rule to avoid wasting. Therefore, they do not fall into the danger of its overgeneralization. Second, adults are under social pressures which lead to the desire to appear consistent and to justify own behaviour (Arkes & Ayton, 1999). Arkes and Ayton hereby referred to studies on reason-based choice by Simonson (Simonson, 1989), suggesting that humans sometimes choose the most justifiable rather than the most rational choice, and to studies on self-justification by Brockner (Brockner, 1992), Fox (Fox & Staw, 1979), Ross (Staw & Ross, 1978), and Staw (Staw, 1976). The authors emphasized that adults are under "social psychological pressures" which play a major role for the occurrence of the SCF (Arkes & Ayton, 1999, p. 597). Arkes and Ayton thus add to self-justification theory and the theory of wastefulness by taking social pressure and reason-based choice into account. Nonetheless, their findings cannot explain why adults base subsequent decisions on the same reasons as their first decision which led to negative consequences. Why adults do not choose different reasons for justifying their second decision thus remains unanswered by this study.

With questions left open by the major theories developed during the early stages of research, the study of the determinants of the SCF continues to the present day. Soman and Cheema, for example, studied whether a "windfall gain", i.e. an unexpected monetary gain received during the time of the decision, can weaken or eliminate the SCF (Soman & Cheema, 2001, p. 52). Results by Strough et al. suggested that age has an influence: The likelihood of committing a SCF was lower in older adults (58 to 91 years) than in younger adults (18 to 27 years) (Strough, Mehta, McFall, & Schuller, 2008). Garland and Newport found that relative ("dollars in proportion to an

[2] Nonetheless, the existence of the Concorde Effect is still debated. A recent study, for example, yielded results suggesting that pigeons are biased towards choices in which previous investments had been made (Magalhaes & White, 2014).

overall project budget") instead of absolute amounts of sunk costs ("dollars") were taken into consideration. This supports the idea that humans keep mental accounts, where "existing investments are compared with reference states" (Garland & Newport, 1991, p. 55).

In 2012 Sleesman and colleagues presented a meta-analysis aimed to provide an overview on the state-of-the-art of the research on the SCF (Sleesman, Conlon, McNamara, & Miles, 2012). They categorized 166 articles published in 35 years of research into four main categories which had been previously defined by Staw and Ross: Project, psychological, social and structural determinants (Staw & Ross, 1987). The results of the quantitative meta-analysis by Sleesman et al. indicated that a main driver of escalation behaviour is the psychological determinant "ego threat": Maintaining one's own reputation yielded the highest sample-size weighted average correlation (correlation coefficient of .378, $n = 391$) among all determinants tested (Sleesman et al., 2012, p. 551). [3] Their résumé was that researchers have laid their focus mainly on psychological and project determinants, with social and structural determinants being not sufficiently researched upon. They stated that group contexts lack attention and that "social context is a vastly underrepresented area in the escalation literature in spite of its significance in organizations" (Sleesman et al., 2012, p. 557).

1.3 Hypothesis and its rationale

The aim of my study was to contribute to the research on the "underrepresented" social factors behind the SCF (Sleesman et al., 2012, p. 557). Nonetheless, the focus was not laid on social determinants only since social and psychological determinants are necessarily entangled. Humans in most cases do not take decisions in isolation but in social environments. My study focused on the social environment triggering psychological mechanisms at the origin of this bias and offered an alternative hypothesis regarding the determinants of the SCF: Situations favouring reason-based choice, i.e. choosing the most justifiable rather than the most rational choice (see section 1.3.1), leads people to be more affected by a confirmation bias (see section 1.3.2.), which in turn causes the SCF. This is because people who feel a need to justify their own choices come up with reasons. After the first decision, while looking for reasons for the second decision, they fall prey of a confirmation bias, because the reasons for their first decision remained salient. The newly acquired information, by contrast, tends to be disregarded since they look as refutations of the good reasons one came up with for the first decision. To test the hypothesis I conducted an experiment with two conditions as will be discussed in the Methods section. In the audience condition self-justification needs were enhanced relative to an anonymous condition through audience presence and the need to state reasons. The scenario used was an adaptation of the one which had been applied in the above described study by Staw on the role of self-justification for the SCF (Staw, 1967). Predictions will be discussed in section 1.4 after having

[3] *Note.* An overview table can be found in "Cleaning up the big muddy: A meta-analytic review of the determinants of escalation of commitment" by D. J. Sleesman, D. E. Conlon, G. McNamara and J. E. Miles, 2012, *Academy of Management Journal*, 55 (3), p. 551. Copyright by the Academy of Management.

clarified reason-based choice and the argumentative theory of reasoning on which this hypothesis was grounded.

1.3.1 Reason-based choice

In the late 1980s the theory of reason-based choice was proposed. According to this theory, humans do not always tend to select the most rational choice but under specific circumstances the most justifiable one. Previous studies by Simonson indicated that, although applied not only for interpersonal purposes, but also in order to convince oneself, reason-based choice is more likely to occur if a need for justification is anticipated (Simonson, 1989). The theory of reason-based choice can explain phenomena which are deemed irrational by classical decision theory, as for example extremeness aversion or asymmetric dominance effects (Shafir, Simonson, & Tversky, 1993). Various experiments have proven that the preference for an option depends on its position within a choice set. Huber, Payne and Puto, for example, discovered that, given two choices, the better option was perceived as being more attractive if the worse choice was also presented (Huber, Payne, & Puto, 1982). Similarly, Simonson and Tversky experimentally demonstrated that, given the choice of monetary reward or a free pen, the introduction of the option of a cheaper pen increased the number of participants choosing the more expensive pen by ten percent in comparison to conditions in which the third option was not presented at all (Tversky & Simonson, 1993). Value-based choice cannot explain these phenomena of context dependency of preferences. Reason-based choice, on the other hand, offers an explanation: A reason for choosing the more expensive pen was generated by introducing an inferior option. The introduction of the better pen made the choice easier to explain, defend and justify (Shafir et al., 1993). This explanation was supported by findings indicating that asymmetric dominance effects are enhanced if individuals anticipate a justification need to others (Simonson, 1989). In the audience condition of my experiment I exactly operated on this increased application of reason-based choice elicited by anticipated justification needs. The prediction was that reason-based choice would be applied more often in the audience condition than in the anonymous condition as reason-based choice is more likely to occur under social pressure (Shafir et al., 1993).

Reason-based choice is often not in line with value-based choice as for example an experiment by Shafir and colleagues showed: They obtained results suggesting that more than half of a group of students would choose to go on vacation as a reward for passing an exam. Even more students would decide to do so if they failed, in order to consulate themselves. Therefore, it would be rational to buy a vacation package, which is on promotion only for a limited time, even without knowing the results of the exam. Nonetheless, given that the exam results were unknown, only one third of the students stated that they would buy the tickets. 61% of the students decided that they would pay five dollars in order to postpone the decision until the exam results would be known. As Shafir and colleagues argued, paying for non-instrumental information makes justification of the choice easier, but could be deemed irrational since the students would have bought the vacation package independently of whether they failed or passed (Shafir et al.,

1993). They concluded that "it appears that people often do not have well-established values, and that preferences are actually constructed – not merely revealed – during their elicitation" (Shafir et al., 1993, p. 34). Although reason-based choice can explain phenomena which value-based choice cannot, they pointed out that reason-based choice does not "replace value-based models of choice" (Shafir et al., 1993, p. 35).

My hypothesis was that the SCF is a possible instance of irrational decision making caused by a confirmation bias resulting from reason-based choice. According to the argumentative theory of reasoning – developed recently by Mercier and Sperber – reason-based choice should occur particularly often if people have only weak intuitions about a choice (Mercier & Sperber, 2011). Uncertainty is a common feature in real-world management situations and reflected in the study design by Staw in which it is explicitly communicated to participants that they should be able to make a good decision with the limited information provided (Staw, 1976). I predicted that reason-based choice would occur more often in the audience condition than in the anonymous condition. Experiments by Norton and Thompson supported this prediction by demonstrating that individuals preferred products with many features under conditions of public choice. On the other hand, if they had to use the products in public, they chose products containing less features (Thompson & Norton, 2011). These findings, along with the research on reason-based choice described above, indicate that, anticipating a justification need to an audience, individuals would decide on justifiable options.

1.3.2 Argumentative theory of reasoning

Mercier and Sperber introduced the argumentative theory of reasoning claiming that the function of reasoning is to "devise and evaluate arguments intended to persuade" as, from an evolutionary perspective, humans are relying to an exceptionally high extent on the communication of correct information (Mercier & Sperber, 2011, p. 57). They argued that biases occurring through commitment are not necessarily accounting for limited decision making capacities in humans but conclude that reason-based choice is well-adapted in the sense that it allows individuals to search "for arguments that support a given conclusion, and, ceteris paribus, favor conclusions for which arguments can be found" (Mercier & Sperber, 2011, p. 57). According to Mercier and Sperber human decision making can be explained by a dual-process model, but not in the classical sense, i.e. by distinguishing between effortless intuition (system 1) and reasoning (system 2) as had been proposed by Kahneman and Tversky (Daniel Kahneman, 2003a). Instead, Mercier and Sperber argued that individuals always reach conclusions unconsciously through the production of inferences which generate "*intuitive beliefs*" (Mercier & Sperber, 2011, p. 58). These intuitive beliefs lead to conscious conclusions. In addition, "*reasoning proper*" emerges, which is characterized by "the awareness not just of a conclusion but of an argument that justifies accepting that conclusion" (Mercier & Sperber, 2011, p. 58). Mercier and Sperber distinguished between, first, an "epistemic decision that we take at a personal level" (accepting an argument because it is "intuitively strong enough") or "personal-level mental action" (i.e. to "construct a complex argu-

ment by linking argumentative steps, each of which we see as having sufficient intuitive strength") and, second, "what is commonly and traditionally meant by *reasoning*" (Mercier & Sperber, 2011, p. 59). By this second type the authors referred to the act of producing arguments and to verbally express these to convince others of the rightfulness of the conclusion. Importantly, the authors regarded reasoning as "a public action that we consciously undertake" (Mercier & Sperber, 2011, p. 59). According to this dual-system theory, the decision making process in the anonymous condition might consist of a personal epistemic decision or a "personal-level mental action" (Mercier & Sperber, 2011, p. 59) but not of reasoning. Only in the audience condition reasoning would be elicited through the need to state reasons to the experimenter.

In my experiment the combination of audience presence and the need to state reasons in the audience condition put participants in a position in which an argument supporting the (unconsciously generated) conclusion had to be publically expressed. I predicted that this would lead to greater average investments to a failing endeavour due to a confirmation bias. This bias has been defined by Nickerson as the "seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand" (Nickerson, 1998, p. 175). Mercier and Sperber claimed that the term "confirmation bias" has been used for two different phenomena: First, for the absence of reasoning proper. Individuals believe in the positive consequences of their intuitive beliefs and, therefore, do not reason if there is no need to argue. In this sense, a confirmation bias could also occur in the anonymous condition, but Mercier and Sperber pointed out that this phenomenon expresses trust in one's own beliefs and cannot be regarded as a real confirmation bias (Mercier & Sperber, 2011). Second, the term confirmation bias has been used to describe the tendency of individuals to overlook evidences and arguments going against their own claims and focusing on those supporting their conclusion. This "genuine confirmation bias" (Mercier & Sperber, 2011, p. 64) derives from the attempt to convince others of the rightfulness of one's own conclusion. Thus, this type of confirmation bias will not lead an individual to favour confirmation in general but only evidences that confirm their own claims. Mercier and Sperber predicted that this type of confirmation bias would only occur in argumentative settings and only when producing, not evaluating, arguments (Mercier & Sperber, 2011).

I predicted that in my experiment a confirmation bias would only occur in the audience condition in which an argumentative setting was provided. The first decision would be based on participants' intuition, especially since they only got limited information which was assumed to lead to uncertainty. I expected that the second decision would be based on the initial, intuitive model, i.e. the first decision: Participants look for reasons to uphold their initial opinion, not because they aim to convince themselves of its correctness, but "to be ready to meet the challenges of others" (Mercier & Sperber, 2011, p. 66). In the audience condition the search for "belief-bolstering material" (McGuire, 1964, p. 222), a term introduced by McGuire to describe the tendency of individuals to search for evidence supporting their view, should occur more frequently

than in the anonymous condition because participants have already publically stated their opinion during the first decision:

> According to the argumentative theory, however, the function of reasoning is primarily social: In particular, it allows people to anticipate the need to justify their decisions to others. This predicts that the use of reasoning in decision making should increase the more likely one is to have to justify oneself. (Mercier & Sperber, 2011, p. 71)

Mercier and Sperber suggested that individuals could become more objective in their reasoning by distancing themselves from their own opinion and by anticipating objections from others. Nonetheless, they argued that this attitude is seldom to be found in real-world situations (Mercier & Sperber, 2011). Therefore, in the control condition I did not create a setting in which participants were more likely to reflect upon their choice and predict objections, but rather introduced an anonymous, and importantly, non-argumentative setting.

1.4 Predictions

To test the hypothesis I conducted an experiment with eighty participants in which the effects of an argumentative setting on investments in a failing endeavour were investigated. In an adaptation of the study by Staw (Staw, 1976) I introduced two conditions: An audience condition in which participants informed the experimenter – who served as a proxy for an audience – about their decisions. In addition, the need for argumentation was enhanced by the experimenter's request to state reasons and the application of voice recording. In the anonymous condition, by contrast, decisions were made through the submission of decision sheets in voting boxes. Participants neither had to reveal their identity nor did they have to interact or state reasons to the experimenter. The predictions were, first, that in the audience condition reason-based choice would be applied more often, and second, that the argumentative context would lead to a greater occurrence of the SCF by means of enhancing a confirmation bias, because the function of reasoning is to provide arguments for already held beliefs rather than to update beliefs (Mercier & Sperber, 2011). Therefore, I expected to find that participants in the audience condition, first, choose investments which are easy to justify and, second, on average invest more money into the initially chosen, failing department due to a confirmation bias leading to the SCF. The experiment drew on studies on the Audience Effect (see section 1.4.1). I assumed that audience presence would contribute to creating an argumentative context because a need for reputation management and self-justification would be generated. In the next two chapters the Audience Effect and Experimenter Demand Effects are discussed as in my study the experimenter served as a proxy for an audience.

1.4.1 Audience Effect

The Audience Effect (AE) describes the phenomenon that "we behave differently when we believe ourselves to be observed" (Frith & Frith, 2012, p. 298). This effect has been first reported

by Zajonc, who demonstrated that the mere presence of others is sufficient to increase the arousal level of an individual. He suggested that presence of others might also play a role for learning, evaluation of danger, and provides cues for appropriate behaviour (Zajonc, 1965). Since Zajonc first described the AE, much research has been conducted in the field. It has been shown that alteration of behaviour due to cues of social observation can happen unconsciously. Haley and Fessler, for example, demonstrated that dictators in a dictator game allocated on average more money to recipients – 37.9% of their endowment in comparison to 24.5% in the control condition – if eye cues were present, i.e. with eyes instead of a university logo on the desktop screen. This difference was less incurred by participants giving more money to recipients in the eye cues condition, but emerged from the increased number of participants allocating above zero: In the eye cues condition twenty-one out of twenty-four participants gave money to the recipients whereas in the control condition only thirteen out of twenty-five did so (Haley & Fessler, 2005). This experiment provides evidence that a cue for human presence is sufficient to increase prosocial concerns. Tennie and colleagues pointed out that the AE is linked to reputation management:

> The audience effect and effects of anonymity are two sides of the same coin, working in opposite directions. When there is anonymity, and this is often the case with large groups, it is hard to track individual reputation, and free riders can invade more easily [21][4]. Removing anonymity and reinstating an audience will allow reputation to be acquired again, and will lead to increases in cooperation [13[5],25[6]]. (Tennie, Frith, & Frith, 2010, p. 484)

In my experiment voice recording was applied to increase concerns about reputation management. I assumed that participants would infer that these audio recordings make their decisions and arguments available over time.

1.4.2 Experimenter Demand Effects

In my study the experimenter served as a proxy for an audience. Experimenter Demand Effects (EDE) were defined as "changes in behavior by experimental subjects due to cues about what constitutes appropriate behavior" (Zizzo, 2010, p. 75). Zizzo distinguished between purely cognitive EDE and social EDE. Social EDE always contain cognitive EDE but not vice versa. Purely cognitive EDE derive from "identifying the task at hand and behaving accordingly, by picking up clues on what constitutes behavior that is appropriate for the task" (Zizzo, 2010, p. 95) whereas social EDE "benefit from the perceived social pressure that the experimenter, as an authority, explicitly or implicitly puts on a subject through instructions and cues." (Zizzo, 2010, p. 79) In my experiment, the anonymous condition only involved purely cognitive EDE. Zizzo argued that this type of EDE can be disregarded because the beliefs about the objectives of the

[4] (Andreoni & Bernheim, 2009)

[5] (Fehr & Gächter, 2002)

[6] (Milinski, Semmann, & Krambeck, 2002)

experiment, which participants form and behave according to, are uncorrelated to the true objectives (Zizzo, 2010). I assumed that in my experiment subjects might understand that the experiment tests for commitment to an initial decision after negative feedback, but, given that individuals in different conditions were always tested in different sessions, would not be able to infer that the experiment investigates the role of argumentation for the SCF.

In the audience condition the appearance of social EDE was triggered purposefully. Social EDE, similar to the Audience Effect, create social pressure. In the Milgram experiment (Milgram, 1974), for example, the presence of the experimenter seemed to have an influence on subjects' behaviour similar to effects evoked by real-world situations with a dictator or other authorities present (Zizzo, 2010). Zizzo argued that an experimenter has both "legitimacy and expertise" (Zizzo, 2010, p. 77), which are both important factors for social power according to French and Raven (French & Raven, 1959). In addition, the experimenter creates the working environment and, therefore, is always in an authorative position relative to the subject (Zizzo, 2010). In the anonymous condition, on the other hand, I aimed to reduce social EDE by creating the belief that both decisions could not be connected to each other and that the identity of the participant could not be identified on the decision sheets. This study design is based on experiments showing that double-blindness reduces social EDE (Zizzo, 2010). Hoffman et al., for instance, observed that in double-blind settings self-regarding preferences drastically increase. In a double-blind dictator game only four out of thirty-six participants gave an endowment of three dollars or more to the recipients. The authors concluded that the "presence of the experimenter, as one who knows subjects' bargaining outcomes, can be one of the most significant of all treatments for reducing the incidence of self-regarding behavior" (Hoffman, McCabe, Shachat, & Smith, 1994, p. 371).

In my experiment, the audience was only a contextual factor which caused a need for argumentation. Thus, the vertical nature of the relationship between experimenter and participant, the desire of a subject to support the experimenter (Rosnow & Rosenthal, 1997), and the characteristics of the audience only played a minor role. Important was that in the audience condition an argumentative context was created in which participants faced a person who explicitly asked them to state reasons while this was not the case in the anonymous condition.

2 Method

2.1 Participants

Eighty subjects, forty per condition, participated in the experiment which was conducted at the Central European University (CEU) in Budapest, Hungary. Participants were recruited via the online CEU Research Participation System[7] or directly at the CEU Main Building[8]. The mean age of participants was 24.83 years in the anonymous condition and 25.03 years in the audience condition. Thirty-two participants in the anonymous condition and thirty-four in the audience condition were students. Out of forty participants nineteen were female in the anonymous condition and twenty-one in the audience condition. The only selection criterion was sufficient English proficiency. One participant in the anonymous condition had to be excluded because he left the decision sheets which he entered into the voting boxes blank. An additional participant was tested to keep sample sizes equal across conditions. Participants were randomly assigned to either of the two conditions except for those directly recruited by the experimenter at the CEU Main Building. These participants were tested in the audience condition to avoid that personal contact endangers the feeling of anonymity in the anonymous condition. All experiments were conducted between April and June 2015 in the CEU Somby Lab[9] and in the CEU Main Building.

2.2 Procedure

Upon arrival participants were informed about the procedure of the experiment and their tasks: First, participants were asked to fill out a consent form for psychological experiments, which guaranteed anonymity in resulting publications, safety during the experiment, and the right to withdraw from the study at any time. Second, participants were provided with a description of the task (cover letter). Third, the first financial report, which contained short descriptions of the two departments and the financial data on sales and earnings of the hypothetical D&A Company from 1999 to 2009, was handed out. Fourth, participants were asked to take their first decision either by filling out a decision sheet (anonymous condition) or by explaining their choice to the experimenter (audience condition). Fifth, participants obtained the results sheet which depicted, along with the initial financial information, the sales and earnings from 2010 to 2014. Both possible initial decisions, investments in the consumer products department or the industrial products department, led to a decline in the chosen department in comparison to the other department. Sixth, participants were asked to make their second decision, again either through a decision sheet (anonymous condition) or by personally stating and justifying their choice to the experimenter (audience condition). Finally, participants were asked to fill out a questionnaire. In addi-

[7] https://ceuparticipate.sona-systems.com

[8] The CEU Main building is located in Nádor utca 9, 1051 Budapest, Hungary.

[9] The CEU Somby Lab is located in Zrinyi utca 14, 1051 Budapest, Hungary.

tion, a personal data sheet including age[10], sex, current profession, background in Economics or Business[11] and experience in Behavioural Economics had to be filled out. Consent form, cover letter, financial reports, decision sheets, questionnaire, and personal data sheet can be found in Appendix A. At the end of the experiment a short debriefing session took place in which participants were informed about the aim of the experiment, the two conditions, deception in the anonymous condition and that both possible choices in the first decision would have led to negative consequences.

2.3 The D&A Financial Decision Case

The "D&A Financial Decision Case" is an adaptation of a scenario used by Staw to study the Sunk Cost Fallacy (Staw, 1976). Although the study by Staw is relatively old, this experimental design was chosen not only because it has been proven to be appropriate for studying the role of self-justification for the SCF, but also because it bears the advantage to introduce high personal responsibility: Participants are not only told what the initial decision was, but take it themselves. This distinguishes it from other standard scenarios applied to study the SCF (e.g., Arkes & Blumer, 1985).

The "D&A Company" stands for "Davis & Anderson Company", which is a hypothetical company equivalent to the "Adams & Smith Company" in Staw's study (Staw, 1976, p. 31). The name was made-up of surnames selected from lists of the most common names in the USA.[12] The company name was changed to prevent a too obvious connection to Staw's study for participants with experience in Behavioural Economics. Nonetheless, the same numerical values were used for the financial information provided in first and second decision (compare Staw, 1976 and instructions in Appendix A). These values did not differ between the two conditions. Although one might argue that the amount of money should be adapted due to the time span of almost forty years since Staw conducted his study, the numbers were not increased as the total value should not play a major role but only the perception that the stakes are high. Differences and similarities to the study by Staw are listed under "Conditions compared to those of Staw (1976)" in Appendix B.

In the cover letter participants were asked to play the role of a corporate executive and to take decisions in the "D&A Financial Decision Case". They were informed that the company is specialized on camera technologies. Participants were provided with the company's financial information of sales and earnings of the previous years and a short description of the relevant departments. They were asked to decide about the allocation of research and development funds. This

[10] Age is asked to rule-out the possibility that the mean age is significantly different in the two conditions. This could be problematic because it has been shown that older adults (58-91 years) commit the Sunk Cost Fallacy less often than younger adults (18 to 27 years) (Strough et al., 2008).

[11] Arkes and Blumer found out that knowledge about the Sunk Cost Fallacy (through textbook and class lectures) does not lead Economics students to commit this fallacy less often (Arkes & Blumer, 1985).

[12] http://www.census.gov/topics/population/genealogy/data/2000_surnames.html

introduction was followed by task descriptions which differed between the two conditions (Appendix A)

2.3.1 The first decision

As basis for their first decision participants obtained the sheet "The D&A Financial Decision Case" (Appendix A). Similar as in the experiment conducted by Staw (Staw, 1976) – with partly the same phrasing to comply with the study design – participants first obtained information on the company and task:

> The Davis and Anderson Company is a large technologically-oriented firm. As the financial history including ten prior years of sales and earnings data depict, the company has started to decline over several preceding years. The directors of the company agree that one of the major reasons for the decline in corporate earnings and deterioration in competitive position lay in some aspects of the firm's program of research and development. Therefore, the directors have concluded that 10 million dollars of additional Research and Development (R&D) funds should be made available. This money can be invested in one of the corporation's two largest divisions: Consumer Products or Industrial Products. For the time being, only one of the two divisions can receive the additional funding. Please imagine yourself in the role of the Financial Vice President and decide upon the division which should receive the 10 million dollars. Make your decision on the basis of the financial data and with regard to the potential benefits that R&D funding will have on the future earnings of the divisions.

This introductory paragraph was followed by descriptions of the consumer products department (CP) and the industrial products department (see Appendix A). These descriptions were written specifically for this experiment because the ones used by Staw were not available in the original paper (Staw, 1976) and including contemporary topics was considered beneficial. The camera industry was chosen as it is an industry producing products to which laypersons can easily relate to. With the financial information being very limited, the descriptions should prevent random choices and add to the feeling of commitment to the initial decision without eliminating uncertainty (for information on the impact of uncertainty for decision making see section 1.3.1 and Mercier & Sperber, 2011). Both departments were aimed to be equally attractive options.

On the same data sheet the financial information, which was taken from the study by Staw (Staw, 1976), was provided. The only difference to the material applied by Staw was that negative numbers were not presented in brackets but through a minus sign ("−"). The financial information was identical in both conditions and depicted the decline of both departments in the last two years (Appendix A). Based on this data participants were asked to make their first decision, which was to choose whether to invest 10 million dollars of additional research and development funds in the consumer products department or the industrial products department. The hypothetical money had to be invested in one department only and could not be split-up. Participants were

informed that they should take the decision in the role of the Financial Vice President and with regard to potential benefits for the profitability of the departments in the future.

2.3.2 The second decision

After submitting their first decision, participants obtained the sheet "The D&A Financial Decision Case 2015". Participants had already been told at the beginning of the experiment that the data they would obtain for the second decision would depend on their first decision. It was important that participants felt responsible for the financial situation at the time of the second decision. Therefore, four versions (one per condition and initial decision) of the "The D&A Financial Decision Case 2015" sheet were produced. The experimenter handed-out the appropriate one, according to the initial choice, in the audience condition. In the anonymous condition participants were asked to open one of two envelopes (marked with "IP" as an abbreviation for industrial products department and "CP" for consumer products department) depending on their first decision.

The data sheet started with an introductory paragraph explaining the situation of the company five years after the first decision and describing the second decision:

> Today, five years after the initial allocation of the 10 million dollars of additional research and development funds to the Consumer Products division[13], the R&D program of the Davis and Anderson Company is again up for re-evaluation. The management of the company is convinced that there is an even greater need for expenditure on research and development. Twenty million dollars have been made available from a capital reserve for R&D funding. As the Financial Vice President you are asked to decide upon its proper allocation. Financial data is provided for each of the five years since the initial allocation and, as earlier, the investment decision is to be made on the basis of future contribution to earnings. Please specify the amount of money that should be allocated to either the Consumer Products or Industrial Products division. This time, however, you are allowed to divide the R&D money in any way you wish among the two major divisions.

On the same sheet the initial (1999 to 2009) and the updated financial data (2010 to 2014) were provided. The department chosen was always the one declining. It had less sales and earnings between 2010 and 2014 than the other department. After the 2009 data on the sheet a text box was depicted which should remind the participant in which department he or she has initially invested in: "First R & D funding decision as of 2009 – 10 million $ for the … division" (see Appendix A). This should, on the one hand, make it more salient to the participant that the first choice led to negative outcomes and, on the other hand, assure him or her that the data provided for the second decision was dependent on the department he or she has initially chosen to invest the 10 million dollars in.

[13] "Industrial Products division" was written at this place if the participant has initially chosen to invest in IP.

Similarly to the procedure for the first decision, participants were asked to take the role of the Financial Vice President and to base their second decision on the financial data with regard to potential benefits on future profitability of the departments. Nonetheless, there were two major differences: First, the R&D funding open for allocation consisted of 20 million dollars instead of 10 million dollars. Second, participants could choose how much they wanted to invest in each of the two departments. As the experiment aimed to clarify why people keep investing in a failing endeavour, a simple all-or-nothing question in the second decision would have be unsuitable. Instead, the possibility for participants to split the endowment of twenty million dollars between the two departments enabled the analysis of investment patterns.

2.4 Variables

2.4.1 Dependent variable

The study aimed to contribute to the research on underlying mechanisms behind the Sunk Cost Fallacy. The degree to which the SCF has been committed was measured by the amount of money participants allocated in the second decision to the initially chosen, failing department. This amount could range from 0 to 20 million dollars. Different than for the initial decision, which had to be an all-or-nothing-investment, participants could now split the available 20 million dollars in any way they wished between the two departments. This design was taken-over from the experiment by Staw, which had been able to shed light on how "negative consequences may actually cause decision makers to increase the commitment of resources and undergo the risk of further negative consequences" (Staw, 1976, p. 27). Although there was no most rational choice in the scenario, investment patterns could be compared.

2.4.2 Independent variables

As depicted in Figure 1, two conditions were implemented: An audience condition (treatment group) and an anonymous condition (control group).

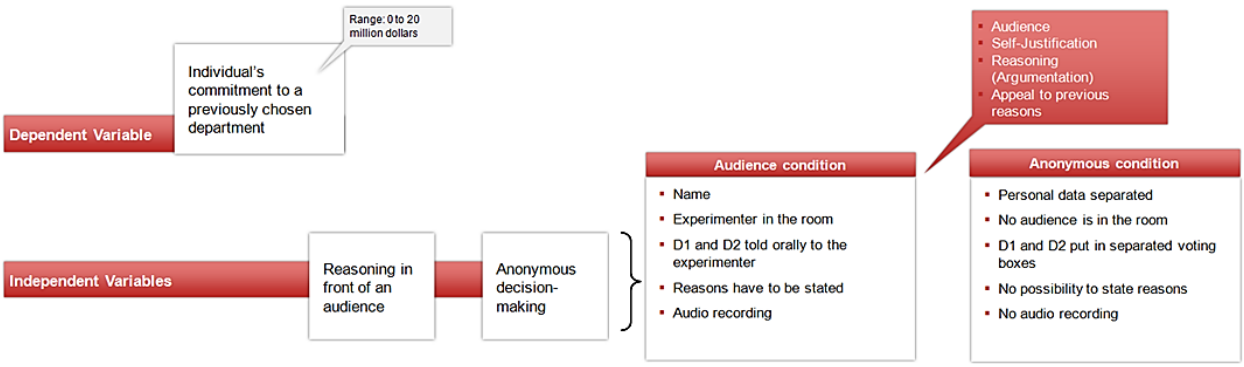

Figure 1: Variable overview

The prediction was that an argumentative context would trigger reason-based choice which would then lead to a confirmation bias which in turn would cause the Sunk Cost Fallacy. In the present experiment the need for argumentation was manipulated: It was enhanced in the audience condition through the presence of the experimenter and the need to justify own choices, and lowered in the anonymous condition in which the identity of the subject did not have to be revealed. The two independent variables were reasoning in front of an audience versus anonymous decision making.

2.4.2.1 The audience condition

In the audience condition an argumentative context was created. In the audience condition the experimenter, who was the author of the study, served as a proxy for an audience.

Figure 2 depicts the setup in the audience condition including (from left to right) the consent form (and beneath it cover letter, personal data sheet and data sheet for the first decision), the audio recorder to record decisions and arguments of the participants, data sheets for the second decision and the questionnaire. The data sheets for the second decision were labelled “IP” or “CP” to assure the participant that the second data sheet was not randomly selected by the experimenter but corresponded to his or her initial decision.

Figure 2: Setup in the audience condition

The audience condition had five main characteristics:

a.) The identity of the participant was revealed

Participants were asked to state their full name on the personal data sheet. Different than in the anonymous condition, the personal data sheet had to be filled-out before the two decisions were made. Therefore, a feeling of personal responsibility was elicited already at the beginning of the experiment.

b.) The experimenter was present in the room during the whole experiment

The experimenter did not only give the explanation for the task, but stayed in the room with the participant during the whole experiment. The experimenter was seated in front of a laptop besides or opposite from the participant. Only one participant was tested per session.

c.) Participants had to personally inform the experimenter about their decisions

Participants were asked to inform the experimenter about their first decision (Appendix A):

> If you have made your decision, please go to the experimenter and tell him or her in **which division** you would like to invest the 10 million dollars and state the **reasons** for your choice.

Based on the initial choice of the participant, i.e. the investment in industrial or consumer products department, the experimenter handed-out the appropriate second data sheet. This data sheet always depicted negative consequences of the initial choice. The participant was then asked to make the second investment decision and to approach the experimenter to personally report his or her choice (Appendix A):

> Please decide in the role of the Financial Vice President what **amount of money you want to spend on each of the two divisions**. Inform the experimenter about your decision and the **reasons** for your choice.

d.) Participants had to state reasons for their decisions

Most importantly for reasoning, which per definition of Mercier and Sperber involves the "mental action of working out a convincing argument" and "the public action of verbally producing this argument so that others will be convinced by it" (Mercier & Sperber, 2011, p. 59), to take place, participants were asked to provide the experimenter with reasons for their first and second investment decisions. This enhanced justification needs and created an argumentative setting emphasizing the need of reasoning. If participants gave very short or ambiguous explanations for their choices, the experimenter asked questions for clarification and / or to support participants in thinking consciously about the reasons for their choice. Reasons had to be stated at the time of the decisions, not post-hoc.

e.) Audio recording was applied

Participants were informed in the consent form that audio recording might be applied. Additionally, when participants approached the experimenter to make their first decisions, they were asked for their consent. All participants agreed to have their arguments for the first and second decision recorded. The audio recordings started when the participant informed the experimenter about the decision and lasted until the participant stated the reasons he or she wanted to provide. Before stating the first decision, between the two decisions and after the second decision audio recording was not applied.

2.4.2.2 The anonymous condition

In the anonymous condition decisions were not reported directly to the experimenter but submitted via voting boxes. This was to avoid that participants feel a need for justification because of audience presence. Voting boxes were chosen as a tool to increase perceived anonymity as many participants were expected to have experienced them previously during elections. Several sheets were placed inside the voting boxes to generate the impression that submissions could not be

connected to a participant's identity. If several participants took part in the experiment during the same session they submitted decisions in the same boxes. Four separated voting boxes were set-up: The first one for the consent form, the second one for the first decision, the third one for the second decision sheet and the last one for the questionnaire.

The experiment started with instructions by the experimenter, who then left the room. Then, the participant submitted the consent form and the first decision sheet in the appropriate voting boxes. Afterwards the participant opened the envelope "IP" if the first choice had been to invest in the industrial products department or "CP" if the first choice had been to spend the 10 million dollars to the consumer products department. The envelope contained the updated financial report. Similar as in the audience condition, the initially chosen department was always the one declining in comparison to the other department. The envelopes were sealed. Therefore, it was possible for the experimenter to evaluate afterwards whether the participant opened the correct envelope. One limitation of this study design was that it involved deception: It was necessary for the analysis of the data to relate first decision, second decision and questionnaire to each other. Thus, the experimenter opened the voting boxes after each participant. If several participants were tested during one session, they obtained pens in different neutral colours before starting the experiment, to enable sorting the materials per participant. Participants were informed about this process of deception during the debriefing session which took place at the end of the experiment.

Figure 3 depicts the setup in the anonymous condition including the four voting boxes, consent form (and beneath it cover letter and data sheet for the first decision), the first decision sheet, the two envelopes containing the second data sheets (dependent on the first decision), the second decision sheet and the questionnaire (including personal data form).

Figure 3: Setup in the anonymous condition

The characteristics of the anonymous condition were the following:

a.) Personal data was separated from the decision sheets and no name had to be stated

In the anonymous condition the personal data sheet was part of the questionnaire and therefore only had to be filled-out after the investment decisions were made. This should enhance the feeling of anonymity during the decision making process. Also, participants did not have to state

their names. The consent form was put in a separate box from the decision sheets. It was avoided to recruit participant for this condition personally. An online recruiting tool was used to prevent much personal contact between experimenter and participant before the experiment.

b.) No audience was present

Interactions with the experimenter only took place before and after the experiment. The experimenter left the room after the instructions were provided and met the participant outside of the lab room after he or she has taken both decisions and has filled-out the questionnaire. Nonetheless, participants were told that they could leave the room to ask the experimenter questions. In some sessions several participants (up to three) were tested during the same session. This was expected to not interfere with perceived anonymity, but to rather enhance it as participants entered their decision sheets in the same voting boxes.

c.) The second decision sheet was separated from the first one

The two decision sheets were put into separate voting boxes. This should encourage participants to think that their second decision could not be connected to their initial decision. Therefore, reputation management should become unnecessary: There is no need to keep-on investing in the initially chosen, failing department in order to appear as a good decision-maker.

d.) It was not required to state reasons for the decisions

Participants only had to circle the department they wanted to give the 10 million dollars to (first decision) and write down their allocations (second decision). The experimenter did not have to be faced for the decisions, no reasons for the choices had to be stated and no questions about the decisions were asked ad-hoc. The questionnaire offered the possibility to explain the decisions but only after both decisions had been made.

e.) No audio recording was applied

Different than in the audience condition, no audio recording was applied.

2.5 Questionnaire

In the last part of the experiment participants were asked to fill-out a questionnaire consisting of likert-scale questions and open questions. General and condition-specific questions were asked. The questionnaires applied in the two conditions can be found in Appendix A.

2.5.1 Likert-scale questions

The questionnaire included seventeen (anonymous condition) or twenty-four (audience condition) 5-point likert-scale questions. Participants were asked to select one of five possible answers: “Strongly disagree”, “Disagree”, “Neither agree nor disagree”, “Agree”, “Strongly agree”.

2.5.1.1 General questions

Most of the questions which were asked in both conditions (= general questions) were based on previous studies published on the SCF:

- "I had a strong desire to complete the started project."

Keil and colleagues manipulated state of completion and sunk costs in combination (15%, 40%, 65% and 90% of the project completed / overall budget spent) in two conditions (with and without alternative project offered). Thus, the experiment used a 2 x 4 factorial design (i.e. eight treatment conditions with n = 39). Time was held constant with a six to eight months project completion period across all treatment groups. They found out that the desire to complete a started project did play a role no matter if an alternative existed or not. In the questionnaire of their study participants mentioned the completion effect half as often as the sunk costs (Keil, Truex, & Mixon, 1995).

- "I spent a long time on the initial decision and perceived it as effortful."

Cunha and Caldieraro obtained results suggesting that the effort level of the initial decision influences whether subjects fall prey of the SCF or not. They found out that the more cognitively demanding a task was the more subjects exaggerated the desirability of the decision outcome. Their results indicated that people recognize time costs invested in cognitive tasks. Therefore, they argued that not only monetary investments but also "nonrecoverable behavioral investments" should be treated as sunk costs (Cunha & Caldieraro, 2009, p. 106).

- "I spent a long time on the second decision and perceived it as effortful."

This question is related to the study by Cunha and Caldieraro described above (Cunha & Caldieraro, 2009).

- "Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."

Arkes and Blumer found that subjects in the sunk cost condition of their experiment had an "inflated estimate of the likelihood that the completed project will be a success" (Arkes & Blumer, 1985, p. 130). It is unclear whether this was the reason or the consequence of the decision to continue investing (Arkes & Blumer, 1985).

- "I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division."

A different experiment by Arkes and Blumer indicated that people would not buy a product which works cheap and fast if they bought a similar product, although of lower quality, not long ago. Arkes and Blumer argued that this might be due to concerns of participants that they would duplicate a recent investment which has been taken not long ago if they would take the new offer. This duplication was aversive since it appeared wasteful (Arkes & Blumer, 1985).

- "I get over negative events quickly and focus on taking actions that result in better outcomes."

Putten et al. obtained results showing that the more "action-oriented people" were, i.e. the more likely they were to "get over negative events quickly, and focus on taking actions to solve them" (Putten et al., 2010, p. 33), the more their decision whether to invest or not came to a 50-50 division. By contrast, investments of "state-oriented people", i.e. people who "typically find it difficult to overcome a negative event, and keep ruminating about it and how it affects their current state" (Putten et al., 2010, p. 33), were motivated by sunk costs. Their conclusion was that action-orientation did not prevent participants from committing the SCF but decreased the likelihood. Mindset seemed to have an effect on the SCF. The authors argued that this supported strength of association models. These models proposed that the SCF depended on the strength of the association between the current investment decision and sunk costs (Putten et al., 2010).

- "I find it difficult to overcome a negative event and keep ruminating about how it affects the current state."

This question was also referring to the study mentioned above (Putten et al., 2010).

- "I felt personally responsible for the outcome of the initial decision."

Staw experimentally demonstrated that participants escalated commitment to a higher extent if they were personally responsible for the initial decision that led to negative outcomes, i.e. when they took the initial decision themselves and were not only told what the first decision was (Staw, 1976).

- "I had the feeling that my initial decision led to negative consequences."

The study by Staw mentioned above provided evidence that commitment to a failing endeavour only occurred to an exceptionally high extent if participants had the feeling that their initial decision led to negative results (Staw, 1976).

The last five questions were not based upon a specific study previously published:

- "I felt very committed to my initial decision throughout the experiment."
- "My initial decision influenced my second decision more than the updated financial report."
- "The financial information at the point of the second decision was the major reason for my decision."
- "I based my second decision on the same reasons as my initial decision."
- "I have been very satisfied with my initial decision directly after taking it."
- "Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome."

2.5.1.2 Condition-specific questions

Except for the question about evaluation by others, all questions condition-specific questions were not formulated based on previous findings but customized for the present experiment.

The following questions were asked only in the audience condition of my experiment:

- "I had the feeling that my decisions were evaluated by others."

Experiments by Brockner and colleagues suggested that investment decisions were influenced by self-presentation. Participants were concerned about how they were perceived by others. Social anxiety and audience size had an impact on investments, for example instructions had more influence on participants with high social anxiety performing in front of a large audience than on those with low social anxiety participating in front of a small audience (Brockner et al., 1981).

- "The presence of the experimenter influenced my decision."
- "It was important for me what others think about my decision."
- "It was important for me what impression the experimenter has of my decision."
- "I had the feeling that I have to make decisions fast because the experimenter was present."
- "I had the feeling that I would violate social norms if I invested all money in one division only in the second decision."
- "I had the feeling that I would violate social norms if I would invest nothing in the failing division in the second decision."
- "I wanted others to think that I make good decisions."
- "I had the feeling that I would be judged based on the decisions I make."

In the anonymous condition the questionnaire contained the following condition-specific likert-scale questions:

- "I felt that nobody can track my initial decision."
- "I had the feeling that my decisions were completely anonymous."

2.5.2 Open questions

In both conditions the questionnaire contained open questions which permitted participants to explain their decisions. The obtained data provided information on post-hoc reasoning. The questionnaire contained three open questions and space for comments. Two of the three questions appeared in both conditions, one was condition-specific.

2.5.2.1 General questions

The open questions asked in both conditions were the following:

- "How satisfied have you been with your first decision directly after taking it? Did your satisfaction change in the course of the experiment, for example after you received the data for the second decision? If so, please explain."
- "Did you change your opinion during the experiment in which department you want to invest more? Why?"
- "Do you have any other comments which you want to mention here?"

2.5.2.2 Condition-specific questions

The condition-specific question in the audience condition focused on the perception of the argumentative context:

- "Did you have the feeling that your decisions were monitored? Would you have made decisions differently if this would not have been the case?"

In the anonymous condition, by contrast, the open question targeted the perception of anonymity in the setting:

- "Did you have the feeling that your decisions were anonymous? Would you have made decisions differently if this would not have been the case?"

2.6 Data analysis

2.6.1 Quantitative analysis

The first and second investment decisions as well as most of the questionnaire data were analysed based on quantitative tests. Statistical results, if not stated otherwise, were calculated using the software IBM SPSS Statistics version 23. The alpha level used as significance criterion was set as .05. The statistical tests applied are stated along with the corresponding test results in the Results section. Non-parametric tests were used to analyse second investments as the data was not found to be normally distributed. Correlations between second investments and questionnaire answers were calculated with Spearman's test. Scatterplots were visually checked for linearity before building the regression models described in Tables 3 and 4. For reasons of clarity no zero points were calculated: The regression models describe predicted investments as intercept plus point of agreement on the 5-point-scale multiplied by the regression coefficient. Part of the questions described in section 2.5.2 allowed for categorization of the answers. As stated in the Results section the resulting categories were used as grouping variables.

2.6.2 Qualitative analysis

Arguments which participants in the audience condition provided for their decisions were audio recorded and analysed based on a procedure recommended by Gorden (Gorden, 1992). I, as the experimenter, listened to the arguments for the first decision to recognize whether participants had carried-over reasons from the first to the second decision. The arguments for the second decision were coded two times, with time in between, based on a list of codes. The two codings were compared and aligned. In the last step, the coded reasons were connected to the second investment decisions of the participants. In Appendix D the list of codes and a more detailed description of the procedure of the analysis can be found. The results of the analysis are stated in subchapter 3.1.3 of the Results section.

3 Results

The aim of the experiment conducted with eighty participants was to test the hypothesis that the Sunk Cost Fallacy is caused by reason-based choice in an argumentative context leading to a confirmation bias. In this section I report the results on the main predictions defined before conducting the experiment and additional results on situations in which the SCF is likely to occur.

3.1 Results on the first prediction – Reason-based choice

The first prediction was that participants in the audience condition would take decisions which are easy to justify due to reason-based choice triggered by a need for argumentation.

3.1.1 Extreme versus intermediate investment decisions

For the second decision, participants divided 20 million dollars between the two departments. As the bar charts (Figure 4) depict, investments into the failing department differed between the two conditions: The modes were 15 million dollars in the anonymous condition (n = 9) and 0 dollars in the audience condition (n = 11). Additional peaks of investments were 5 million dollars in the anonymous condition (n = 8) and 10 million dollars in the audience condition (n = 8). Audio recording data, described in section 3.1.3, indicated that investments in the audience condition were indeed easy to justify and could be understood as signals: Consideration of the updated data depicting the negative results of the initial decision led to zero investments in the audience condition (“I made a mistake”). The expectation or hope of a turnaround as a consequence of continued investment and the desire to “give a boost” to the department which performed well (fair and rewarding behaviour) were the major motivators to invest 10 million dollars.

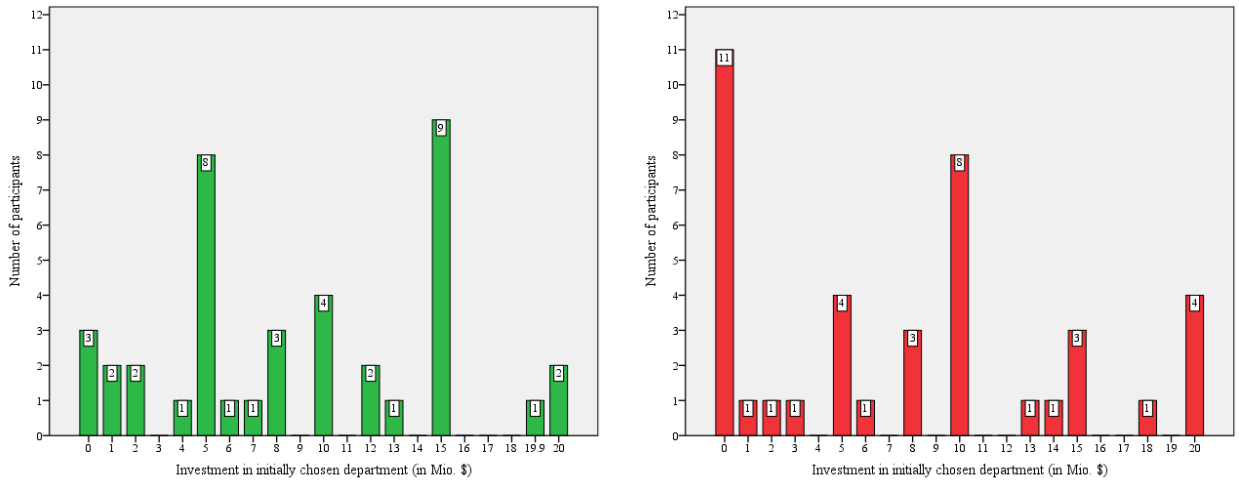

Figure 4: Modes differ in the anonymous (left) and the audience condition (right)

The data signified that in the anonymous condition intermediate options were preferred, i.e. investments which allocate part of the money to both departments and still allow expressing a

preference (5 or 15 million dollars). In the audience condition, by contrast, more extreme decisions were made, in particular because of the many zero investments.

3.1.2 Salient points of investment

Across conditions the investment points most often chosen were 0, 5, 8, 10, 15 and 20 million dollars. Except for investment point 8, each could be associated with one condition (see section 3.1.3). These condition-specific investment points (0, 5, 10, 15, and 20 million dollars) might have been especially salient because of their position within the total range: 0% 25%, 50%, 75% and 100% of the maximum possible investment. They accounted for 65% of all investments in the anonymous condition and 75% of investments in the audience condition (Table 1). In the audience condition these "salient points" were chosen 10% more often than in the anonymous condition, indicating that saliency is more important if a need for argumentation exists.

Table 1: Frequency table of second investments

	Anonymous condition		Audience condition	
Million $	*n*	%	*n*	%
0	3	7.5	11	27.5
1	2	5.0	1	2.5
2	2	5.0	1	2.5
3	0	0.0	1	2.5
4	1	2.5	0	0.0
5	8	20.0	4	10.0
6	1	2.5	1	2.5
7	1	2.5	0	0.0
8	3	7.5	3	7.5
9	0	0.0	0	0.0
10	4	10.0	8	20.0
11	0	0.0	0	0.0
12	2	5.0	0	0.0
13	1	2.5	1	2.5
14	0	0.0	1	2.5
15	9	22.5	3	7.5
16	0	0.0	0	0.0
17	0	0.0	0	0.0
18	0	0.0	1	2.5
19	0	0.0	0	0.0
19,9	1	2.5	0	0.0
20	2	5.0	4	10.0
Total (N = 80)	40	100.0	40	100.0

The underlying assumption of salient points was that certain numbers were chosen more frequently than others because of their saliency, similarly to the phenomenon that social judgment is determined by the saliency of certain attributes or characteristics, i.e. features that "attract our attention when we see something or someone with them" (Stangor, n.d., p. 94). The applicability of the concept of saliency in this context was supported by the result that, although participants had the possibility to choose any investment within the range 0 to 20 million dollars, only one participant chose an investment which was not an integer: 19.9 million dollars (Table 1).

3.1.3 Association between investments and reasons in the audience condition

The distribution curve of investments into the failing department across conditions could be dissected into six segments (Figure 5). Each segment was a range starting at a local minimum and

ending at the next local minimum. The segments could be associated with one condition each. Investments within ranges A and D were chosen by double as many participants in the audience as in the anonymous condition whereas the opposite was true for segments B and E.

Figure 5: Distribution curve and its segments

Fig. 2a: Modes in the anonymous condition

Fig. 2b: Modes in the audience condition

Audio data provided information on the reasons which guided investment decisions in the audience condition. As the overview of the audio recording results in Figure 6 depicts, specific reasons were associated with investments in certain ranges. This supports the prediction that participants chose investments which were expected to be comprehensible to others.

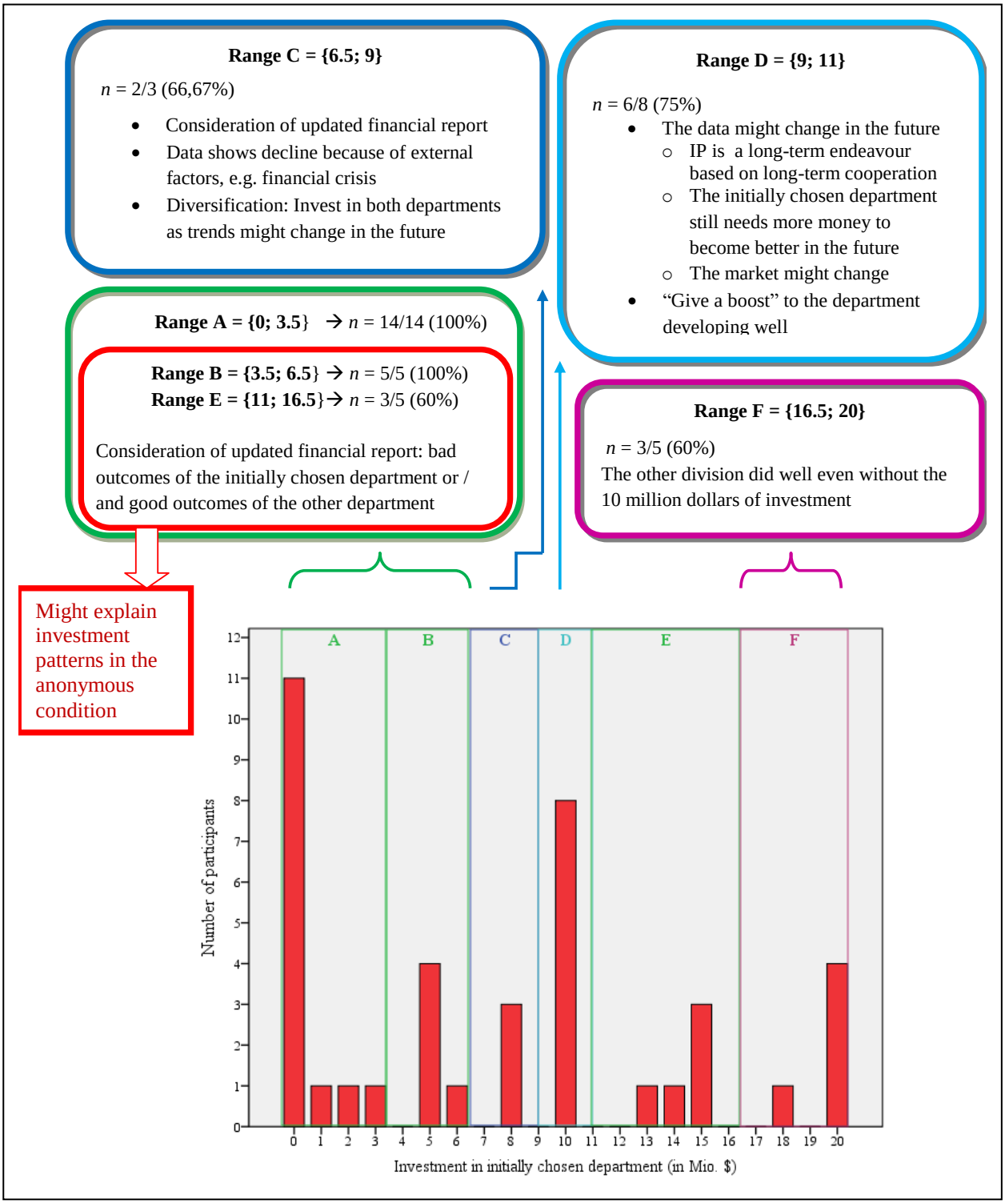

Figure 6: Reasons underlying second investments in the audience condition based on the audio data

The overview of reasons underlying investments in certain ranges described in Figure 6 supported the prediction that participants in the audience condition chose investments which were easy to justify: The majority of the participants who invested between 0 and 3.5 million dollars to the failing department stated that consideration of the data, i.e. the bad outcomes of their initial decision, the good results yielded by the not chosen department, or both, was the main reason for their choice. Investments in ranges 3.5 to 6.5 and 11 to 16.5 million dollars were also mainly due to consideration of the updated financial report. Although there was no most rational choice in the scenario, these results suggested that participants who focused on the updated data only invested within these ranges. This is of particular interest since in the anonymous condition the majority of participants (n = 22), double as many as in the audience condition (n = 10), chose an investment lying within these two ranges. In the audience condition, by contrast, consideration of the updated data mainly led to investments between 0 and 3.5 million dollars (n = 14) with zero being the mode (n = 11). In the anonymous condition only three participants invested nothing into the failing department. Zero investments as results of consideration of the updated financial report might indicate the aim of participants in the audience condition to present themselves as good decision-makers and to signal to the experimenter that they learned from their mistake.

Salient points of investment (see section 3.1.2) can be associated with the same reasons as those of the corresponding ranges (Figure 6). Consideration of the updated data was the reason stated by all participants in the audience condition investing nothing (n = 11/11) or 5 million dollars (n = 4/4) in the initially chosen department and by 66.67% of those investing 15 million dollars (n = 2/3). 75% of participants who allocated an equal amount of money to both departments (10 million dollars) expressed the hope or expectation that the data might change in the future (n = 6/8). Reasons underlying full investments (20 million dollars) were the expectation that the data might change in the future and the argument that the other department did well even without initial investment (each n = 2/4). In sum, all reasons underlying salient points of investments (SP) were the same as those underlying investments in the corresponding ranges with only two exceptions: First, consideration of external factors was a dominant reason behind SP 15 but not investments in range E. Second, the expectation that the data might change was a dominant reason behind SP 20 but not investments in range F.[14]

These overviews of reasons are based on the analysis of the ad-hoc reasons participants provided for their second investment decisions. These reasons are described in more detail below.

3.1.3.1 Consideration of the updated financial report

Almost all participants (n = 33) referred to the updated data, i.e. how sales and earnings in the two departments developed, in their argumentation for the second decision. 27.5% of the participants in the audience condition (n = 11) stated the updated data as the only reason for their second choice. All of these participants invested within range A and 81.82% (n = 9) invested noth-

[14] The selection criterion for a reason to be "dominant" was that it had been stated by 50% or more of the participants choosing an investment within the specific range or investing in the specific salient point.

ing into the initially chosen department. The remaining two participants invested one and three million dollars. By contrast, all seven participants who did not mention the updated data as a reason for their second decision invested above zero. Their investments fell within ranges C to F and thus are relatively high. All participants choosing to invest everything in the failing department (20 million dollars) fell into this category (n = 4). Overall, this data suggested that high investments were associated with disregarding the updated data.

3.1.3.2 Expecting the data to change in the future

Sixteen participants stated the argument that the data might change in the future. They argued that IP is a long-term branch (n = 3), that the initially chosen department needs more money to show improvement (n = 6), that the market might change (n = 1), and that a diversified product range is important as market trends could change (n = 3). The reason that the data might change in the future is an argument stated by 66.67% of the participants who invested eight million dollars in the failing department (n = 2), and by 75% of the participants who distributed the money equally between the two departments (n = 6). This reason stood behind investments in all ranges.

3.1.3.3 "Give a boost" to the department developing well

Thirteen participants expressed that they wanted to invest parts of the 20 million dollars endowment to the department not initially chosen because they want to give it a "boost", so it will continue to rise in sales and earnings or at least stay stable. This reason underlay investments in all ranges, but was particularly often stated by participants investing in range C or D: 66.67% of those who invested eight million dollars (n = 2) and 75% of those who invested 10 million dollars (n = 6) stated this reason. Two out of these thirteen participants explicitly said that they invested in the initially not chosen department to offer it "reward" for its good development in recent years. These rewards were relatively high: Eight and ten million dollars.

3.1.3.4 "The other department performed well even without the ten million dollars"

Seven participants stated that the other department performed well even without the allocation of money in the first decision. The reason was often provided to argue in favour of high investments in the failing department (ten million dollars or more): It only appeared as an argument for investments in ranges D to F with the exception of one outlier (investment of five million dollars in initially chosen department). Similarly to the argument described in 3.1.3.3 this reason was always mentioned in combination with other reasons.

3.1.3.5 Outsourcing of responsibility

Responsibility for the negative outcome of the initial decision was not always searched upon oneself: 20% of the participants (n = 8) outsourced responsibility. Responsibility for the negative outcomes was searched for in two factors: First, participants referred to external factors, as for example the financial crisis after 2008 or claimed that cooperation with hospitals (as mentioned in the instructions, see Appendix A) might have failed. Second, participants argued that the ini-

tially chosen department might have done “something wrong”, for example in marketing. Participants who outsourced responsibility invested in ranges A, C, D and E. 66.67% of the participants (n = 2) who invested eight million dollars referred to external factors (n = 2). Also, 37.50% (n = 3) who allocated equal amounts to both conditions emphasized the possible failure of the department itself.

3.1.3.6 Holding on to the initial decision

“Holding on to the initial decision” is a category containing several arguments:

- Reasons for the initial decision were carried over to the second decision (n = 4)
- Self-justification: Claiming that one’s initial decision was good (n = 2)
- Wastefulness: Arguing that giving-up on the failing department would mean wasting the money already invested (n = 1)
- Stick with “gut feeling” one had at the time of the first decision (n = 1)
- “Gamble”: Take the risk of further investing in the declining department (n = 1)

Eight out of nine participants who held on the initial decision invested ten million dollars or more to the failing department. All investments lay within ranges C, D, E, and F and thus were relatively high.

3.1.3.7 Feeling that the initial decision was bad

Five participants stated that they had the feeling that their initial decision was bad. The investments of these participants did not follow a certain pattern but appeared in ranges A, B, C and E. 80% of these participants chose a salient point of investment..

3.1.3.8 Multiple reasons for the second decision

Twenty-six participants stated not only one of the reasons described in sections 3.1.3.1 to 3.1.3.7 but multiple reasons for their second decision. All participants who invested an equal amount of money in both departments (n = 8) fell into this category. The updated financial report was stated as one reason by twenty-two of them. Eighteen out of these twenty-two participants considered more than one factor apart from the updated financial data. Only one of these participants with multiple reasons apart from the updated report invested nothing in the initially chosen department whereas seven out of eight who had chosen an equal investment fell into this category. With the modes of investments in the audience condition being zero and ten million dollars, this data indicated that relatively high investments (ten million dollars) were associated with sophisticated reasoning (multiple reasons apart from the updated report).

In sum, the influence of the argumentative context became evident through the investment in different ranges in the two conditions. Specific reasons underlay certain investments in the audience condition. These reasons made the choices justifiable.

3.2 Results on the second prediction – Confirmation bias

The second prediction was that participants in the audience condition would on average invest more money into the failing department than participants in the anonymous condition due to a confirmation bias leading to the Sunk Cost Fallacy.

3.2.1 Second investments in the two conditions

3.2.1.1 Disproving the influence of the first decision

In order to study the investment differences in the two conditions, the possibility of an influence of the first decision on second investments had to be taken into consideration in a preliminary analysis. In the anonymous condition twelve and in the audience condition nine out of forty participants chose to invest the initial endowment of ten million dollars in the consumer products department (CP). Although designed as equally attractive options, the descriptions which the participants obtained before their first decision might explain why the majority of the participants in both conditions initially invested into the industrial products department (IP): A small cue is provided pointing towards the advantages of IP in a long-term perspective (Appendix A). Audio recording data supported this interpretation: Only three out of thirteen participants in the audience condition who stated the argument that the data might change in the future as a motive behind their second investment decision had chosen CP in their first decision (Figure 7). Three participants in the audience condition explicitly stated that they kept on investing in the failing department because IP was a "long-term branch" (see section 3.1.4.2).

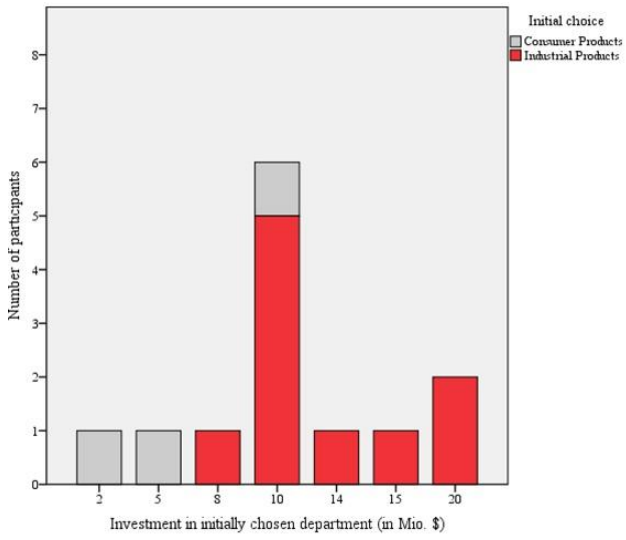

Figure 7: Investments of participants expecting or hoping that the data might change in the future

Nonetheless, the initial decision had no significant influence on investments in the second decision: In the audience condition participants who had initially chosen to invest in CP (*Mdn* = 3) did not invest differently in the failing department in the second decision than those who had chosen IP (*Mdn* =10) as the Kolmogorov-Smirnov Z test proved, *K-S Z* = 1.16, *p* = .073 (*ns*, ex-

act sig., 2-tailed). Second investments in the anonymous condition also did not differ significantly, *K-S Z* = 0.66, *p* = .538 (*ns*, exact sig., 2-tailed), based on whether participants had initially invested in CP (*Mdn* = 6) or IP (*Mdn* = 9).

3.2.1.2 Comparison of second investments in the audience and the anonymous condition

The mean investment was slightly lower in the audience condition (*M* = 7.65, *SD* = 6.73, *n* = 40) than in the anonymous condition (*M* = 8.97, *SD* = 5.91, *n* = 40). Nonetheless, the histograms (bin: $\sqrt{n}$ = 6) with plotted normal curves (Figure 8) indicated that means failed to capture the differences between investments in the two conditions since no normal distribution was found. Kolmogorov-Smirnov tests with Lilliefors Significance Correction confirmed that the distribution of second investments in the anonymous condition, *D* (40) = 0.15, *p* = .025 (< .05), and in the audience condition, *D* (40) = 0.15, *p* = .029 (< .05), were significantly non-normal. Thus, non-parametric tests were applied.

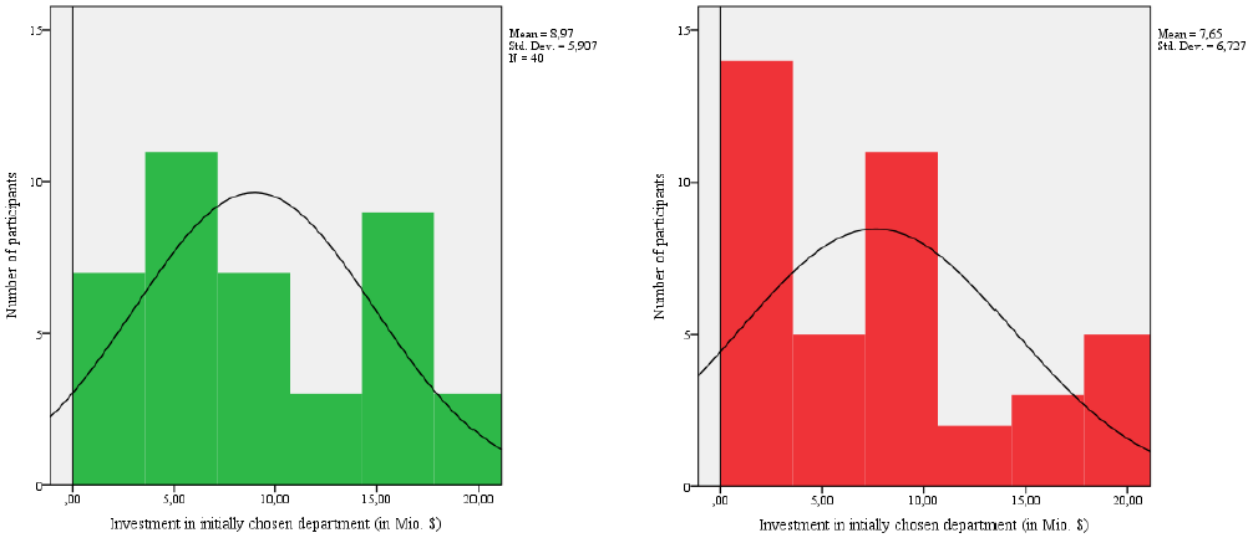

Figure 8: Histograms with plotted normal curves

Different than predicted, a Mann-Whitney U test showed that there was no significant difference between second investments in the two conditions, *U* = 686.50, *p* = .137 (*ns*, exact sig., 1-tailed[15]), *r* = −.12[16]. Although the initial decision had no significant influence on investment decisions (see section 3.2.1.1), the data was post-hoc matched to minimize a potential influence of the initial decision to invest in IP or CP and individual differences.[17] Participants were matched based on their initial decision (CP vs. IP) and the root mean square (RMS) differences of their questionnaire answers (information on the procedure and data used can be found in the section

[15] The prediction was one-directional: Second investments were predicted to be higher in the audience than in the anonymous condition. Therefore, a 1-tailed test was performed.

[16] The effect size estimate *r* was not calculated through SPSS. The equation used to convert a *Z*-score given by SPSS into *r* was $r = Z/\sqrt{N}$ (Field, 2005, p. 532)

[17] Post-hoc matching, opposed to analysing the differences between the conditions independently according to the initial decision, provided the advantage that sample sizes did not have to be reduced.

"Post-hoc matching" in Appendix D). The Wilcoxon signed-rank test performed on the matched data confirmed that there is no significant difference between the second investments in the two conditions, $T = 225.00$, $p = .163$ (*ns*, exact sig., 1-tailed), $r = -.16$.

3.2.2 Questionnaire results on the second prediction

3.2.2.1 Correlations of second investments and questionnaire answers

Correlations between investments in the second decision and questionnaire answers were calculated using Spearman's test.[18] Correlation coefficients of all fifteen general questions and two (An.) or nine (Aud.) condition-specific questions are listed in Appendix D. Bonferroni corrections were performed by dividing the desired significance level ($p < .05$) by the number of questions asked per condition. The Bonferroni-corrected significance thresholds were .003 ($\alpha = .05/17$) in the anonymous condition and .002 ($\alpha = .05/24$) in the audience condition. The difference between the conditions was caused by the higher number of condition-specific questions in the audience condition (see section 2.5.1). As the Bonferroni correction increased the probability of a Type 2 error to occur (e.g., Sinclair et al., 2013) "moderate" correlations which were equal or larger than .30 (Cramer & Howitt, 2004, p. 39) were reported in this section. The uncorrected p-values are presented in the tables, but correlations which remained significant after Bonferroni correction are marked with an asterisk.

Correlations which were larger than .30 in one condition, but not in the other, provided insights on the hypothesis tested (Table 2).

Table 2: Correlations between second investments and questionnaire answers differing in the two conditions

	Anonymous condition			Audience condition		
Question	r_s	p	n	r_s	p	n
"Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	.64	< .001 *	39	.24	.137	40
"I based my second decision on the same reasons as my initial decision."	.10	.562	39	.42	.008	40
"I get over negative events quickly and focus on taking actions that result in better outcomes."	-.25	.129	38	-.48	.002 *	40

* surviving Bonferroni correction by the respective number of questions

In the anonymous condition a significant correlation between second investments and the belief that continued investment in initially chosen department might lead to positive outcomes in the

[18] As the initial choice had no significant effect on second investments (see section 3.2.1.1), correlation coefficients were calculated without separating answers of participants who had initially chosen IP and CP.

future was found. In the audience condition second investments were significantly correlated, in a negative relationship, with being "action-oriented" as per definition of Putten and colleagues (Putten et al., 2010, p. 33) Although not significant after Bonferroni correction, the positive relationship in the audience condition between second investments and agreement to have taken this decision based on the same reasons as the first decision should be noted. These results indicated that in an argumentative context high investments were linked to a failure to update beliefs.

3.2.2.2 Regression models

In the anonymous condition a regression model was built based on all significant[19] correlations between second investments and questionnaire answers in this condition (Table 13 in Appendix D) using a stepwise backward method[20] in SPSS. Nonetheless, none of the regression coefficients reached significance except for the belief that continued investment in the failing department would eventually result in positive outcomes (Table 15 in Appendix D).

A simple linear regression was calculated to predict second investments in the anonymous condition based on this belief. A significant regression equation was found ($F(1, 37) = 23.63$, $p < .001$), with an R^2 of .39. A participant's predicted investment in the failing department is equal to −0.33 (constant) + 2.86 (agreement on belief) million dollars when this belief is measured on a 5-point likert-scale (1 = "Strongly disagree" to 5 = "Strongly agree"). Participant's second investment increased 2.86 million dollars for each higher point on the scale of the belief (Table 3).

Table 3: Regression model predicting investments in the anonymous condition

Variable	*B*	*SE B*	β	*t*	*p*
Constant	-0.33	2.08		-0.16	.877
"Although my initial decision led to negative consequence, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	2.86	0.59	.62*	4.86	< .001

Note: $R^2 = .39$, $*p < .001$

In the audience condition a regression model was also calculated based on the correlations between second investments and questionnaire answers which were significant before Bonferroni correction. The regression model depicted in Table 16 in Appendix D was built with a stepwise backward method and showed that the only the two significant regression coefficients were agreement to have based the second decision on the same reasons as the initial decision and being "action-oriented" (Putten et al., 2010, p. 33). A multiple linear regression was calculated to predict investments based on agreement to these two factors. A significant regression equation

[19] For the regression models in both anonymous and audience condition all correlations which were significant before Bonferroni correction were considered as in the second step non-significant regression coefficients were excluded (see Table 15 and 16 in Appendix D).

[20] The backward method was preferred over a forward method to reduce the probability of suppressor effects to occur (Field, 2005, p. 161).

was found (F (2, 37) = 12.58, $p < .001$), with and R^2 of .41. A participant's predicted second investment is equal to 10.89 (constant) + 2.28 (agreement to have based the second decision on the same reasons as the first decision) – 2.88 (agreement to being action-oriented). Agreement is measured as 1 = "Strongly disagree", 2 = "Disagree", 3 = "Neither agree nor disagree", 4 = "Agree", 5 = "Strongly agree". Investments in the failing department increased 2.28 million dollars for each step in agreement to have based the second decision on the same reason as the first decision and decreased 2.88 million dollars for each step in agreement to being action-oriented. Both questionnaire answers were significant predictors of second investment decisions (Table 4).

Table 4: Regression model predicting investments in the audience condition

Variable	*B*	*SE B*	β	*t*	*p*
Constant	10.89	4.14		2.63	.012
"I based my second decision on the same reasons as my initial decision."	2.28	0.75	.39*	3.03	.004
"I get over negative events quickly and focus on taking actions that result in better outcomes."	-2.88	0.82	-.45*	-3.52	< .001

Note: R^2 = .41, *p < .001

3.2.2.3 Open questions on the feeling to be monitored and perceived anonymity

Participants in the audience condition were asked whether they felt that their decisions were monitored and whether they would have made decisions differently if this would not have been the case. Eight out of forty participants stated to have felt monitored, twenty-five answered with "No", two with "Maybe", three gave unclear answers and two did not answer the question. It remained unclear why only 20% of the participants felt monitored. Some answers suggested that participants did not perceive experimenter presence and the need to state reasons as "monitoring" (one participant, for example, stated that she did not have this feeling "because the experimenter was not watching me all the time") and that the question was interpreted as referring to the position within the scenario ("a business decision definitely other people can monitor"), but the statements could not be generalized. Three participants wrote that they would have made decisions differently without monitoring and two answered with "Maybe", but the number of participants was too small to detect a common pattern. Nonetheless, some insights were given on why participants claimed that they would not have made decisions differently without monitoring: Participants claimed that they based their decisions on facts only (n = 6), that they did not let themselves be influenced by others' opinions (n = 3), that they believed to have made the right decision (n = 3), that they only cared for the aim to maximize profits for the company (n = 1), that they were "independently minded" or sure of themselves (n = 2), and that monitoring only played a small factor as not enough information was provided (n = 1). Investments were not influenced based on whether participants felt monitored (*Mdn* = 7) or not (*Mdn* = 5), U = 99.50, p = .993 (*ns*, exact sig., 2-tailed), r = −.003.

In the anonymous condition participants were asked whether they felt that their decisions were anonymous and whether they would have made decisions differently if this would not have been the case. Twenty-two participants agreed to have felt that their decisions were anonymous, nine stated their doubts, one answered with "Maybe" and eight participants either did not give a definite answer (n = 5) or did not answer at all (n = 3). Participants explained their doubts by stating that they "still felt some sort of pressure (of the norms to be successful, to make the right decision, and to be better than the other participants)" or that "I don't believe in anonymity generally, so did not have this feeling". Eighteen out of forty participants were tested with other participants during the same session. The proportion of participants feeling anonymous was almost the same among those who were tested with others (61.11%, n = 11/18) and those tested alone (50%, n = 11/22). 27.27% of those tested alone indicated that they did not feel anonymous (n = 6) as opposed to 16.67% among those tested with others (n = 3). There was no significant difference in investments between participants tested alone and with others, U = 169.00, p = .434 (*ns*, exact sig., 2-tailed), r = -.13. Four participants claimed that they would have made decisions differently in a non-anonymous setting. Although not generalizable, participants offered explanations: "I may have put more money into consumer goods because I wouldn't want it to look as though, to others, that I was investing our money into a sinking ship" and "probably yes, especially for the second one, since I wouldn't have admitted or accepted I chose a department which had less potential (even if it was still lucrative) in the real world: I would had to face those who don't receive any more funding. I would have invested a 'minimal' sum to it". Statements on why participants would not have changed their decision were numerous: Participants argued that they made the best possible decision with the information and knowledge they had (n = 5), that anonymity does not influence strategy or information amounts which guided their choice (n = 2) and that within the scenario they played a non-anonymous role anyways (n = 1). Second investments did not differ based on whether participants stated to have felt anonymous (*Mdn* = 10) or not (*Mdn* = 6), U = 79.00, p = .394 (*ns*, exact sig., 2-tailed), r = −.16.

3.3 Results on situations in which the Sunk Cost Fallacy is likely to occur

The questionnaire offered additional results which provided insights into factors behind the Sunk Cost Fallacy which were related to but not captured by the two experimental conditions.

3.3.1 Correlations between questionnaire answers and second investments

In both anonymous and audience condition investments in the initially chosen, failing department were significantly correlated, in a negative relationship, with agreement that the updated financial information was the major reason for the second decision. This result supports the prediction that high investments in the failing department were due to disregarding the updated data. In both conditions, although not significant after Bonferroni correction, moderate correlations between second investments and commitment to the initial decision as well as the desire to complete the started project should be noted (Table 5).

Table 5: Correlations between second investments and questionnaire answers which are similar in the two conditions

	Anonymous condition			Audience condition		
Question	r_s	p	n	r_s	p	n
"I felt very committed to my initial decision throughout the experiment"	.45	.005	38	.38	.014	40
"The financial information at the point of the second decision was the major reason for my decision."	-.43	.007	39	-.58	< .001 *	40
"I had a strong desire to complete the started project."	.43	.007	38	.41	.009	40

* surviving Bonferroni correction by the respective number of questions

3.3.2 Factors behind the Sunk Cost Fallacy proposed in previous studies

The questionnaire contained likert-scale questions targeting factors which were proposed as determinants of the SCF in previous studies (see section 2.5.1). Correlations between these factors and second investments of participants are described in Table 6.

Table 6: Correlations between second investments and factors proposed in previous studies

	Anonymous condition			Audience condition		
Question	r_s	p	n	r_s	p	n
"I had a strong desire to complete the started project."	.43	.007	38	.41	.009	40
"I spent a long time on the initial decision and perceived it as effortful."	-.23	.165	39	-.16	.339	40
"I spent a long time on the second decision and perceived it as effortful."	-.01	.953	39	-.14	.405	40
"Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	.64	< .001 *	39	.24	.137	40
"I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division."	.27	.097	39	.14	.386	40
"I get over negative events quickly and focus on taking actions that result in better outcomes."	-.25	.129	38	-.48	.002 *	40
"I find it difficult to overcome a negative event and keep ruminating about how it affects the current state."	.05	.748	38	.15	.348	40

* surviving Bonferroni correction by the respective number of questions

The only factor which was found to be moderately (although not significantly after Bonferroni correction) correlated with second investments in both conditions was the desire to complete a

started project. This factor has previously been studied by Keil et al. (Keil et al., 1995). Arkes and Blumer have observed in one of their experiments that participants in the sunk cost condition rated the chances of a project to be successful higher than participants who had not invested in the project yet (Arkes & Blumer, 1985). This finding is supported by the present experiment: Second investments were in the anonymous condition significantly correlated with agreement to the belief that continued investment in the initially chosen department would result in positive consequences eventually. Agreement to being "action-oriented" (Putten et al., 2010, p. 33), which in the questionnaire was described as to "get over negative events quickly and focus on taking actions that result in better outcomes" following the wording used by Putten and colleagues (Putten et al., 2010), on the other hand, was significantly correlated to second investments in the audience condition only. Evidence for the influence of effort, as has been suggested by a study by Cunha and Caldieraro (Cunha & Caldieraro, 2009), on second investments could not be found, neither for the perceived effort of the first nor the second decision. Also, the theory of wastefulness which had been proposed by Arkes and Blumer (Arkes & Blumer, 1985) was not supported by these results: There was no significant correlation in neither of the two conditions.

3.3.3 Satisfaction with the first decision and opinion change over time

Participants in both conditions were asked the same question: "How satisfied have you been with your first decision directly after taking it? Did your satisfaction change in the course of the experiment, for example after you received the data for the second decision? If so, please explain." Responses were categorized into Yes/Yes ("I have been satisfied with the first decision directly after taking it and my satisfaction changed after I received the data for the second decision."), Yes/No ("I have been satisfied directly after taking the first decision, but my satisfaction changed in the course of the experiment") and No/No ("I was neither satisfied directly after taking the initial decision nor later in the course of the experiment"). Without considering participants whose answers could not be categorized either because the statements were unclear or because they did not answer, the highest proportion of participants in both anonymous condition (n = 11) and audience condition (n = 11) were initially satisfied but their satisfaction changed after they had received the updated data. The number of participants who were initially satisfied and remained so is almost equally high in both anonymous condition (n = 11) and audience condition (n = 9). Only a very small number of participants in both anonymous condition (n = 3) and audience condition (n = 5) stated to neither have been satisfied directly after taking the decision nor after receiving the updated data. This categorization allowed for comparison of second investment decisions between categories and across conditions: Second investments of participants belonging to satisfaction category Yes/Yes (*Mdn* = 15 (An.), *Mdn* = 10 (Aud.)) and Yes/No (*Mdn* = 5 (An.), *Mdn* = 1 (Aud.) differed significantly both within the anonymous condition, U = 27.00, p = .025 (< .05, exact sig., 2-tailed), r = −.48, and within the audience condition, U = 17.50, p = .012 (< .05, exact sig., 2-tailed), r = −.56. Participants who remained satisfied over the course of the experiment (Yes/Yes) tended to invest more into the failing department (An.: M =

12.73, *Mdn* = 15, *Mode* = 15, Aud.: *M* = 12.56, *Mdn* = 10, *Mode* = 10) than those whose satisfaction changed (Yes/No) (An.: M = 6.55, *Mdn* = 5, *Modes* = 5 and 15, Aud.: *M* = 4, *Mdn* = 1, *Mode* = 0). Sample sizes in category No/No were in both conditions too small for comparison. In sum, this data suggested that satisfaction had an influence on investment decisions. This influence did not differ between anonymous and audience condition: Investments within category Yes/Yes, $U = 46.50$, $p = .840$ (*ns*, exact sig., 2-tailed), $r = -.05$, and within category Yes/No, $U = 37.00$, $p = .120$ (*ns*, exact sig., 2-tailed), $r = -.33$, were not significantly different in the conditions. In conclusion, answers to this question suggested that satisfaction had an influence on investments into a failing department, but that this influence was the same across conditions.

The second open question was also similar in both conditions: "Did you change your opinion during the experiment in which department you want to invest more? Why?" The number of participants who stated that they changed their opinion during the experiment was the same ($n = 22$) in both conditions. The number of participants who claimed to not have changed their opinion was also almost equal in both anonymous condition ($n = 16$) and audience condition ($n = 13$). One answer in the anonymous condition and four in the audience condition could not be identified as either "Yes" (opinion change) or "No" (no opinion change). In both conditions one participant did not answer this question. Participants' second investments differed significantly based on whether they changed their opinion (*Mdn* = 5 (An.), *Mdn* = 2 (Aud.)) or not (*Mdn* = 15 (An.), *Mdn* = 15 (Aud.)) both in the anonymous, $U = 20.50$, $p < .001$ (exact sig., 2-tailed), $r = -.75$ and in the audience condition, $U = 27.50$, $p < .001$ (exact sig., 2-tailed), $r = -.68$. Second investments of participants who changed their opinion were much lower (An.: *M* = 5.23, *Mdn* = 5, *Mode* = 5, Aud.: *M* = 3.68, *Mdn* = 2, *Mode* = 0) than second investments of those who did not change their opinion (An.: *M* = 14.49, *Mdn* = 15, *Mode* = 15, Aud.: *M* = 14.23, *Mdn* = 15, *Mode* = 20). Investments of those who changed their opinion ((*Mdn* = 5 (An.), *Mdn* = 2 (Aud.)) were not significantly different in the anonymous and audience condition, $U = 184.50$, $p = .172$ (*ns*, exact sig., 2-tailed), $r = -.21$. Similarly, investments of those who did not change their opinion (*Mdn* = 15 (An.), *Mdn* = 15 (Aud.)) were not significantly different in the two experimental conditions, $U = 96.50$, $p = .746$ (*ns*, exact sig., 2-tailed), $r = -.06$. In sum, whether participants changed their opinion in which department they wanted to invest more during the experiment had an influence on their investment decisions, but this influence was the same across conditions.

4 Discussion

4.1 Discussion of the results

This study aimed to investigate determinants of the Sunk Cost Fallacy (SCF) by manipulating the social environment which triggers psychological mechanisms at the origin of this cognitive bias. The hypothesis was that the SCF is caused by reason-based choice combined with a confirmation bias. The predictions were, first, that participants in the audience condition would apply reason-based choice more often than participants in the anonymous condition due to the argumentative context of their decisions and, second, that they would on average invest more money into the failing department due to a confirmation bias. The first prediction is supported by the results of the experiment conducted with eighty participants: Participants in the audience condition tended to take more extreme decisions and chose salient points of investments more often. In addition, audio recording data revealed that specific reasons underlay certain investments indicating that participants chose justifiable investment points. On the second prediction, on the other hand, the results are ambiguous: There was no significant difference between the investments in the two conditions and only few instances of participants carrying over their reasons from first to second decision were documented by the audio recording data. Nonetheless, regression models showed that agreement to being "action-oriented" (Putten et al., 2010, p. 33) and to have based the second decision on the same reasons as the first decision are significant predictors of second investments in the audience condition, but not in the anonymous condition. Whether these ambiguous results are due to the experimental setup – reason-based choice in this scenario led to zero investments – or if the hypothesis should be rejected can only be answered by a follow-up experiment. Nonetheless, the results of the present study offer valuable information on the factors underlying the SCF and the circumstances under which this bias is more likely to occur.

4.1.1 Results on the first prediction – Reason-based choice

The data suggest that participants in the audience condition indeed applied reason-based choice more often than participants in the anonymous condition:

First, participants in the audience condition made more extreme decisions than participants in the anonymous condition: 27.5% of the participants in the audience condition (as opposed to 7.5% in the anonymous condition) invested nothing and 10% (in comparison to 5% in the anonymous condition) everything in the initially chosen department. In the anonymous condition participants chose less extreme options by allocating money to both departments and still showing a preference for one (5 or 15 million dollars). In addition, equal allocations of 10 million dollars to both departments were taken by 20% of the participants in the audience condition, but only by 10% of the participants in the anonymous condition.

Second, 75% of the participants chose salient investment points. These were 10% more than in the anonymous condition. This backs the claim that saliency is more important if there is a need to communicate: The investment points 0, 5, 10, 15 and 20 million dollars might be salient, as described in section 3.1.2., because they are fractions of the whole endowment (0%, 25 %, 50%, 75%, 100% of 20 million dollars). Salient features per definition attract attention (Stangor, n.d.) and as such are easier to explain than investment points which do not draw the attention of the audience (e.g., intermediate investment points as for example 2, 3, 4 etc.). The fact that 80% of the participants who mentioned that they had the feeling that their initial decision "was bad" chose a salient point of investment (n = 4/5) indicates that participants feeling a need for justification were likely to choose a salient point (see section 3.1.3.7).

Third, different investment points were preferred in the two conditions and certain types of reasons were associated with them. In the audience condition the modes of investments were 0 and 10 million dollars as opposed to 5 and 15 million dollars in the anonymous condition (see section 3.1.1). The analysis of the audio recordings, which provide ad-hoc information on the reasoning behind participants' decisions in the audience condition, suggests that investments of 10 million dollars were taken by participants who either hoped for a positive turnaround or wanted to give the other department, which developed well, "a boost". It was explicitly mentioned by some participants that they wanted to give a "reward" to this department. Therefore, the audio data indicate that appearing fair might have motivated equal investments. Zero investments, by contrast, were chosen by participants who mainly focused on the updated financial report. The financial data was also the major motivator behind investments of 5 and 15 million dollars into the failing department. The fact that consideration of the updated data led to zero investments in the audience condition but also to investments of 5 and 15 million dollars indicates that participants in the anonymous condition might have often chosen investments of 5 and 15 million dollars because they had considered the updated financial report. In the audience condition, by contrast, participants learned from the updated financial data that made a mistake. Thus, they took zero investments to signal to the experimenter that they learned from their mistake (see section 3.1.3 including Figure 6).

Although there was no statistically significant difference between investments in the two conditions (see section 3.2.1.2) the distribution curve reveals differences in the investment patterns. Local minima and maxima allowed for a dissection of the distribution curve into ranges: 0 to 3.5 (range A), 3.5 to 6.5 (range B), 6.5 to 9 (range C), 9 to 11 (range D), 11 to 16.5 (range E) and 16.5 to 20 (range F). Double as many or more participants in the audience condition than in the anonymous condition chose an investment within ranges A and D whereas the opposite holds true for investments in ranges B and E (see Figure 5 in section 3.1.3).

Previous findings suggested that humans anticipating a need to justify themselves apply reason-based choice more often (Simonson, 1989) . Thus, the prediction was that in the audience condition participants would often choose the most justifiable rather than the most rational choice due to the need to state reasons for their decisions to the experimenter. The prediction is confirmed

mainly by the insights which the audio recordings provide into the arguments which underlay certain investments in the audience condition.

- Zero investments (n = 11):
  - All participants mentioned the updated financial report as the main reason for their decision (see section 3.1.3.1).
  - Only one participant provided more than one reason apart from the updated financial report (see section 3.1.3.8). This supports the interpretation that only considering the updated report led to zero investments in the audience condition.
  - 81.8% of the participants who mentioned the updated financial report as the only reason for their choice invested nothing in the initially chosen department. All of them invested within range A (see section 3.1.3.1). This supports the interpretation that participants in the audience condition wanted to signal that they have realized that their first decision has been a mistake and therefore turned away from this department completely.
  - Seven out of forty participants did not mention the updated financial report at all. None of them invested anything in the failing department (see section 3.1.3.1).
- Investments of 5 million dollars (n = 4):
  - All participants who invested 5 million dollars in the failing department mentioned the updated financial report as the main reason for their decision (see Figure 6 in section 3.1.3).
- Investments of 10 million dollars (n = 8):
  - 75% (n = 6/8) chose this investment point because they hoped or expected the data to change in the future (see section 3.1.3.2) This supports self-justification theory, which predicts that participants escalate commitment in "hope of a turnaround" that would make their initial decision justifiable (Sleesman, Conlon, McNamara, & Miles, 2012, p. 546).
  - All eight participants stated multiple reasons for their second decision. Except for one, all considered more than one factor apart from the updated financial report. This suggests that sophisticated reasoning stood behind equal investments and thus, that appearing to be considerate seemed to be goal (see section 3.1.3.8).
  - 75% of the participants (n = 6/8) argued that they want to "give a boost" to the department doing well. One of these participants explicitly stated that she wanted to give a "reward" to the department. This indicates that participants were interested in presenting themselves as being fair (see section 3.1.3.3).
  - Three participants outsourced responsibility for the negative outcomes of the initial decision by claiming that the department "did something wrong" with marketing. This also indicates the wish to appear fair: Participants punished the department as they did not regard the negative outcomes of the initial decision as their own mistake but rather as the mistake of others (see section 3.1.3.5)

- Investments of 15 million dollars (n = 3):
  - The dominant reasons behind this investment (each stated by n = 2/3) were the updated financial report and/or outsourcing of responsibility to external factors as for example the financial crisis (see section 3.1.3).
- Investments of 20 million dollars (n = 4):
  - Recurring reasons (each stated by n = 2) which motivated these investments were the hope or expectation that the data would change in the future and the argument that the other department did well even without the initial investment (see section 3.1.3).
  - None of the participants who invested everything in the initially chosen department mentioned the updated financial report as a factor driving their choice (see section 3.1.3.1).

Audio recording data demonstrate that the same reasons underlay the above mentioned investment points and investments in the corresponding ranges. The only exceptions were that in range F the argument that the data might change in the future played a minor role and that in range E consideration of the updated financial data was the only major reason, not with external factors in addition (see section 3.1.4). In sum, the audio recording data support the prediction that in the audience condition participants would have an interest in making their investments comprehensible to others: Zero investments were chosen more often than 5 and 15 million dollars if the updated financial report was considered, which indicates that participants wanted to show that they learned from their mistake. The argument that the other department performed well even without initial investment was often provided to argue in favour of high investments (equal or higher than 10 million dollars) into the failing department. The argument appeared for investments in ranges D to F with the exception of one outlier. This reason was always mentioned in combination with other reasons (see section 3.1.3.4). Sophisticated reasoning behind high investments might express the aim to make decisions more comprehensible to the audience (see section 3.1.3.8).

4.1.2 Results on the second prediction – Confirmation bias

Mercier and Sperber have argued that a "genuine confirmation bias" (Mercier & Sperber, 2011, p. 64), i.e. the tendency to overlook evidences and arguments going against own claims and focusing on those supporting own conclusions, would only occur in argumentative settings and only when producing, not evaluating, arguments (Mercier & Sperber, 2011). The second prediction that a confirmation bias would occur more often in the audience than in the anonymous condition due to the argumentative context in this setting was based on this claim. The results on this prediction are ambiguous. The prediction is not supported by investment decisions and audio data: First, no significant difference between the investments in the two conditions was found (see section 3.2.1.2). Second, audio recording data revealed that only four participants carried reasons from their first decision over to the second decision (see section 3.1.3.6). Third, the modes of investments were higher in the anonymous condition (5 and 15 million dollars) than in

the audience condition (0 and 10 million dollars). Nonetheless, questionnaire data support the hypothesis. Different factors are correlated with second investments in the two conditions: In the anonymous condition the belief that continued investment in the failing department would eventually result in positive outcomes was significantly correlated, in a positive relationship, with second investments. In the audience condition, by contrast, second investments were significantly correlated, in a negative relationship, with agreement to getting over negative events quickly and focusing on taking actions that result in better outcomes, i.e. being "action-oriented" as defined by Putten and colleagues (Putten et al., 2010, p. 33). Also, a positive correlation of a moderate size (although not significant after Bonferroni correction) between agreement to having based the second decision on the same reasons as the initial decision and second investments was found (see section 3.2.2.1). In addition, regression models support the hypothesis. 41% of the variability of second investments in the audience condition could be explained by a regression model (described in section 3.2.2.2) considering participants' agreement to have based their second decision on the same reasons as their first decision and to agreement to the statement "I get over negative events quickly and focus on taking actions that result in better outcomes". An increase of 2.28 million dollars per point in agreement to have based the second decision on the same reason as the first decision (on a 5-point likert-scale ranging from "Strongly disagree" to "Strongly agree")[21] was predicted. This supports the hypothesis that a confirmation bias leads to investments in failing endeavours. The regression model predicted a decrease of 2.88 million dollars in investments per step in agreement to being "action-oriented" (Putten et al., 2010, p. 33). This indicates that overcoming a negative decision is important to avoid falling prey of the Sunk Cost Fallacy. These results are of particular interest since in the anonymous condition neither of these two variables was moderately correlated with second investment decisions (see section 3.2.2.1). A simple regression model, with the predictor variable being the agreement to the belief that continued investment in the failing department would result in positive consequences eventually, accounted for 39% of the variability of second investments in the anonymous condition. For each point of agreement on the 5-point likert-scale the model predicted that 2.86 million dollars more would be spent on the failing department (see section 3.2.2.2). In conclusion, high investments into the failing department in the anonymous condition seem to be motivated by the belief that continued investment would lead to positive results in the future. In the audience condition, by contrast, high investments were likely to occur if participants were not "action-oriented" (Putten et al., 2010, p. 33) and held on to the reasons that guided their initial decision.

The open questions do not offer much insights into the second prediction: Investments do not differ based on whether participants stated to have felt that their decisions were monitored or not (audience condition) or whether they have felt that their decisions were anonymous or not (anonymous condition). Only eight out of forty participants in the audience condition stated to

[21] It has to be noted that a methodological limitation of this study is that the scale was created post-hoc: The numbers (1 = "Strongly disagree", 2 = "Disagree", 3 = "Neither agree nor disagree", 4 = "Disagree", 5 = "Strongly disagree") were not presented in the questionnaire but only the corresponding text as can be seen in the instructions in Appendix A.

have felt that their decisions were monitored. There was no significant difference found between investments of participants in the audience condition stating to have felt monitored and those who did not (see section 3.2.2.3). It might be the case that the question was misunderstood. An Experimenter Demand Effect as described by Zizzo (Zizzo, 2010) might have been at work: In the audience condition stating that one felt observed was irrelevant as it was expected in an experiment. So, participants might have taken the question as "to what extent have you been affected by the audience?" and so they wanted to assert their autonomy by stating that they had not been affected. Also, results indicate that participants thought that the question referred to the position within the scenario (see section 3.2.2.3).

In sum, the data offered ambiguous results on the tested hypothesis: On the one hand, questionnaire data provided strong evidence that a failure to update beliefs stands behind high second investments in an argumentative context only. Also, investment patterns and audio data confirm the prediction that reason-based choice occurred in the audience condition. On the other hand, investment decisions did not differ significantly between the two conditions and there were only few instances documented in the audio data of participants carrying-over reasons from the first to the second decision. A follow-up experiment is suggested in section 4.4 to clarify these results.

4.1.3 Circumstances under which the Sunk Cost Fallacy is likely to occur

Which factors underlie the SCF and under which circumstances is this bias more likely to occur? The present study offers some insights with regard to these questions:

First, the presence or absence of an argumentative context has an influence on investments in a failing endeavour. This concerns the main hypothesis of this study and arguments speaking in favour and against it can be found in sections 4.1.1 and 4.1.2.

Second, correlations between investment decisions and answers to likert-scale questions provide insights into the variables which might make high investments into a failing endeavour more likely: In both conditions a moderate correlation between second investments and agreement that the updated financial information was the major reason for the second decision was found. Nonetheless, the correlation was only significant in the audience condition (see section 3.3.1). This indicates that high investments in a failing endeavour are linked to disregarding the updated information. In addition, the desire to complete a started project and commitment to the initial decision were moderately, although not significantly after Bonferroni correction, correlated with second investments in both condition (see section 3.3.1). These results suggest that these are factors important for the occurrence of the SCF independent of the existence of an argumentative context.

Third, open questions show that satisfaction with the initial decision and opinion change over time both had large effects on investment decisions regardless of the condition (see section 3.3.3).

Fourth, several questions targeting different factors proposed in previous studies were included in the questionnaire as a meta-study has shown that multiple factors might account for the SCF (Sleesman et al., 2012). The prediction was that different determinants interact, but that reason-based choice combined with a confirmation bias is a major driver:

- Wastefulness, although previously suggested to be one of the main determinants of the Sunk Cost Fallacy (e.g., Arkes & Blumer, 1985; Haller & Schwabe, 2014), was not significantly correlated with investment decisions in neither anonymous nor audience condition in my experiment (see section 3.3.2). In addition, only one participant mentioned wastefulness as a factor ad-hoc according to the audio recording data (see section 3.1.3.6). Nonetheless, the belief that continued investments would lead to positive outcomes in the future was found to be significantly correlated with second investments in the anonymous condition (see section 3.2.2.1). Arkes and Blumer argued that this might either be a reason, a consequence, or both of the decision to continue investing (Arkes & Blumer, 1985).
- Putten, Zeelenberg and Dijk have argued that mindset influences how prone an individual is to commit a SCF (Putten et al., 2010). Agreement to being "action-oriented", i.e. to "get over negative events quickly, and focus on taking action to solve them" (Putten et al., 2010, p. 33), was in my experiment significantly correlated with second investments in the audience condition, but not in the anonymous condition (see section 3.3.2). Agreement to being "state-oriented", i.e. to "find it difficult to overcome a negative event, and keep ruminating about it and how it affects their current state" (Putten et al., 2010, p. 33), on the other hand, was not significantly correlated with second investments in neither of the two conditions (see section 3.3.2.). These results indicate that not mindset is a determinant of the SCF, but the failure to update beliefs and that this failure is more likely to occur if individuals who are not "action-oriented" (Putten et al., 2010, p. 33) face the need for argumentation.
- Cunha and Caldieraro suggested that perceived effort influences whether participants are likely to hold-on to a failing endeavour because not only monetary but also behavioural resources are taken into consideration (Cunha & Caldieraro, 2009). Results of my study do not support this claim: Neither perceived effort of the first nor the second decision was found to be significantly correlated with allocations to the failing department (see section 3.3.2).
- Keil, Truex and Mixon experimentally demonstrated that "subjects' willingness to continue a project increased with the level of sunk cost and the degree of project completion, but that subjects were more apt to justify their continuation on the basis of sunk cost" (Keil et al., 1995, p. 372). The results of the present experiment back these findings but further investigation is recommended: Although not significantly after Bonferroni corrections, the desire to complete the started project was moderately correlated with second investments in both conditions (see section 3.3.2).

4.1.4 Role of the experimental setting for investment decisions

Audio data suggest that participants in the audience condition tended to invest nothing in the failing department to prove that they learned from their mistake (see section 3.1.3). The study design might favour zero investments if reason-based choice is at work as admitting a mistake might be easier in this experimental setting than in real-world situations:

First, real stakes might be lacking. In real-world settings long-term reputation management and concerns about resources, for example, are important. In this one-shot game participants had no relationship to the experimenter, no future encounter was to be expected and no real monetary stakes were involved. Incentivization is recommended for future experiments to mirror decision making in real-world settings more accurately.

Second, commitment to the initial decision, although not significant after Bonferroni correction, was found to be moderately correlated with second investments in both conditions (see section 3.3.1). A prerequisite for commitment might be the feeling of being capable of taking a good decision in the first place. Results of my experiment prove that participants indeed applied reason-based choice in an argumentative context. Nonetheless, participants might not have felt capable of providing good reasons for their initial decision since they did not feel like experts in the field and the information provided left participants in uncertainty. Therefore, they might have provided the best reasons they could come-up with, but were not committed to them. Thus, no failure to update beliefs occurred in the second decision. Participants who regard themselves as epistemic authorities in comparison to the audience or feel knowledgeable in the field might not admit a mistake as easily. This might contribute to the explanation why the results of the experiment by Staw were not replicated although the same scenario was used (see section 2): Being business students "enrolled in the College of Commerce and Business Administration at the University of Illinois" (Staw, 1976, p. 30) participants might have been more self-confident with regard to the task independent of the experimental conditions.

4.2 Limitations

The experiment I conducted bore several limitations:

First, a limitation of the present study is that the two options (investing in the consumer products department or the industrial products department) in the first decision turned out not to be equally attractive. A small cue in the description of the industrial products department suggested its advantages in a long-term perspective. The advantage of this cue is that it provided further evidence that participants in the audience condition applied reason-based choice. Its disadvantage is that it led to an asymmetry between the two conditions: The effect of the first decision on second investments seemed to be larger in the audience than in the anonymous condition. Nonetheless, in neither of the two conditions second investments differed significantly based on whether CP or IP has been chosen for the initial investment (see section 3.2.1.1).

Second, the audience might not have been large enough to mirror an argumentative context as it would occur in real-world settings: The audience only consisted of one experimenter. Participants who often take part in experiments might be used to this kind of observation. Nonetheless, the main element of the argumentative context in the present study was not audience presence but the need to state reasons. This element was implemented in the study. In addition, audio recording was applied.

Third, the scenario did not provide a measure of irrationality. This is a structural limitation which is inherent to many studies on the SCF since irrationality is detected at an aggregated, not an individual level. This particular scenario has been chosen despite this limitation due to the benefits it bears: It has already been successfully applied to test for the impact of self-justification on the SCF (Staw, 1976). Also, it enabled participants to take the first decision themselves. Participants were not only informed about what the initial decision has been as it is the case in many other standard experiments on the SCF (e.g., Arkes & Blumer, 1985). This was advantageous because "explicitly choosing the failed course of action creates a condition that comprises only decision makers who have an actual preference for the course of action" (Sleesman et al., 2012, p. 546). Although having no measure of irrationality could be regarded as a limitation, the scenario should be suitable to test the hypothesis: If the SCF is indeed caused by reason-based choice, it is not important what investments participants choose, but to detect whether preference reversal occurs. If reason-based choice is applied in an argumentative context, it is unlikely that subjects take inconsistent choices.

4.3 Impact and practical applications

The impact of my study is threefold:

First and foremost, it contributes to the scientific understanding of the SCF and targets social determinants which have been underrepresented in the last 35 years of research (Sleesman et al., 2012). My study drew on a relatively new theory to investigate the bias from a different viewpoint: The argumentative theory of reasoning by Mercier and Sperber (Mercier & Sperber, 2011). This shed light on the social environment behind self-justification, a psychological mechanism which had been shown to be a major driver behind the SCF (Staw, 1976). The experiment presented in this Master thesis pinned down one bias and studied its underlying mechanisms and conditions of appearance and thereby demonstrated the limitations of the concept of the homo economicus. From a Cognitive Science perspective this study is of relevance due to the inherent interdisciplinarity of the field of Behavioural Economics: Research on the SCF is not only conducted in Psychology and Economics, but also in other disciplines involved in Cognitive Science, as for example Neuroscience (e.g., Haller & Schwabe, 2014) and Cognitive Biology (e.g., Magalhaes & White, 2014). In my experiment an economic topic was studied with methods from experimental Psychology. In addition, this study took social factors underlying psychological mechanisms into account and drew on a theory grounded in Philosophy (Mercier & Sperber, 2011).

Second, my study adds to the understanding of social determinants behind the SCF. This can support management decisions in the private and public sector. Results of the experiment which could be of interest for practical considerations include, for example, the following:

- More extreme decisions can be expected if a person has to justify her or his decisions in front of others. This is the case because reason-based choice is likely to be applied in an argumentative context. If the person takes his or her decisions anonymously, by contrast, less extreme decisions could be expected.
- Investment points which are "salient", i.e. investment points which draw the attention of the audience, might be preferred in a setting in which people anticipate a need for justification.
- People who find or expect to find themselves in an argumentative context tend to take choices which are justifiable.
- Arkes and Blumer obtained results which showed that participants who had already invested in an endeavour "have an inflated estimate of the likelihood that the completed project will be a success" in comparison to participants who had not made a prior investment (Arkes & Blumer, 1985, p. 130). In my experiment the hope of a turnaround was significantly correlated with high investments in a failing endeavour in an anonymous setting.
- Whether the Sunk Cost Fallacy occurs seems to be highly dependent on whether updated data is considered or not.

These insights can be used for nudging initiatives (Thaler & Sunstein, 2008), for example by facilitating less extreme decisions through increasing anonymity or lessening personal responsibility, for consulting and leadership seminars (e.g. raising awareness about heuristics and biases unconscious to the decision-makers themselves), to create a better working environment by making decisions more understandable to colleagues or employees, and for raising awareness that the organizational structure influences decision making (e.g. in an argumentative context people will choose justifiable decisions).

Third, the present study provides data on individual decision making which can serve as a basis for future experiments, as for example the planned study comparing the occurrence of the Sunk Cost Fallacy in hierarchical versus egalitarian groups described in the next chapter.

4.4 Outlook

My study provided experimental evidence that participants apply reason-based choice in an argumentative context. Open remains the question how and under which circumstances choosing the most justifiable rather than the most rational choice can lead to the Sunk Cost Fallacy since my results on the role of the confirmation bias were ambiguous. In this section a follow-up experiment is proposed which mirrors social settings under which managerial decisions in the real-world are taken more accurately. Previous studies have shown that "groups in escalation situations exacerbate tendencies dominant at the individual level, even if those tendencies are coun-

terproductive" (Whyte, 1993, p. 446f.). An experiment on group decision making could help to clarify the ambiguous results I obtained on the role of the confirmation bias for the SCF. The hypothesis of the proposed follow-up experiment is the same as in the experiment I conducted: An argumentative context favouring reason-based choice leads people to be more affected by a confirmation bias which in turn causes the SCF. The study design is identical with the difference lying only in the manipulation of the independent variable: Investment decisions of leaders in hierarchical groups are compared to decisions resulting from majority votes in egalitarian groups (Table 7).

Table 7: Decision making in hierarchical and egalitarian groups

Condition	First decision	Knowledge at time of the second decision	Second decision
Group with egalitarian structure	Majority vote based on anonymous submissions of group members →No argumentative context, anonymous	Group members do not know the decisions of each other → Anonymous	Outcome is mutually discussed and second decision collaboratively taken → No argumentative context on an individual level, partially anonymous
Group with hierarchical structure	Leader takes first decision and justifies it in front of the group → Argumentative context, not anonymous	Group members know about the initial decision of the leader and the reasons behind the decision → Not anonymous	Leader takes second decision and justifies it in front of the group → Argumentative context, not anonymous
Individual – Anonymous condition	Submission of first decision in voting box → No argumentative context, anonymous	The first decision is in the voting box → Anonymous	Submission of second decision in voting box → No argumentative context, anonymous
	Can serve as baseline condition for the group experiment		
Individual – Audience condition	Participant justifies first decision to the experimenter → Argumentative context, not anonymous	Experimenter knows about the decision and the reasons behind it, audio recording was applied → Not anonymous	Participant justifies second decision to the experimenter → Argumentative context, not anonymous

In the hierarchical condition one participant per group is appointed as the leader, takes the first decision and has to justify it in front of the other group members. In the egalitarian condition, by contrast, the decision of each member is submitted anonymously. The decision of a leader (hierarchical group condition) or the outcome of a majority vote (egalitarian group condition) always leads to negative consequences, meaning that the sales and earnings of the chosen department are lower than those of the other department. For the second decision, hierarchical group members are informed about the outcome of their leader's decision. The leader now decides on the second decision and again has to justify it in front of his or her group. In the egalitarian group the outcome of the initial decision is mutually discussed and the second decision taken collaboratively.

Ideally, the experiment should be conducted with participants who have a background in business or economics and be incentivized. Group sizes should be odd numbers to guarantee clear results from the anonymous votes, large enough to provide a feeling of anonymity about the first decision within the egalitarian group and should be the same in both conditions. The anonymous condition of the present study could serve as baseline condition (Table 7).

In addition, insights into group decision making could be gained: Uniformity pressure is suspected to be especially strong under conditions of uncertainty, i.e. in situations in which "whether or not an opinion is correct cannot be immediately determined by reference to the physical world" (Festinger, 1954, p. 118). Participants could be asked to anonymously state the decision they would take on an individual level before they discuss the results of the first decision in the group. These individual decisions could be assessed to gain insights into informational influence and its effect on group polarization (Myers & Lamm, 1976). Nonetheless, the main aim of the follow-up study is to test whether reason-based choice and a confirmation bias cause the SCF. The prediction is that leaders of hierarchical groups will apply reason-based choice which in turn will lead to a confirmation bias as leaders fail to update their beliefs. Thus, leaders are expected to fall prey of the SCF more often than members of an egalitarian group. Investments in the failing department during the second round of decision making are predicted to be higher in the hierarchical group condition than in the egalitarian group condition.

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Appendix A – Instructions

Anonymous condition

CONSENT FORM

Psychology experiment, Budapest, ….. / ….. / 2015

You are about to participate in an experiment on decision-making. Your participation is voluntary and you can withdraw at any time from the experiment.

None of your personal details will appear in any published document. Furthermore, it will not be possible to associate your name to any decision or behavior related to the task. The results of the experiment may lead to the publication of statistical data that will under no circumstances refer to you personally.

We do not envisage any negative consequence for you in taking part in this experiment. You participation will allow us to investigate specific aspects of human psychology and behavior.

If you need any further information, please ask the experimenter.

Please complete the form and sign below if you agree to take part in the experiment.

I, ……..… agree to participate in the current research study.

I am participating voluntarily. I understand that I can withdraw from the study, without repercussions, at any time. I understand that anonymity in any resulting publications will be ensured.

Signed: …….. Date: …..... / …….. / 2015

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The D&A Financial Decision Case

Thank you for volunteering for this experiment on financial problem-solving. Your participation helps us to understand decision-making in various contexts. Your task is to play the role of a corporate executive and to solve the "D&A Financial Decision case". Attached to this paper you find information about the "Davis and Anderson company" (D&A) which is specialized on camera technologies. You are provided with the company's financial information of sales and earnings of the previous years and a short description of relevant departments. The information is taken from the annual report of the company. You are going to decide about the allocation of research and development funds.

Please take your first decision in view of the financial report. Then, according to your initial decision please open the envelope "IP" if you have chosen Industrial Products or "CP" if you have chosen Consumer Products and take out one package containing the financial report and the second decision sheet. The updated financial report depicts the sales and earnings of the D&A company five years after your initial decision. Based on this information make your second decision and fill-out the decision sheet which is attached to it. After taking your second decision please fill out the questionnaire.

Thank you for your participation!

The D&A Financial Decision Case

The Davis and Anderson Company is a large technologically-oriented firm. As the financial history including ten prior years of sales and earnings data depict, the company has started to decline over several preceding years. The directors of the company agree that one of the major reasons for the decline in corporate earnings and a deterioration in competitive position lay in some aspects of the firm's program of research and development. Therefore, the directors have concluded that 10 million dollars of additional Research and Development (R&D) funds should be made available. This money can be invested in one of the corporation's two largest divisions: Consumer Products or Industrial Products. For the time being, only one of the two divisions can receive the additional funding. Please imagine yourself in the role of the Financial Vice President and decide upon the division which should receive the 10 million dollars. Make your decision on the basis of the financial data and with regard to the potential benefits that R&D funding will have on the future earnings of the divisions.

Consumer Products
The consumer products developed by the D&A company are high-tech cameras at affordable prices. These products are split into two main specializations: Cameras for outdoor activities and small, low-weight cameras for everyday usage. The main challenge is to provide compelling advantages in comparison to mobile phone cameras without exceeding the price limits for the target group, which are active, travel-loving and social adults in the age range of 18 to 45 years. Future investment could target design elements and new products like a waterproof and particularly small hybrid model.

Industrial Products
The D&A company does not limit itself to the production of consumer products but also uses its technologies for the production of cameras used in industry. Recently two new potential targets were defined: The development of cameras for clinical usage and cameras for laptops. Technological features initially developed for consumer products, as for example water and lipid resistance, could be re-adapted for these purposes. Both ideas for new industrial products require intense research but have the potential to lead to long-term cooperation with major technology-oriented companies and hospitals.

CONSUMER PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	624	14.42
2000	626	10.27
2001	649	8.65
2002	681	8.46
2003	674	4.19
2004	702	5.35
2005	717	3.92
2006	741	4.66
2007	765	0.48
2008	770	-0.12
2009	769	-0.63

INDUSTRIAL PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	670	15.31
2000	663	10.92
2001	689	11.06
2002	711	10.44
2003	724	9.04
2004	735	6.38
2005	748	5.42
2006	756	3.09
2007	784	3.26
2008	788	-0.81
2009	791	-0.80

* In millions of dollars.

Decision Sheet 1

Please make your decision based on the financial information provided and with regard to the potential benefits on future earnings of the divisions and **circle your chosen division.**

In the role of the Financial Vice President I want to assign the additional 10 million dollars to

- The Consumer Products division
- The Industrial Products division

Now please enter this sheet into the box and open envelope “IP” if you have chosen Industrial Products or “CP” if you have chosen Consumer Products and take out one package containing the financial report and the second decision sheet.

The D&A Financial Decision Case 2015

Today, five years after the initial allocation of the 10 million dollars of additional research and development funds to the Consumer Products division, the R&D program of the Davis and Anderson Company is again up for re-evaluation. The management of the company is convinced that there is an even greater need for expenditure on research and development. Twenty million dollars have been made available from a capital reserve for R&D funding. As the Financial Vice President you are asked to decide upon its proper allocation. Financial data is provided for each of the five years since the initial allocation decision and, as earlier, the investment decision is to be made on the basis of future contribution to earnings. Please specify the amount of money that should be allocated to either the Consumer Products or Industrial Products division. This time, however, you are allowed to divide the R&D money in any way you wish among the two major divisions.

CONSUMER PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	624	14.42
2000	626	10.27
2001	649	8.65
2002	681	8.46
2003	674	4.19
2004	702	5.35
2005	717	3.92
2006	741	4.66
2007	765	0.48
2008	770	-0.12
2009	769	-0.63

First R & D funding decision as of 2009 – 10 million $ for the Consumer Products division

2010	771	-1.12
2011	774	-1.96
2012	762	-3.87
2013	778	-3.83
2014	783	-4.16

INDUSTRIAL PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	670	15.31
2000	663	10.92
2001	689	11.06
2002	711	10.44
2003	724	9.04
2004	735	6.38
2005	748	5.42
2006	756	3.09
2007	784	3.26
2008	788	-0.81
2009	791	-0.80

First R & D funding decision as of 2009 – 10 million $ for the Consumer Products division

2010	818	0.02
2011	829	-0.09
2012	827	-0.23
2013	846	0.06
2014	910	1.28

* In millions of dollars.

The D&A Financial Decision Case 2015

Today, five years after the initial allocation of the 10 million dollars of additional research and development funds to the Industrial Products division, the R&D program of the Davis and Anderson Company is again up for re-evaluation. The management of the company is convinced that there is an even greater need for expenditure on research and development. Twenty million dollars have been made available from a capital reserve for R&D funding. As the Financial Vice President you are asked to decide upon its proper allocation. Financial data is provided for each of the five years since the initial allocation decision and, as earlier, the investment decision is to be made on the basis of future contribution to earnings. Please specify the amount of money that should be allocated to either the Consumer Products or Industrial Products division. This time, however, you are allowed to divide the R&D money in any way you wish among the two major divisions.

INDUSTRIAL PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	670	15.31
2000	663	10.92
2001	689	11.06
2002	711	10.44
2003	724	9.04
2004	735	6.38
2005	748	5.42
2006	756	3.09
2007	784	3.26
2008	788	-0.81
2009	791	-0.80

First R & D funding decision as of 2009 – 10 million $ for the Industrial Products division

2010	771	(1.12)
2011	774	(1.96)
2012	762	(3.87)
2013	778	(3.83)
2014	783	(4.16)

CONSUMER PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	624	14.42
2000	626	10.72
2001	649	8.65
2002	681	8.46
2003	674	4.19
2004	702	5.35
2005	717	3.92
2006	741	4.66
2007	765	2.48
2008	770	-0.12
2009	769	-0.63

First R & D funding decision as of 2009 – 10 million $ for the Industrial Products division

2010	818	0.02
2011	829	-0.09
2012	827	-0.23
2013	846	0.06
2014	910	1.28

* In millions of dollars.

Decision Sheet 2

Please make your decision based on the financial information provided and with regard to the potential benefits on future earnings of the divisions and **write down the amount of money you want to spend on each division.**

Out of the **20 million dollars** for R&D funding I, as the Financial Vice President, want to assign

- ☐ million dollars to the Consumer Products division
- ☐ million dollars to the Industrial Products division

After making your decision please put this sheet into the box and fill-out the questionnaire.

Questionnaire

Thank you for your work on the D&A Financial Decision Case. This questionnaire is the last part of the experiment. Please write the answers or circle the most appropriate choice.

- Age:
- Sex:

- Current profession (student, employed, in training, etc.):

- I have a background in Economics or Business:

Yes	No

If yes, please explain:

- I have experience in Behavioural Economics:

Yes	No

1) I felt very committed to my initial decision throughout the experiment.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

2) I felt personally responsible for the outcome of the initial decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

3) I had the feeling that my initial decision led to negative consequences.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

4) I felt that nobody can track my initial decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

5) I had the feeling that my decisions were completely anonymous.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

6) My initial decision influenced my second decision more than the updated financial report.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

7) The financial information at the point of the second decision was the major reason for my decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

8) I based my second decision on the same reasons as my initial decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

9) I have been very satisfied with my initial decision directly after taking it.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

10) Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

11) I had a strong desire to complete the started project.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

12) I spent a long time on the initial decision and perceived it as effortful.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

13) I spent a long time on the second decision and perceived it as effortful.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

14) Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

15) I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

16) I get over negative events quickly and focus on taking actions that result in better outcomes.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

17) I find it difficult to overcome a negative event and keep ruminating about how it affects the current state.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

18) How satisfied have you been with your first decision directly after taking it? Did your satisfaction change in the course of the experiment, for example after you received the data for the second decision? If so, please explain.

19) Did you change your opinion during the experiment in which department you want to invest more? Why?

20) Did you have the feeling that your decisions were anonymous? Would you have made decisions differently if this would not have been the case?

21) Do you have any other comments which you want to mention here?

This is the end of the experiment.

Thank you for your participation!

Audience condition

CONSENT FORM

Psychology experiment, Budapest, ….. / ….. / 2015

You are about to participate in an experiment on decision-making. Your participation is voluntary and you can withdraw at any time from the experiment.

None of your personal details will appear in any published document. Furthermore, it will not be possible to associate your name to any decision or behavior related to the task. The results of the experiment may lead to the publication of statistical data that will under no circumstances refer to you personally.

In the course of the experiment voice recording might be applied. Under no circumstances will these audio tapes be handed to third persons or associated with your name in any resulting publication.

We do not envisage any negative consequence for you in taking part in this experiment. You participation will allow us to investigate specific aspects of human psychology and behavior.

If you need any further information, please ask the experimenter.

Please complete the form and sign below if you agree to take part in the experiment.

I, ……..… agree to participate in the current research study.

I am participating voluntarily. I understand that I can withdraw from the study, without repercussions, at any time. I understand that anonymity in any resulting publications will be ensured.

Signed: …….. Date: …..... / …….. / 2015

Personal Data

- First name:
- Surname:

- Age:
- Sex:

- Current profession (student, employed, in training, etc.):

- I have a background in Economics or Business:

Yes	No

If yes, please explain:

- I have experience in Behavioural Economics:

Yes	No

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The D&A Financial Decision Case

Thank you for volunteering for this experiment on financial problem-solving. Your participation helps us to understand decision-making in various contexts.

Your task is to play the role of a corporate executive and to solve the "D&A Financial Decision case". Attached to this paper you find information about the "Davis and Anderson company" (D&A) which is specialized on camera technologies. You are provided with the company's financial information of sales and earnings of the previous years and a short description of the relevant departments. You are going to decide about the allocation of research and development funds.

Please take your first decision in view of the financial report. Then, you will receive an updated financial report which depicts the sales and earnings of the D&A company five years after your initial decision. Based on this information we ask you to take the second decision. In the last part of the experiment you are asked to fill-out a questionnaire.

The D&A Financial Decision Case

The Davis and Anderson Company is a large technologically-oriented firm. As the financial history including ten prior years of sales and earnings data depict, the company has started to decline over several preceding years. The directors of the company agree that one of the major reasons for the decline in corporate earnings and a deterioration in competitive position lay in some aspects of the firm's program of research and development. Therefore, the directors have concluded that 10 million dollars of additional Research and Development (R&D) funds should be made available. This money can be invested in one of the corporation's two largest divisions: Consumer Products or Industrial Products. For the time being, only one of the two divisions can receive the additional funding. Please imagine yourself in the role of the Financial Vice President and decide upon the division which should receive the 10 million dollars. Make your decision on the basis of the financial data and with regard to the potential benefits that R&D funding will have on the future earnings of the divisions.

Consumer Products
The consumer products developed by the D&A company are high-tech cameras at affordable prices. These products are split into two main specializations: Cameras for outdoor activities and small, low-weight cameras for everyday usage. The main challenge is to provide compelling advantages in comparison to mobile phone cameras without exceeding the price limits for the target group, which are active adults in the age range of 18 to 45 years interested in social activities, sports and travel. Future investment could target design elements and new products, e.g. a waterproof and particularly small hybrid model.

Industrial Products
The D&A company does not limit itself to the production of consumer products but also applies its technologies for the production of cameras used in industry. Recently two new potential targets were defined: The development of cameras for clinical usage and cameras for laptops. Technological features initially developed for consumer products, as for example water and lipid resistance, could be re-adapted for these purposes. Both ideas for new industrial products require intense research but have the potential to lead to long-term cooperation with major technology-oriented companies and hospitals.

CONSUMER PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	624	14.42
2000	626	10.27
2001	649	8.65
2002	681	8.46
2003	674	4.19
2004	702	5.35
2005	717	3.92
2006	741	4.66
2007	765	2.48
2008	770	-0.12
2009	769	-0.63

INDUSTRIAL PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	670	15.31
2000	663	10.92
2001	689	11.06
2002	711	10.44
2003	724	9.04
2004	735	6.38
2005	748	5.42
2006	756	3.09
2007	784	3.26
2008	788	-0.81
2009	791	-0.80

* In millions of dollars.

If you have made your decision, please go to the experimenter and tell him or her in **which division** you would like to invest the 10 million dollars and state the **reasons** for your choice.

The D&A Financial Decision Case 2015

Today, five years after the initial allocation of the 10 million dollars of additional research and development funds to the Consumer Products division, the R&D program of the Davis and Anderson Company is again up for re-evaluation. The management of the company is convinced that there is an even greater need for expenditure on research and development. Twenty million dollars have been made available from a capital reserve for R&D funding. As the Financial Vice President you are asked to decide upon its proper allocation. Financial data is provided for each of the five years since the initial allocation and, as earlier, the investment decision is to be made on the basis of future contribution to earnings. Please specify the amount of money that should be allocated to either the Consumer Products or Industrial Products division. This time, however, you are allowed to divide the R&D money in any way you wish among the two major divisions.

CONSUMER PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	624	14.42
2000	626	10.27
2001	649	8.65
2002	681	8.46
2003	674	4.19
2004	702	5.35
2005	717	3.92
2006	741	4.66
2007	765	2.48
2008	770	-0.12
2009	769	-0.63

First R&D funding decision as of 2009: 10 million $ for the Consumer Products division

2010	771	-1.12
2011	774	-1.96
2012	762	-3.87
2013	778	-3.83
2014	783	-4.16

INDUSTRIAL PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	670	15.31
2000	663	10.92
2001	689	11.06
2002	711	10.44
2003	724	9.04
2004	735	6.38
2005	748	5.42
2006	756	3.09
2007	784	3.26
2008	788	-0.81
2009	791	-0.80

First R&D funding decision as of 2009: 10 million $ for the Consumer Products division

2010	818	0.02
2011	829	-0.09
2012	827	-0.23
2013	846	0.06
2014	910	1.28

*In millions of dollars.

Please decide in the role of the Financial Vice President what **amount of money you want to spend on each of the two divisions**. Inform the experimenter about your decision and the **reasons** for your choice.

The D&A Financial Decision Case 2015

Today, five years after the initial allocation of the 10 million dollars of additional research and development funds to the Industrial Products division, the R&D program of the Davis and Anderson Company is again up for re-evaluation. The management of the company is convinced that there is an even greater need for expenditure on research and development. Twenty million dollars have been made available from a capital reserve for R&D funding. As the Financial Vice President you are asked to decide upon its proper allocation. Financial data is provided for each of the five years since the initial allocation decision and, as earlier, the investment decision is to be made on the basis of future contribution to earnings. Please specify the amount of money that should be allocated to either the Consumer Products or Industrial Products division. This time, however, you are allowed to divide the R&D money in any way you wish among the two major divisions.

INDUSTRIAL PRODUCTS CONTRIBUTION TO SALES AND EARNINGS

Fiscal year	Sales*	Earnings*
1999	670	15.31
2000	663	10.92
2001	689	11.06
2002	711	10.44
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2012	827	-0.23
2013	846	0.06
2014	910	1.28

* In millions of dollars.

Please decide in the role of the Financial Vice President what **amount of money you want to spend on each of the two divisions**. Inform the experimenter about your decision and the **reasons** for your choice.

Questionnaire

Thank you for your work on the D&A Financial Decision Case. This questionnaire is the last part of the experiment. Please write the answers or **circle** the most appropriate choice.

1) I felt very committed to my initial decision throughout the experiment.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

2) I felt personally responsible for the outcome of the initial decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

3) I had the feeling that my initial decision led to negative consequences.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

4) I had the feeling that my decisions were evaluated by others.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

5) The presence of the experimenter influenced my decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

6) It was important for me what others might think about my decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

7) It was important for me what impression the experimenter has of my decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

8) I had the feeling that I have to make decisions fast because the experimenter was present.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

9) My initial decision influenced my second decision more than the updated financial report.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

10) The financial information at the point of the second decision was the major reason for my decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

11) I based my second decision on the same reasons as my initial decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

12) I had the feeling that I would violate social norms if I invested all money in one division only in the second decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

13) I had the feeling that I would violate social norms if I would invest nothing in the failing division in the second decision.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

14) I wanted others to think that I make good decisions.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

15) I had the feeling that I would be judged based on the decisions I make.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

16) I have been very satisfied with my initial decision directly after taking it.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

17) Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

18) I had a strong desire to complete the started project.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

19) I spent a long time on the initial decision and perceived it as effortful.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

20) I spent a long time on the second decision and perceived it as effortful.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

21) Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

22) I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

23) I get over negative events quickly and focus on taking actions that result in better outcomes.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

24) I find it difficult to overcome a negative event and keep ruminating about how it affects the current state.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

25) How satisfied have you been with your first decision directly after taking it? Did your satisfaction change in the course of the experiment, for example after you received the data for the second decision? If so, please explain.

26) Did you change your opinion during the experiment in which department you want to invest more? Why?

27) Did you have the feeling that your decisions were monitored? Would you have made decisions differently if this would not have been the case?

28) Do you have any other comments which you want to mention here?

Thank you for your participation!

Appendix B – Results

In Table 8 and Table 9 investment decisions (in hypothetical million dollars) and answers to likert-scale questions (5-point scale: 1 = “Strongly disagree”, 2 = “Agree”, 3 = “Neither agree nor disagree”, 4 = “Agree”, 5 = “Strongly Agree”) are provided. Personal data (age, sex, profession etc.) and information on the experimental session (date, location etc.) are not included to guarantee anonymity to the participants. All gathered data, including the original forms filled-out by the participants, are stored by the experimenter. Answers to open questions and the audio files containing the arguments provided by participants in the audience condition can be obtained by contacting the author of the study (ina.bauer@hotmail.com).

Table 8: Investment decisions and answers to likert-scale questions of participants in the anonymous condition

Participant	Decision 1	Decision 2		Questionnaire answers																
		CP	IP	Q1: "I felt very committed to my initial decision throughout the experiment"	Q2: "I felt personally responsible for the outcome of the initial decision."	Q3: "I had the feeling that my initial decision led to negative consequences."	Q4: "My initial decision influenced my second decision more than the updated financial report."	Q5: "The financial information at the point of the second decision was the major reason for my decision."	Q6: "I based my second decision on the same reasons as my initial decision."	Q7: "I have been very satisfied with my initial decision directly after taking it."	Q8: "Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome."	Q9: "I had a strong desire to complete the started project."	Q10: "I spent a long time on the initial decision and perceived it as effortful."	Q11: "I spent a long time on the second decision and perceived it as effortful."	Q12: "Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	Q13: "I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division."	Q14: "I get over negative events quickly and focus on taking actions that result in better outcomes."	Q15: "I find it difficult to overcome a negative event and keep ruminating about how it affects the current state."	Q An. 1: "I felt that nobody can track my initial decision."	Q An. 2: "I had the feeling that my decisions were completely anonymous."
An1	CP	0	20	2	1	3	2	2	1	5	2	2	2	2	2	4	2	2	4	2
An2	IP	15	5	3	3	2	3	2	2	4	2	4	2	2	4	2	4	3	4	2
An3	IP	20	0	2	4	4	5	5	2	5	5	4	4	3	4	4	2	2	4	3
An4	CP	5	15	4	4	3	3	5	2	5	1	2	3	3	3	3	2	2	5	1
An5	IP	10	10	3	4	4	3	4	5	2	1	1	4	4	2	3	5	4	2	2
An6	CP	15	5	4	5	3	2	5	2	5	1	3	2	4	4	4	5	4	4	2
An7	CP	4	16	3	4	4	2	2	2	4	2	3	4	4	4	3	2	2	2	4
An8	IP	10	10	4	5	4	3	4	2	4	2	3	4	4	2	4	4	4	4	2
An9	IP	15	5	4	4	4	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
An10	IP	19	1	n.a.	n.a.	2	4	4	2	5	2	n.a.	3	n.a.	3	2	2	2	n.a.	n.a.
An11	CP	12	8	4	3	4	4	4	2	4	4	2	4	3	2	2	4	4	3	3
An12	IP	14	6	2	3	3	2	3	2	5	4	3	2	4	3	3	5	5	5	4
An13	IP	0.1	19.9	5	2	3	4	2	2	3	5	3	4	5	3	3	5	2	4	4
An14	IP	15	5	4	2	4	3	4	4	4	4	2	4	4	4	2	2	3	4	4
An15	CP	12	8	3	4	2	5	4	4	4	2	4	3	4	3	2	2	2	2	2
An16	IP	18	2	4	5	4	2	4	2	5	2	2	4	4	4	3	2	4	4	4
An17	IP	20	0	1	4	2	2	2	1	5	5	4	4	2	4	4	1	2	2	4
An18	CP	15	5	3	4	4	5	2	4	4	4	5	4	4	3	4	4	5	3	4
An19	IP	5	15	5	4	3	2	5	3	3	5	4	4	5	3	3	5	2	4	2
An20	IP	5	15	4	5	2	1	4	2	4	2	4	4	4	4	4	3	5	4	2
An21	CP	7	13	2	4	3	3	2	4	4	4	3	2	2	4	4	3	4	3	3
An22	CP	10	10	4	3	1	3	5	2	4	2	4	3	3	3	3	4	2	4	4
An23	IP	19	1	2	4	5	3	2	1	5	5	4	n.a.	2	4	4	1	1	4	2
An24	IP	5	15	4	4	2	2	5	2	5	3	5	4	4	4	4	4	2	1	4
An25	CP	5	15	4	4	3	3	3	2	4	3	4	3	2	4	2	2	3	4	4
An26	IP	15	5	2	2	2	2	4	1	5	1	4	4	4	3	2	1	4	4	1
An27	IP	5	15	n.a.	4	3	3	3	4	3	3	3	3	4	4	4	3	4	3	3
An28	IP	12	8	2	4	4	4	2	2	5	4	3	2	3	2	5	4	5	5	2
An29	IP	12	8	3	4	4	3	5	5	5	2	4	4	4	3	2	3	4	4	4
An30	IP	0	20	5	5	1	2	2	1	1	5	5	4	4	3	3	5	4	2	4
An31	CP	2	18	4	4	4	4	3	2	4	4	3	3	4	4	3	2	3	4	2
An32	IP	5	15	5	3	3	1	2	1	5	1	3	4	4	1	1	5	2	5	1
An33	IP	5	15	3	3	2	3	4	2	3	5	3	4	4	3	3	2	4	3	3
An34	IP	0	20	3	4	2	3	3	2	5	4	4	4	2	3	3	3	1	3	3
An35	IP	12	8	2	2	4	2	3	3	4	2	4	4	4	4	3	4	4	4	2
An36	IP	5	15	2	4	4	4	5	4	3	4	2	4	4	3	3	4	5	2	3
An37	CP	5	15	2	2	2	3	4	2	4	2	3	2	2	3	4	4	2	4	2
An38	IP	7	13	5	5	1	1	1	5	5	5	5	3	5	5	3	5	5	5	4
An39	IP	15	5	4	4	4	3	5	2	5	5	2	5	5	3	3	4	3	4	4
An40	IP	10	10	3	3	4	2	3	1	5	2	3	3	3	2	2	4	2	4	2

Table 9: Investment decisions and likert-scale answers of participants in the audience condition

		CP	IP	Q1: "I felt very committed to my initial decision throughout the experiment"	Q2: "I felt personally responsible for the outcome of the initial decision."	Q3: "I had the feeling that my initial decision led to negative consequences. "	Q4: "My initial decision influenced my second decision more than the updated financial report."	Q5: "The financial information at the point of the second decision was the major reason for my decision."	Q6: "I based my second decision on the same reasons as my initial decision."	Q7: "I have been very satisfied with my initial decision directly after taking it."	Q8: "Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome."	Q9: "I had a strong desire to complete the started project."	Q10: "I spent a long time on the initial decision and perceived it as effortful."	Q11: "I spent a long time on the second decision and perceived it as effortful."	Q12: "Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	Q13: "I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division."	Q14: "I get over negative events quickly and focus on taking actions that result in better outcomes."	Q15: "I find it difficult to overcome a negative event and keep ruminating about how it affects the current state."	Q Aud. 1: "I had the feeling that my decisions were evaluated by others."	Q Aud. 2: "The presence of the experimenter influenced my decision."	Q Aud. 3: "It was important for me what others might think about my decision."	Q Aud. 4: "It was important for me what impression the experimenter has of my decision."	Q Aud. 5: "I had the feeling that I have to make decisions fast because the experimenter was present."	Q Aud. 6: "I had the feeling that I would violate social norms if I invested all money in one division only in the second decision."	Q Aud. 7: "I had the feeling that I would invest nothing in the failing division in the second decision."	Q Aud. 8: "I wanted others to think that I make good decisions."	Q Aud. 9: "I had the feeling that I would be judged based on the decisions I make."
Aud1	IP	19	1	4	4	5	2	1	4	2	1	4	3	2	2	2	5	4	5	4	1	4	4	2	1	4	2
Aud2	IP	0	20	4	3	2	1	1	3	4	2	4	4	4	2	2	4	2	3	4	4	2	3	1	4	1	4
Aud3	IP	10	10	4	4	2	2	5	1	4	1	2	4	2	2	2	4	2	2	4	3	2	4	4	3	4	3
Aud4	CP	2	18	4	4	2	4	3	4	3	2	4	5	2	5	4	5	4	3	4	4	4	4	4	5	3	3
Aud5	CP	0	20	4	5	2	2	4	1	4	2	4	5	2	3	3	4	4	2	4	4	4	4	5	2	4	4
Aud6	IP	5	15	4	4	3	3	3	2	3	3	3	4	4	2	2	3	2	3	2	2	4	4	3	2	3	3
Aud7	IP	0	20	4	5	2	4	3	2	4	3	3	3	4	2	3	3	4	3	3	5	3	3	4	2	3	2
Aud8	CP	3	17	4	4	3	4	2	4	4	2	2	5	2	3	3	4	2	3	4	4	4	4	3	3	5	2
Aud9	CP	0	20	3	4	4	2	1	2	3	1	2	4	2	1	1	4	2	3	4	2	3	3	5	5	4	2
Aud10	IP	10	10	4	4	5	2	1	3	4	3	2	4	2	2	2	4	2	2	3	4	4	4	2	4	4	3
Aud11	IP	20	0	4	4	2	4	1	4	4	1	4	4	2	2	2	4	2	3	4	2	3	2	4	4	4	3
Aud12	CP	0	20	2	4	5	4	1	4	2	1	2	5	4	1	1	4	2	2	2	2	2	4	5	1	4	2
Aud13	IP	0	20	4	4	2	3	1	1	1	2	3	3	4	1	1	4	1	4	4	5	4	3	4	2	4	2
Aud14	IP	10	10	4	5	3	4	2	5	5	2	3	4	2	3	4	5	4	3	1	4	4	4	4	3	2	4
Aud15	IP	20	0	1	4	4	2	1	1	1	1	1	4	5	2	1	4	2	2	4	2	4	4	2	5	4	2
Aud16	IP	12	8	3	5	4	3	3	1	4	1	1	4	4	1	1	4	3	4	4	4	4	4	1	1	4	2
Aud17	IP	15	5	3	4	4	4	1	4	3	1	1	4	2	1	2	4	4	4	3	2	5	3	3	3	5	3
Aud18	IP	7	13	4	4	4	3	1	2	1	1	3	3	4	3	3	3	3	4	4	5	3	3	4	4	4	2
Aud19	IP	0	20	4	4	3	4	2	2	2	2	4	2	4	2	2	4	4	3	3	5	4	3	5	4	2	1
Aud20	IP	20	0	1	2	2	1	1	5	1	1	1	5	5	1	1	1	5	5	4	2	4	4	2	1	5	4
Aud21	IP	10	10	5	3	2	4	2	2	1	1	2	4	4	2	2	3	2	5	5	4	4	4	5	2	4	3
Aud22	IP	10	10	4	3	4	3	1	2	2	1	3	4	3	2	2	4	2	4	4	4	4	4	5	4	4	3
Aud23	IP	12	8	4	4	5	3	5	5	4	4	5	4	3	3	5	4	4	4	5	5	2	2	4	4	2	2
Aud24	IP	20	0	3	4	2	4	1	1	1	1	2	4	2	1	1	2	2	4	4	5	1	1	2	1	5	1
Aud25	CP	8	12	5	5	2	1	2	2	2	2	2	5	5	2	2	1	1	5	5	4	5	4	5	5	5	2
Aud26	IP	20	0	2	2	3	2	4	4	4	4	4	4	2	2	3	4	4	2	3	3	4	3	1	2	3	2
Aud27	IP	12	6	2	4	2	4	1	5	2	2	1	5	2	1	1	4	4	1	4	1	4	4	3	2	5	1
Aud28	CP	5	15	4	4	4	3	2	3	3	2	5	4	4	3	3	4	4	4	3	4	3	3	4	3	4	4
Aud29	CP	5	15	4	3	3	1	1	1	1	1	2	4	3	1	1	3	1	4	4	2	2	2	3	2	2	4
Aud30	IP	20	0	2	4	4	4	3	4	5	4	1	5	1	2	2	4	5	4	4	5	4	2	3	4	4	3
Aud31	IP	15	5	4	4	4	1	2	3	4	3	2	5	2	1	1	4	3	3	4	2	2	2	3	1	4	1
Aud32	IP	10	10	2	2	4	4	2	3	3	3	4	2	4	4	4	4	4	3	4	4	2	4	1	4	2	4
Aud33	CP	10	10	4	3	3	2	1	1	2	1	4	4	4	3	2	4	4	4	4	4	2	2	4	4	3	2
Aud34	IP	5	15	4	4	4	4	3	4	3	4	2	4	4	2	2	3	4	2	4	4	2	2	4	2	4	2
Aud35	IP	5	15	4	4	2	3	1	4	1	3	4	3	5	5	2	3	3	4	4	3	3	3	5	3	4	3
Aud36	IP	20	0	5	5	2	4	2	1	5	2	3	3	4	2	2	3	2	5	4	3	3	3	4	1	5	1
Aud37	IP	20	0	4	3	5	5	2	3	2	2	1	5	2	1	1	2	4	3	3	3	4	4	1	3	4	2
Aud38	IP	6	14	4	2	3	4	4	2	2	5	4	1	4	5	5	3	3	3	4	4	2	1	5	5	2	4
Aud39	IP	10	10	3	4	4	4	2	4	3	4	4	3	2	2	2	4	4	1	5	4	4	2	4	2	4	2
Aud40	IP	2	18	4	4	1	3	2	2	2	2	3	2	4	2	2	2	2	4	3	3	2	2	4	2	2	4

Appendix C – Comparison to the study by Staw (Staw, 1976)

The scenario used in the present experiment is an adaptation of the one applied by Staw to study self-justification as a determinant of the Sunk Cost Fallacy (Staw, 1976). Similarities and differences between the original scenario and the adaptation are described in Table 10.

Table 10: Similarities and differences to the study by Staw

Staw (1976)	Similar	Differences in the present experiment
Simulation of a business decision making scenario (role-playing exercise)	✓	
Two independent variables: Personal responsibility for the initial decision (yes / no) and consequences of the initial decision (positive / negative)	×	One independent variable: Reasoning in front of an audience versus anonymous decision making
Dependent variable: Investments to a failing department, i.e. the amount of money subjects allocate to an initially chosen department (0 to 20 million $)	✓	
Location: College of Commerce and Business Administration, University of Illinois, Urbana-Champaign (USA)	×	Location: Central European University, Budapest (Hungary)
Year: 1976	×	Year: 2015
240 participants	×	80 participants
Undergraduate students studying at the College of Commerce and Business Administration (University of Illinois)	×	Neither a business- / economics-related background nor a student status is a prerequisite for participation
No real monetary stakes	✓	
Incentive: Participation “as one means to fulfil a course research requirement” (Staw, 1976, p. 30)	×	Not incentivized
Subjects are asked to provide their names on each page of the material	×	Only participants in the audience condition are asked to state their names
Hypothetical corporation *Adams & Smith Company*	×	Hypothetical corporation *Davis & Anderson Company*
Hypothetical times of the decisions: De-	×	Hypothetical times of the decisions: De-

cision 1: 1967 | Decision 2: 1972		cision 1: 2010 | Decision 2: 2015
Scenario: The sales and earnings of a large technology-oriented company have started to decline in the previous years with the reason lying in the research and development program	✓	
Subjects take the decisions in the role of the Financial Vice President	✓	
Decision 1: Decide whether to spend 10 million $ of R&D funds in the Consumer or the Industrial Products department	✓	
Decision 2: Subjects are told that 5 years after the first decision the R&D program is again up for re-evaluation. Now they can divide 20 million dollars in any way they wish among the same two departments.	✓	
Subjects are asked to take the decisions based on the data of the last ten years (decision 1) / last 15 years (decision 2) with regard to the potential benefits on future earnings of the departments.	✓	
Participants in all conditions are asked to circle the chosen department (decision 1) / to state the amount they want to allocate to the departments (decision 2) and to write a brief paragraph defending their allocation decision after each decision	×	Anonymous condition: Similar to Staw's procedure | Audience condition: Inform the experimenter personally about the decisions and provide arguments
Consequences of the first decision: Half of the participants receive data suggesting that the first decision led to positive outcomes, the other half that it led to negative outcomes	×	The initial choice always leads to negative consequences (in both conditions)
Manipulation of personal responsibility: Half of the subjects take the first decision themselves, the other half are told that the first decision has been made by another financial officer	×	All participants take the first and the second decision themselves
Self-justification as a determinant of the SCF is studied through manipulating personal responsibility and consequences of the first decision	×	The role of the social environment triggering psychological mechanisms is studied: Absence or presence of an argumentative context (incl. audience)

Appendix D – Data analysis

Analysis of the audio recordings

Arguments of participants in the audience condition were audio recorded and analysed based on a procedure recommended by Gorden (Gorden, 1992): First, I defined coding categories (see "list of codes"). They are based on the notes which I have taken during the experiment. Categories are "all-inclusive", i.e. a category exists for every relevant argument, and "mutually exclusive", i.e. every argument can only fall into one category (Gorden, 1992, p. 183). Participants' responses can fall into multiple categories, however, if they stated several arguments. Second, codings were assigned numerical values. In the next step, I listened to the voice recordings of the first decision to recognize reasons recurring for the second decision (see section 3.1.4.6). Then, I listened to the argumentation for the second decision of the same participant and assigned the corresponding codes. This was repeated until all responses of participants in the audience conditions were coded. To test the reliability of the coding, the "test-retest method" was applied (Gorden, 1992, p. 185): I coded the audio recordings a second time, after a time span in between, without referring to the initial coding. Afterwards, I compared the two codings: If there were differences, I re-listened to the audio recording and then determined the final coding. In the final step, I connected the codings with second investment decisions of the participants.

List of codes

1. Consideration of updated financial report: Bad outcomes of initially chosen department or positive outcomes of the other department
2. "The other division did well even without the 10 million dollars of initial investment."
3. The data might change in the future.
   3a. IP is a long-term endeavour based on long-term cooperation.
   3b. The initially chosen department still needs more money to yield better results in the future.
4. Outsourcing of responsibility:
   4a. The data is negative because of external factors, e.g. financial crisis.
   4b. "What they have done" vs. "What I have done"
5. Reasons stated in the first decision are carried over to the second decision.
6. Self-justification: "My initial decision was good."
7. Absence of reasons
8. Fairness
9. Feeling that not enough information is provided, insecurity what to think about the data
10. Wastefulness
11. "Give a boost" to the department doing well
12. "Reward": The department with the better outcomes deserves the money.
13. Diversification: Invest in both departments as trends might change.
14. "Obviously, my decision was bad."
15. Stick with gut feeling
16. "Gamble": Take the risk of further investing in declining department.

Post-hoc matching

In the first step the root mean square (RMS) differences of questionnaire answers (only questions which were similar in both conditions were considered) between all participants in the two conditions were calculated. In the second step, the initial choice was marked (see 3.2.1.1). In the third step, participants were matched according to RMS difference and initial choice: First, participants initially choosing CP in the audience condition were matched to participants, who also chose CP, with the smallest RMS difference in the anonymous condition, because fewer participants in the audience condition initially decided on CP. Second, participants in the anonymous condition initially choosing IP were matched to participants with the smallest RMS difference in the audience condition who also chose IP, because there are less participants initially choosing IP in the anonymous condition. Third, the three remaining participants in the anonymous condition were matched with the remaining participants in the audience condition with the smallest RMS difference regardless of the initial choice. Finally, the two exceptional cases in the anonymous condition – participant "An9" answered only 3 out of 15 questions and "pAn10" 9 out of 15 – were matched with the two remaining participants in the audience condition.

Table 11: Matched pairs

	Audience condition		Anonymous condition		Selection critera	
	Participant	**2. investment (m. $)**	**Participant**	**2. investment (m. $)**	**RMS Difference**	**Initial choice**
Step 1:	Aud4	2	An6	15	1	Both CP
	Aud5	0	An22	10	1,125462868	Both CP
	Aud8	3	An4	5	0,774596669	Both CP
	Aud9	0	An21	7	1,238278375	Both CP
	Aud12	0	An37	5	1,211060142	Both CP
	Aud25	8	An31	2	1,460593487	Both CP
	Aud28	5	An18	15	0,816496581	Both CP
	Aud29	5	An25	5	0,894427191	Both CP
	Aud33	10	An11	12	0,856348839	Both CP
Step 2:	Aud17	5	An2	5	0,894427191	Both IP
	Aud16	8	An3	0	0,774596669	Both IP
	Aud39	10	An5	10	1,095445115	Both IP
	Aud3	10	An8	10	0,774596669	Both IP
	Aud7	20	An12	6	1,505545305	Both IP
	Aud21	10	An13	19,9	0,930949336	Both IP
	Aud26	0	An14	5	1,125462868	Both IP
	Aud10	10	An16	2	0,632455532	Both IP
	Aud20	0	An17	0	1,032795559	Both IP
	Aud13	20	An19	15	0,577350269	Both IP
	Aud11	0	An20	15	1,095445115	Both IP
	Aud37	0	An23	1	1,195228609	Both IP
	Aud14	10	An24	15	1,154700538	Both IP
	Aud30	0	An26	5	1,095445115	Both IP
	Aud18	13	An27	15	0,88640526	Both IP
	Aud15	0	An28	8	1,154700538	Both IP
	Aud23	8	An29	8	1,032795559	Both IP
	Aud40	18	An30	20	1,095445115	Both IP
	Aud24	0	An32	15	1,183215957	Both IP
	Aud2	20	An33	15	0,966091783	Both IP
	Aud6	15	An34	20	0,894427191	Both IP
	Aud22	10	An35	8	0,774596669	Both IP
	Aud19	20	An36	15	1,032795559	Both IP
	Aud35	15	An38	13	1,264911064	Both IP
	Aud34	15	An39	5	0,856348839	Both IP
	Aud31	5	An40	10	0,730296743	Both IP
Step 3:	Aud27	6	An1	0	1,238278375	An.-CP, Aud.-IP
	Aud32	10	An7	4	1,341640786	An.-CP, Aud. IP
	Aud36	0	An15	12	1,414213562	An.-CP, Aud.-IP
Step 4:	Aud1	1	An10	1	1,632993162	Both IP
	Aud38	14	An9	5	1,290994449	Both IP

Table 12: RMS differences of questionnaire answers (first decision CP marked grey and IP white)

	An1	An2	An3	An4	An5	An6	An7	An8	An9	An10	An11	An12	An13	An14	An15	An16	An17	An18	An19	An20	An21	An22	An23	An24	An25	An26	An27	An28	An29	An30	An31	An32	An33	An34	An35	An36	An37	An38	An39	An40
Aud1	1,807	1,506	1,390	1,461	1,949	1,807	1,414	1,571	0,577	1,633	1,770	2,160	1,966	1,633	1,461	1,673	1,862	1,673	1,713	1,673	1,506	1,612	1,439	1,732	1,291	1,949	1,488	1,915	1,549	2,266	1,390	2,049	1,826	1,390	1,528	1,897	1,571	2,324	1,966	1,592
Aud2	1,844	1,751	1,571	1,826	1,732	1,949	1,265	1,612	1,291	1,374	1,291	1,789	1,633	1,211	1,155	1,461	1,549	1,317	1,673	1,549	1,366	1,528	2,018	1,390	1,390	1,732	1,165	1,880	1,366	1,770	1,390	2,176	0,966	1,438	1,653	1,265	1,807	1,949	1,506	1,789
Aud3	1,342	1,155	1,438	1,033	1,390	1,065	1,211	0,775	1,155	1,155	1,000	1,317	1,317	1,414	1,317	1,095	1,713	1,414	1,317	1,461	1,033	1,317	0,856	1,832	1,342	1,183	1,528	1,102	1,291	1,366	1,653	1,183	1,291	1,211	1,125	1,291	1,366	1,065	1,880	1,211	1,033
Aud4	1,844	1,317	1,571	1,461	1,390	1,000	1,317	1,065	1,155	1,599	1,291	1,317	1,592	1,366	1,265	1,095	1,862	1,033	1,461	0,816	1,155	1,238	2,121	1,238	1,342	1,612	0,802	1,438	1,033	1,770	1,291	1,807	1,317	1,483	1,125	1,155	1,483	1,342	1,366	1,549
Aud5	1,915	1,461	1,571	1,414	1,528	1,125	1,317	1,238	1,291	1,453	1,483	1,506	1,461	1,461	1,414	1,211	1,932	1,461	1,366	1,317	1,414	1,125	2,087	1,291	1,438	2,017	1,165	1,693	1,265	1,915	1,438	1,732	1,633	1,342	1,483	1,506	1,483	1,528	1,265	1,506
Aud6	1,414	1,065	1,033	1,291	1,751	1,317	1,125	1,317	0,577	1,247	1,211	1,438	1,390	1,238	1,183	1,291	1,342	1,342	1,291	1,342	0,775	1,095	1,254	1,211	0,894	1,826	0,926	1,366	1,438	1,713	0,894	1,897	1,183	0,894	1,414	1,390	1,095	1,751	1,390	1,291
Aud7	1,844	1,317	1,390	1,414	1,483	1,291	1,265	1,125	1,291	1,247	1,238	1,506	1,155	1,414	1,033	1,414	1,751	1,366	0,730	1,211	1,317	1,183	1,813	1,342	1,807	0,964	1,571	1,461	1,342	1,807	1,000	1,612	1,095	1,183	1,438	1,265	1,438	1,571	1,211	1,366
Aud8	1,414	1,125	1,155	0,775	1,713	0,894	1,125	0,816	0,577	1,000	1,265	1,342	1,438	1,291	1,291	0,856	1,693	1,390	1,291	0,730	1,033	1,095	1,512	1,366	1,095	1,265	1,069	1,265	1,238	1,932	0,816	1,366	1,291	1,211	1,033	1,528	1,211	1,713	1,183	1,065
Aud9	1,592	1,065	1,506	1,342	1,366	1,033	1,438	0,816	0,577	1,667	0,966	1,183	1,653	1,571	1,571	1,238	1,915	1,238	1,528	1,065	1,238	1,366	1,852	1,633	1,265	1,549	1,225	1,095	1,291	1,826	1,265	1,461	1,438	1,461	1,461	0,966	1,183	1,265	1,932	1,438
Aud10	1,483	1,414	1,291	1,095	1,571	1,125	0,966	0,931	0,577	1,453	1,183	1,414	1,592	1,155	1,461	0,632	1,789	1,366	1,592	1,095	1,265	1,483	1,558	1,612	1,125	1,528	0,964	1,291	1,265	2,049	0,775	1,770	1,317	1,571	1,183	1,317	1,483	2,017	1,265	1,265
Aud11	1,693	0,966	1,571	1,265	1,342	1,238	1,366	1,125	1,155	1,247	1,065	1,366	1,549	1,265	1,155	1,211	1,862	1,765	1,414	1,095	1,155	1,000	2,018	1,483	1,000	1,571	1,035	1,528	0,966	1,732	1,291	1,483	1,317	1,238	1,183	1,265	1,291	1,571	1,461	1,265
Aud12	1,366	1,483	1,317	1,483	1,862	1,549	1,612	1,414	1,291	1,795	1,366	1,483	1,693	1,770	1,770	1,732	1,807	1,770	1,612	1,915	1,390	1,633	1,363	1,826	1,633	2,098	1,648	1,211	1,807	2,309	1,414	1,751	1,770	1,317	1,592	1,653	1,211	2,394	1,528	1,065
Aud13	1,862	1,238	1,265	1,438	1,673	1,366	1,291	1,211	1,155	1,333	1,317	1,483	1,000	1,291	1,125	1,438	1,732	1,732	1,291	0,577	1,125	1,390	1,095	1,732	1,211	1,265	1,673	1,000	1,633	1,390	1,366	0,966	1,592	1,065	1,155	1,211	1,390	1,414	1,414	1,183	1,390
Aud14	1,789	1,291	1,592	1,528	1,549	0,966	1,125	1,265	0,816	1,374	1,461	1,438	1,612	1,571	1,238	1,291	1,807	1,342	1,528	1,291	1,125	1,211	1,871	1,155	1,265	1,966	0,926	1,549	1,390	1,713	1,265	1,966	1,528	1,461	1,506	1,390	1,414	1,713	1,571	1,483
Aud15	1,592	1,612	1,095	1,693	2,066	1,789	1,571	1,506	1,732	1,826	1,366	1,438	1,949	1,612	1,880	1,438	1,342	1,571	1,915	1,483	1,183	1,897	1,309	1,966	1,461	1,673	1,336	1,155	1,807	2,129	1,211	2,280	1,183	1,549	1,461	1,342	1,592	2,280	1,528	1,612
Aud16	1,653	1,592	0,775	1,317	2,206	1,693	1,095	1,390	0,816	1,414	1,612	1,862	1,673	1,549	1,414	1,317	1,265	1,673	1,461	1,414	1,549	1,571	0,802	1,483	1,238	1,612	1,464	1,653	1,713	1,983	0,856	1,949	1,317	1,125	1,571	1,789	1,612	2,206	1,414	1,414
Aud17	1,438	0,894	1,125	1,155	1,983	1,183	1,155	1,238	0,577	1,202	1,390	1,366	1,673	1,461	1,506	1,095	1,549	1,506	1,633	1,155	1,265	1,183	1,309	1,528	0,775	1,438	1,309	1,390	1,414	1,949	1,000	1,693	1,461	1,238	1,125	1,673	1,183	1,983	1,549	1,095
Aud18	1,880	1,366	1,291	1,506	1,438	1,291	1,317	0,856	0,000	1,599	1,000	1,265	1,095	1,211	1,317	1,265	1,897	0,894	0,730	1,033	1,317	1,390	1,753	1,438	1,291	1,653	0,886	1,291	1,155	1,438	0,856	1,571	1,033	1,438	1,000	1,033	1,571	1,483	1,033	1,317
Aud19	2,145	1,506	1,770	1,826	1,238	1,438	1,592	1,342	0,577	1,915	1,342	1,633	1,414	1,549	1,366	1,713	2,160	1,317	1,033	1,366	1,366	1,653	2,204	1,571	1,693	2,017	0,964	1,693	1,592	1,483	1,291	1,949	1,317	1,732	1,342	1,033	1,693	1,653	1,549	1,713
Aud20	1,528	1,592	1,000	1,897	2,696	2,176	1,673	2,049	2,380	1,374	1,880	1,713	1,789	1,751	1,862	1,932	1,033	1,862	1,932	1,932	1,633	1,483	1,225	1,693	1,438	1,770	1,813	1,807	1,966	2,236	1,612	2,295	1,506	1,125	1,693	2,129	1,438	2,295	1,789	1,673
Aud21	1,932	1,390	1,366	1,693	2,033	1,506	1,483	1,366	1,414	1,599	1,414	1,571	0,931	1,528	1,571	1,612	1,770	1,342	0,856	1,291	1,653	1,033	1,793	1,033	1,366	1,862	1,336	1,751	1,612	1,366	1,317	1,633	1,342	1,155	1,366	1,732	1,506	1,506	1,238	1,483
Aud22	1,732	1,211	1,291	1,506	1,483	1,065	1,265	0,931	0,577	1,700	1,065	1,095	1,095	1,211	1,461	1,211	1,862	0,816	1,033	1,033	1,211	1,183	1,793	1,238	1,238	1,693	0,886	1,238	1,095	1,612	1,065	1,612	1,265	1,390	0,775	1,155	1,342	1,438	1,095	1,265
Aud23	2,206	1,789	1,732	1,826	1,238	1,693	1,461	1,238	0,577	1,915	1,238	1,789	1,633	1,414	1,317	1,549	2,221	1,095	1,317	1,549	1,633	1,807	2,138	1,612	1,693	1,915	1,282	1,807	1,033	1,949	1,438	1,770	1,549	1,732	1,291	1,095	1,983	1,880	1,414	1,592
Aud24	1,693	1,506	1,693	1,211	2,017	1,807	1,592	1,483	1,291	0,943	1,653	1,932	1,789	1,751	1,211	1,713	2,033	2,000	1,549	1,633	2,000	1,438	1,909	1,880	1,571	1,291	1,813	1,949	1,633	2,176	1,438	1,183	1,592	1,438	1,612	2,000	1,612	2,324	1,751	1,211
Aud25	2,394	1,693	1,592	1,949	2,309	1,506	1,949	1,461	1,414	2,082	1,673	1,571	1,612	1,880	1,983	1,653	2,049	1,390	1,291	1,125	1,732	1,673	2,053	1,592	1,633	2,066	1,535	1,633	1,770	1,592	1,461	2,033	1,571	1,673	1,633	1,807	2,000	1,155	1,438	1,915
Aud26	1,155	1,291	1,366	1,183	1,633	1,713	1,125	1,633	1,732	1,000	1,506	1,770	1,844	1,125	1,000	1,438	1,571	1,732	1,844	1,612	1,183	1,461	1,581	1,713	1,317	1,317	1,134	1,751	1,390	2,394	1,211	1,966	1,342	1,366	1,211	1,483	1,155	2,309	1,770	1,390
Aud27	1,238	1,317	1,483	1,033	2,049	1,528	1,633	1,528	1,633	0,943	1,653	1,789	2,066	1,862	1,751	1,549	1,673	2,129	2,000	1,549	1,549	1,528	1,581	1,949	1,528	1,571	1,711	1,571	1,966	2,436	1,483	1,770	1,713	1,342	1,612	1,932	1,125	2,490	1,826	1,317
Aud28	1,915	1,414	1,291	1,633	1,528	1,438	1,317	1,238	0,000	1,633	1,183	1,265	1,211	1,033	1,265	1,317	1,862	0,816	1,033	1,414	1,095	1,291	1,813	1,390	1,183	1,983	0,886	1,438	0,816	1,732	1,125	1,844	1,317	1,342	1,238	1,155	1,571	1,291	1,155	1,461
Aud29	1,461	1,183	1,317	1,483	1,751	1,673	1,000	1,366	0,816	0,816	0,966	1,612	1,342	1,291	1,125	1,390	1,390	1,438	1,528	1,390	1,604	1,095	0,894	1,592	1,363	1,751	1,095	1,363	1,342	1,592	1,265	1,549	1,183	1,414	1,483	1,317	2,098	1,390	1,065	
Aud30	1,673	1,291	1,414	1,342	1,826	1,211	1,065	1,155	1,155	1,202	1,414	1,342	1,770	1,528	1,390	1,000	1,770	1,438	1,732	1,125	1,612	1,414	1,773	1,506	1,265	1,095	1,363	1,549	1,183	2,066	1,211	1,549	1,483	1,549	0,966	1,528	1,549	2,033	1,438	1,125
Aud31	1,342	1,211	1,390	0,816	1,770	1,483	1,317	1,183	0,000	0,943	1,238	1,826	1,713	1,549	1,265	1,414	1,826	1,826	1,506	1,549	1,633	1,342	1,439	1,653	1,238	1,483	1,626	1,653	1,506	2,206	1,183	1,065	1,633	1,065	1,438	1,789	1,291	2,352	1,549	0,730
Aud32	1,751	1,880	1,506	1,983	1,633	2,129	1,342	1,673	1,633	1,886	1,414	1,770	1,693	1,238	1,483	1,653	1,653	1,291	1,807	1,770	1,342	1,789	1,890	1,789	1,592	1,826	1,134	1,751	1,483	2,000	1,461	2,394	1,065	1,713	1,461	1,125	1,751	2,309	1,653	1,844
Aud33	1,770	1,265	1,438	1,549	1,390	1,483	1,414	1,125	0,816	1,491	0,856	1,317	1,211	1,155	1,095	1,461	1,862	0,966	0,966	1,265	1,265	1,549	1,558	1,549	1,291	1,571	1,035	1,438	1,033	1,571	1,125	1,483	1,033	1,291	1,065	1,033	1,483	1,528	1,211	1,265
Aud34	1,549	1,342	1,265	1,183	1,506	1,414	1,238	0,966	0,000	1,291	0,730	1,390	1,065	1,183	1,342	1,238	1,807	1,483	0,931	1,438	1,483	1,317	1,558	1,549	1,265	1,673	1,309	1,414	1,390	1,751	0,894	1,155	1,183	1,155	1,317	1,291	1,414	1,966	0,856	0,856
Aud35	1,966	1,291	1,366	1,732	1,633	1,549	1,571	1,317	1,155	1,795	1,155	1,342	1,065	1,342	1,390	1,612	1,770	1,065	0,775	1,342	1,183	1,155	1,890	1,366	1,265	2,000	1,069	1,506	1,342	1,265	1,265	1,789	1,125	1,155	1,366	1,238	1,461	1,265	1,238	1,528
Aud36	2,017	1,366	1,483	1,461	2,017	1,612	1,713	1,390	1,414	1,333	1,612	1,897	1,461	1,751	1,414	1,789	1,966	1,673	0,894	1,414	1,673	1,291	1,753	1,571	1,390	1,949	1,464	1,807	1,713	1,612	1,291	1,571	1,549	1,183	1,653	1,897	1,571	1,732	1,633	1,506
Aud37	1,183	1,366	1,183	0,966	2,017	1,390	1,095	1,238	0,816	1,374	1,390	1,673	1,789	1,366	1,506	1,033	1,633	1,673	1,789	1,317	1,461	1,528	1,195	1,653	1,125	1,291	1,389	1,438	1,549	2,295	0,856	1,732	1,461	1,438	1,291	1,751	1,390	2,324	1,549	1,155
Aud38	2,280	1,770	2,129	2,266	1,414	2,066	1,807	1,751	1,291	2,261	1,211	1,693	1,390	1,483	1,732	1,949	2,352	1,438	1,528	1,880	1,732	1,713	2,619	1,897	1,751	2,191	1,464	2,066	1,612	1,506	1,789	2,066	1,390	1,966	1,592	1,183	1,966	2,000	1,693	1,880
Aud39	1,826	1,483	1,592	1,291	1,095	1,506	1,238	1,265	0,577	1,528	1,265	1,732	1,528	1,183	1,342	1,291	2,082	1,653	1,390	1,528	1,528	1,549	1,909	1,789	1,506	1,789	1,225	1,826	1,291	2,129	1,265	1,592	1,528	1,549	1,211	1,238	1,549	2,098	1,342	1,342
Aud40	1,932	1,342	1,673	1,844	1,713	1,789	1,438	1,592	1,732	1,491	1,317	1,693	1,291	1,571	1,183	1,770	1,693	1,483	1,238	1,612	1,438	1,033	2,087	1,265	1,265	2,000	1,309	1,932	1,612	1,095	1,506	1,862	1,183	1,155	1,713	1,483	1,506	1,826	1,612	1,571

Correlations between second investments and questionnaire answers

The correlation coefficients of second investments and questionnaire answers were calculated in both anonymous condition (Table 13) and audience condition (Table 14) applying Spearman's test.

Table 13: Correlations between second investments and questionnaire answers in the anonymous condition

Question	r_s	p	Significance threshold (Bonferroni-corrected)	n
A.) General questions				
Q1: "I felt very committed to my initial decision throughout the experiment"	0.45	.005	< .003	38
Q2: "I felt personally responsible for the outcome of the initial decision."	0.17	.292	< .003	39
Q3: "I had the feeling that my initial decision led to negative consequences."	-0.29	.071	< .003	40
Q4: "My initial decision influenced my second decision more than the updated financial report."	0.26	.117	< .003	39
Q5: "The financial information at the point of the second decision was the major reason for my decision."	-0.43	.007	< .003	39
Q6: "I based my second decision on the same reasons as my initial decision."	0.10	.562	< .003	39
Q7: "I have been very satisfied with my initial decision directly after taking it."	0.23	.164	< .003	38
Q8: "Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome."	0.23	.160	< .003	38
Q9: "I had a strong desire to complete the started project."	0.43	.007	< .003	38
Q10: "I spent a long time on the initial decision and perceived it as effortful."	-0.23	.165	< .003	39
Q11: "I spent a long time on the second decision and perceived it as effortful."	-0.01	.953	< .003	39

Q12: "Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	0.64	< .001	< .003	39
Q13: "I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division."	0.27	.097	< .003	39
Q14: "I get over negative events quickly and focus on taking actions that result in better outcomes."	-0.25	.129	< .003	38
Q15: "I find it difficult to overcome a negative event and keep ruminating about how it affects the current state."	0.05	.748	< .003	38
B.) Condition-specific questions				
Q An. 1: "I felt that nobody can track my initial decision."	-0.08	.613	< .003	40
Q An. 2: "I had the feeling that my decisions were completely anonymous."	0.05	.782	< .003	39

Table 14: Correlations between second investments and questionnaire answers in the audience condition

Question	r_s	p	Significance threshold (Bonferroni corrected)	n
A.) General questions				
Q1: "I felt very committed to my initial decision throughout the experiment"	0.38	.014	< .002	40
Q2: "I felt personally responsible for the outcome of the initial decision."	-0.02	.902	< .002	40
Q3: "I had the feeling that my initial decision led to negative consequences."	-0.19	.232	< .002	40
Q4: "My initial decision influenced my second decision more than the updated financial report."	0.30	.056	< .002	40
Q5: "The financial information at the point of the second decision was the major reason for my decision."	-0.58	< .001	< .002	40

Q6: "I based my second decision on the same reasons as my initial decision."	0.41	.008	< .002	40
Q7: "I have been very satisfied with my initial decision directly after taking it."	-0.01	.962	< .002	40
Q8: "Before taking the second decision I had the feeling that my initial decision would lead to a desirable outcome."	-0.06	.719	< .002	40
Q9: "I had a strong desire to complete the started project."	0.41	.009	< .002	40
Q10: "I spent a long time on the initial decision and perceived it as effortful."	-0.16	.339	< .002	40
Q11: "I spent a long time on the second decision and perceived it as effortful."	-0.14	.405	< .002	40
Q12: "Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	0.24	.137	< .002	40
Q13: "I had the feeling that the 10 million dollars would be wasted if I choose to invest the 20 million dollars to the other division."	0.14	.386	< .002	40
Q14: "I get over negative events quickly and focus on taking actions that result in better outcomes."	-0.48	.002	< .002	40
Q15: "I find it difficult to overcome a negative event and keep ruminating about how it affects the current state."	0.15	.348	< .002	40
B.) Condition-specific questions				
Q Aud. 1: "I had the feeling that my decisions were evaluated by others."	0.02	.939	< .002	40
Q Aud. 2: "The presence of the experimenter influenced my decision."	0.10	.560	< .002	40
Q Aud. 3: "It was important for me what others might think about my decision."	-0.14	.387	< .002	40
Q Aud. 4: "It was important for me what impression the experimenter has of my decision."	-0.12	.468	< .002	40

Q Aud. 5: "I had the feeling that I have to make decisions fast because the experimenter was present."	0.31	.054	< .002	40
Q Aud. 6: "I had the feeling that I would violate social norms if I invested all money in one division only in the second decision."	0.28	.081	< .002	40
Q Aud. 7: "I had the feeling that I would violate social norms if I would invest nothing in the failing division in the second decision."	0.26	.100	< .002	40
Q Aud. 8: "I wanted others to think that I make good decisions."	-0.12	.448	< .002	40
Q Aud. 9: "I had the feeling that I would be judged based on the decisions I make."	-0.11	.487	< .002	40

Regression models

Regression models were built based on questionnaire answers which were significantly correlated (before Bonferroni correction) with second investments in the anonymous (Table 15) and audience condition (Table 16).

Table 15: Initial regression analysis in the anonymous condition

Variable	*B*	*SE B*	β	*t*	*p*
Constant	3.45	5.31		0.65	.521
"I felt very committed to my initial decision throughout the experiment."	1.27	0.83	.24	1.54	.133
"The financial information at the point of the second decision was the major reason for my decision."	-1.44	0.82	-.23	-1.76	.088
"I had a strong desire to complete the started project."	0.38	0.93	.06	0.41	.686
"Although my initial decision led to negative consequences, I believe that continued investment in the initially chosen department would result in positive consequences eventually."	1.89	0.64	.42*	2.93	.006

Note: $R^2 = .52$, $*p < .01$

Table 16: Initial regression analysis in the audience condition

Variable	*B*	*SE B*	β	*t*	*p*
Constant	5.46	6.11		0.89	.378
"I felt very committed to my initial decision throughout the experiment."	1.58	0.79	.23	2.01	.053
"The financial information at the point of the second decision was the major reason for my decision."	-1.80	0.91	-.26	-1.98	.056
"I based my second decision on the same reasons as my initial decision."	1.73	0.69	.30*	2.53	.016
"I had a strong desire to complete the started project."	1.19	0.68	.21	1.76	.088
"I get over negative events quickly and focus on taking actions that result in better outcomes."	-1.66	0.80	-0.26*	-2.08	.045

Note: $R^2 = .60$, $*p < .05$

Comments from participants

At the end of the questionnaire participants were offered the possibility to state comments. Participants expressed their concerns about the limited amount of information provided for the decisions (n = 3 (Aud.), n = 3 (An.)) and asked for more information about the market. They were also interested in "non-financial data (…) like consumer reports or market research reports to know what is the trend in consumers' preferences", a "discount rate (in order to calculate a net present value)" and how much of the money was spent for production. They also wished to know what the sales and earnings were before 2007. Two participants, one person in each condition, pointed out that R&D investments need more time to show their effects. Two participants in the audience condition expressed that they might have done better if they had a background in Business. Some comments referred to means of improving the decision making process and the scenario: "The way numbers are presented (in a column e.g. instead of a graph) may perhaps influence what I can read off them (and what decision I make after)" (Aud.), "allocating money for R&D is important but more important is to supervise the R&D activities" (Aud.), "for the first part of the experiment, the data was too similar, so it was hard to find any significant difference between two options" (Aud.), "I wouldn't invest as much money neither in first decision, nor in 2nd decision" (An.). One participant expressed that he did not believe that he could make a correct choice (An.): "I felt that my first choice couldn't be right even if I chose the other department, because the experiment should be symmetric". In general, more participants wrote comments in the audience condition (n =14) than in the anonymous condition (n = 9). In addition, participants in the audience condition responded more politely, e.g. thanked for the experiments or expressed that they liked it (n = 5 (Aud.), n = 1 (An.)) and did not leave improper remarks (n = 2 in the anonymous condition). In sum, this could indicate that participants were more concerned about their reputation and felt more responsible for their part in the experiment.

Summary (Extended Abstract)

Committing a Sunk Cost Fallacy (SCF) consists in basing the decision whether to invest in a project or activity on past decisions rather than on benefits expected in the future. Behavioural economists hypothesized that people fall prey of this cognitive bias because of loss aversion, concerns about wastefulness or self-justification needs. The present study drew on the latter one and aimed to investigate the social environment triggering psychological mechanisms at the origin of the fallacy. My hypothesis was that situations favouring reason-based choice lead people to be more affected by a confirmation bias, a bias which has been demonstrated to be at work especially when people have to reason deliberate, which in turn causes the SCF. This is because people who feel a need for justification have to find reasons for their choices. Therefore, they will put too much weight on the reasons for their initial decision, which remained salient, and too little on newly acquired information as they appear as refutations of their initial choice. The hypothesis was based on studies on reason-based choice by Shafir and colleagues, who suggested that people under specific circumstances choose the most justifiable rather than the most rational choice (Shafir et al., 1993), and on the argumentative theory of reasoning by Mercier and Sperber, which proposed that reasoning evolved for argumentation due to the reliance of humans on communication (Mercier & Sperber, 2011).

An experiment with eighty participants was conducted at the Central European University in Budapest. In an adaptation of a scenario by Staw (Staw, 1976) participants solved a financial decision case: For the first decision participants in the role of managers had to assign 10 million dollars to one of two company departments. For the second decision they received updated financial information depicting the negative consequences of their initial choice and had to decide how to divide 20 million dollars among the same two departments. The SCF was measured by the propensity in the second round of decision making to invest in the same department as in the first round (dependent variable). In a between-group design participants either anonymously submitted their decisions in voting boxes (anonymous condition) or justified their decisions to the experimenter (audience condition). The predictions were, first, that participants in the audience condition would apply reason-based choice more often due to the argumentative context, and, second, that this in turn would lead to a greater occurrence of the SCF because of a confirmation bias.

Experimental results confirmed the first prediction: Participants in the audience condition chose justifiable decisions by either investing nothing to the failing department (“I made a mistake”) or allocating equal amounts (rewarding and fair behaviour, hope of a turnaround), whereas in the anonymous condition allocations of 5 or 15 million dollars were preferred. In addition, participants in the audience condition decided on salient points of investments more often. Evidence that specific reasons underlay investment decisions was provided by the audio data. Regarding the second prediction results were ambiguous: There was no significant difference between sec-

ond investments in the two conditions. Also, only few participants carried reasons from the first decision over to the second decision according to the audio data. Nonetheless, correlations between questionnaire answers and second investments indicated a relationship between the failure to update beliefs and second investments in the audience condition only. Additionally, regression models support the hypothesis: Being action-oriented and basing the second decision on the same reasons as the first decision were significant predictors of second investments in the audience condition. A follow-up experiment on hierarchical versus egalitarian group decision making is recommended to clarify these ambiguous results. Additionally, the study offered insights on factors underlying the SCF: Moderate correlations, although not significant after Bonferroni correction, indicate that high second investments in both conditions were positively correlated with the desire to complete a started project and commitment to the initial decision. Negative correlations between second investments and agreement that the financial information was the major reason for the second decision were found in both conditions. Nonetheless, this correlation was only significant in the audience condition. This finding supports the hypothesis that the SCF is caused by a failure to update beliefs.

This study is relevant for Cognitive Science due to its interdisciplinarity: The hypothesis is grounded in Philosophy and takes social factors into account. The topic relevant for Economics is studied with methods from experimental Psychology and offers insights into human decision making with possible applications in management.

Zusammenfassung (Extended Abstract in German)

Unter der Sunk Cost Fallacy (SCF) versteht man das Phänomen, dass Entscheidungen, anstatt im Hinblick auf die Zukunft, auf Basis vergangener Entscheidungen und Investitionen getroffen werden. Verhaltensökonomen stellten die Hypothesen auf, dass diese kognitive Verzerrung (*cognitive bias*) auf Grund von Verlustaversion (*loss aversion*), Bedenken bezüglich Verschwendung (*wastefulness*) oder einem Rechtfertigungsbedürfnis (*self-justification*) auftritt. Die vorliegende Studie stützte sich auf letzteres und setzte den Fokus auf den Einfluss des sozialen Umfelds auf psychologische Mechanismen, welche der SCF zu Grunde liegen. Die Hypothese war, dass Situationen welche die Wahl der am rechtfertigbarsten anstatt der rationalsten Entscheidung (*reason-based choice)* begünstigen zu einem höheren Auftreten eines Bestätigungsfehlers (*confirmation bias*) führen, welcher besonders häufig auftritt wenn Menschen bewusst argumentieren, was wiederum zum Auftreten der SCF führt. Dies ist der Fall, da Menschen die das Gefühl haben sich rechtfertigen zu sollen, Gründe für ihre Entscheidungen suchen. Die Aufmerksamkeit wird auf die Gründe für die erste Entscheidung, die präsent bleiben, gerichtet und zu wenig auf die neu gewonnenen Informationen, da diese als widersprüchlich zur ersten Entscheidung erscheinen. Diese Hypothese basierte auf Studien von Shafir über *reason-based choice* (Shafir et al., 1993) und der *Argumentative Theory of Reasoning* von Mercier und Sperber, welche besagt, dass vernünftiges Urteilen (*reasoning*) sich, aus evolutionärer Perspektive, entwickelt hat um Argumentation zu ermöglichen. Grund dafür ist die Abhängigkeit des Menschen von Kommunikation (Mercier & Sperber, 2011).

Zur Testung der Hypothese wurde ein Experiment mit achtzig TeilnehmerInnen an der Central European University in Budapest durchgeführt. In einer Adaption des Szenarios, welches von Staw verwendet wurde (Staw, 1976), trafen die TeilnehmerInnen finanzielle Entscheidungen: In der ersten Entscheidung konnten sie 10 Millionen Dollar in eine von zwei Firmenabteilungen investieren. Für die zweite Entscheidung erhielten sie aktualisierte finanzielle Informationen, welche die negativen Konsequenzen ihrer ersten Entscheidung zeigten und bekamen 20 Millionen Dollar zur Verfügung gestellt, welche sie auf dieselben Firmenabteilungen aufteilen konnten. Die Sunk Cost Fallacy wurde an der Neigung gemessen, bei der zweiten Entscheidung in die gleiche Abteilung zu investieren wie in der ersten Entscheidung (abhängige Variable). In einem between-group design reichten die TeilnehmerInnen ihre Entscheidungen entweder anonym in Wahlboxen ein (*anonymous condition*) oder teilten die Entscheidung inklusive der Begründung der Leiterin des Experiments mit (*audience condition*). Die Vorhersagen waren, erstens, dass TeilnehmerInnen in der *audience condition* rechtfertigbare Entscheidungen treffen würden, was wiederum, zweitens, zu vermehrten Auftreten der SCF führen würde auf Grund eines Bestätigungsfehlers.

Experimentelle Resultate bestätigten die erste Vorhersage: TeilnehmerInnen in der *audience condition* trafen leichter rechtfertigbare Entscheidungen indem sie entweder nichts in die schei-

ternde Abteilung investierten („Ich habe einen Fehler gemacht“) oder indem sie beiden Abteilungen gleich hohe Anteile zukommen ließen (belohnendes und faires Verhalten, Hoffnung auf positive Umkehr in der Zukunft). In der *anonymous condition* hingegen wurden Allokationen von 5 oder 15 Million Dollar präferiert. Zudem entschieden sich TeilnehmerInnen in der *audience condition* öfter für *salient points of investment*, also Investitionspunkte welche die Aufmerksamkeit auf sich zogen. Beweise dafür, dass bestimmte Gründe hinter spezifischen Investitionsentscheidungen standen lieferten Tonaufnahmen. Betreffend der zweiten Vorhersage waren die Resultate nicht eindeutig: Es gab keine signifikante Differenz zwischen den Investitionen, die in der zweiten Entscheidung getätigt worden waren, zwischen den beiden Konditionen. Außerdem übernahmen, gemäß den Tonaufnahmen, nur wenige TeilnehmerInnen die Gründe ihrer ersten Entscheidung für die zweite Entscheidung. Allerdings deuten Korrelationen zwischen Fragebogen-Antworten und Investitionsentscheidungen darauf hin, dass nur in der *audience condition* zweite Investitionsentscheidungen und das Misslingen eigene Überzeugungen zu verändern in einer Beziehung zueinander standen. Regressionsmodelle unterstützen ebenfalls die Hypothese: Die Eigenschaft handlungsorientiert zu sein und die zweite Entscheidung basierend auf den gleichen Gründen wie die erste Entscheidung zu treffen waren in der *audience condition* signifikante Prädiktoren der zweiten Investitionsentscheidungen. Ein Folgeexperiment über Entscheidungen in hierarchischen versus egalitären Gruppen wird empfohlen um diese nicht eindeutigen Resultate zu klären. Die Studie gab zudem Einsicht in Faktoren, die der SCF unterliegen: Die moderaten, wenn auch nach Bonferroni-Korrektur nicht signifikanten, Korrelationen deuteten auf eine mögliche Beziehung zwischen Investitionen, die in der zweiten Entscheidung getätigt wurden, sowohl mit dem Wunsch ein Projekt fertig zu stellen, als auch einem Verbundenheitsgefühl zur ersten Entscheidung, hin. Negative Korrelationen zwischen diesen Investitionen und der aktualisierten, finanziellen Information als Hauptgrund für die zweite Entscheidung wurde in beiden Konditionen gefunden, war jedoch nur in der *audience condition* signifikant. Dieses Ergebnis unterstützte die Hypothese, dass die SCF dadurch ausgelöst wird, dass Meinungen nicht aktualisiert werden.

Diese Studie ist relevant für die Kognitionswissenschaft auf Grund ihrer Interdisziplinarität: Die Hypothese ist grundiert in der Philosophie und berücksichtigt soziale Faktoren. Das Thema, welches relevant für die Ökonomie ist, wird erforscht mit Methoden der experimentellen Psychologie und bringt Erkenntnisse über menschliche Entscheidungsprozesse mit möglichen Anwendungsbereichen im Management.

Curriculum Vitae

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Personal Information

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Professional Experience

Since 09/2015 ***Die Umsetzer Unternehmensberatung GmbH*** **(Vienna)**
Project support
- Project Management
- Support the consulting team specialized in strategy, implementation and leadership
- Organizing and preparing strategy workshops and management projects for international companies and public administration organisations
- Research, especially in the field of Behavioural Economics

09/2014 – 06/2015 ***Central European University – Behavioural Economics Lab*** **(Budapest)**
Internship
- Working as part of an international research team on Behavioural Economics and Behavioural Game Theory
- Project work on altruistic versus mind-directed punishment
- Conducting and supporting experiments on cognitive biases

03/2014 - 07/2014 ***Research Studios Austria – Studio Smart Agent Technologies*** **(Vienna)**
Internship
- Bridging business and academic research
- Introductory work on Information Extraction and Natural Language Processing

10/2007 – 09/2012 ***Der Standard Verlagsgesellschaft m.b.H.*** **(Vienna)**
Freelance Journalist
- Wrote a variety of articles ranging from political debates to cultural phenomena, first for the student supplement, later for the university supplement of the quality newspaper
- Research through digital sources and interviews
- Communication with editorial team and working in teams

Academic Studies

Since 10/2013 ***University of Vienna*** **(Vienna)**
Cognitive Science, MSc
- Interdisciplinary Focus: Linguistics, Computer Science, Artificial Intelligence, Biology, Neuroscience, Philosophy, Psychology
- International Focus: English Master program supported by the European Union, degree awarded from home institution and five partner universities
- Specialization: Behavioural Economics – Decision-making, nudging, cognitive heuristics and biases

09/2010 – 06/2014 ***University of Vienna*** **(Vienna)**
Comparative Literature, BA
- Conferment of Bachelor degree with Excellent Pass ("Ausgezeichneter Erfolg")
- Complementary Programmes: Sociology, Social Anthropology, Psychoanalysis, Sinology

Academic Studies Abroad

09/2014 – 06/2015 ***Eötvös Loránd University*** **(Budapest)**

09/2012 – 05/2013 ***University of St. Andrews*** **(St. Andrews)**

Extracurricular Engagement

06/2015 **Workshop on Electroencephalography (EEG)**
University of Ljubljana and *University Medical Centre Ljubljana* / Ljubljana

09/2012 – 05/2013 **Professional Skills Curriculum**
University of St. Andrews / St. Andrews

04/2011 **Media project *Backpack Journalism***
People's media / Austria and Romania

10/2008– 06/2009 ***Weiße Flecken*–Journalistic memorial project for the victims of Nazism**
Step 21 / Austria, Germany, Poland

Qualification / Additional Skills / Prizes

Languages **English**: Business fluent
Cantonese: Native speaker (spoken)
French: Elementary skills
Mandarin: Elementary skills
Hungarian: Beginner's level
Latin: Elementary reading skills

EDP Excellent proficiency in MS Excel, MS PowerPoint, MS Word
Proficient knowledge of reference management programs (Mendeley,…)
Basic knowledge of SPSS (Software Package for Statistical Analysis)
Elementary knowledge of GATE (General Architecture for Text Engineering)

Scholarships **Scholarship from *e-fellows.net***
Merit-based scholarship*, University of Vienna* (2010, 2011, 2012, 2013)
Erasmus Grant (9 months for studies in the UK, 10 months for studies in Hungary)