MICROFOUNDATIONS OF ORGANIZATIONAL ADAPTATION

ESSAYS ON HOW ORGANIZATIONS ADAPT AND WHY THEY MAY FAIL

Dissertation

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We are nothing; what we search for is everything.

[Friedrich Hölderlin, Hyperion, in: Neue Thalia,
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Enjoy reading this piece on organizational adaptation and individual search: *we are nothing, what we search for is everything*!

General Introduction

GENERAL INTRODUCTION

Organizations face turbulent environments, where political institutions as the European Union are challenged; trade alliances, such as NAFTA, are being questioned; digital technologies emerge at a very high development rate and their global scalability threatens existing business models; pressing global societal challenges require coordinated and collective efforts of multiple actors. In times like these, fast-paced and interconnected change makes it very difficult for organizations to anticipate developments and adapt accordingly. Yet, inadequate adaptation may threaten organizational survival and prosperity in the future, as famous examples like Kodak, Yahoo or Nokia have impressively shown in the past. The ability to manage organizational adaptation is, thus, a key driver of competitive advantage for organizations.

Most of the literature on organizational adaptation builds on the *Behavioral Theory of the Firm* (Cyert and March, 1963). In this literature, organizational adaptation is characterized by maintaining what is successful (exploitation) and trying new alternatives to improve performance (exploration) (Cyert and March; 1963, March and Simon, 1958). Organizations adjust their exploitation and exploration activities to performance feedback (Levinthal and March, 1981). While high performance is associated with exploitation and reinforced strategic persistence, low performance feedback is assumed to lead to exploration (Greve, 2003). The basic problem in organizational adaptation is, thus, to engage in sufficient exploitation, when performance feedback is low, and to devote enough energy to exploration in successful times (Levinthal and March, 1993). This is often referred to as the exploration-exploitation dilemma, which reflects the difficulties organizations face when adapting to a changing environment (Posen and Levinthal, 2012).

While recent studies on organizational adaptation provide important insights into how diverse organizations adapt (Battard, Donnelly, and Mangematin, 2017; Eggers and Park, 2018), our understanding of why organizations adapt differently is yet fragmented (Vergne and Depeyre, 2016). Understanding the sources and persistence of heterogeneity in organizational adaptation among firms is, however, central to understand differences in performance and the origins of competitive advantage (Gavetti, Levinthal, and Ocasio, 2007; Rumelt, Schendel, and Teece, 1991). This dissertation aims to contribute to the literature with an in-depth analysis of reasons for heterogeneity in organizational adaptation. Thus, the first research question asks:

(1) Why do organizations adapt differently?

The reasons why organizations adapt differently may stem from different levels such as the institutional-, organizational- or individual-level. At the core of all organizational processes stands individual decision-making. Here, the notion of microfoundations received much interest in strategy and organization research (Gavetti, 2005; Lippman and Rumelt, 2003). The aim of a microfoundations perspective is to understand how individual-level actors impact organizations and how the interaction of individuals leads to organization-level outcomes such as performance (Felin and Foss, 2005). The central impetus of the microfoundations literature is, thus, to unpack macro concepts. In organizational adaptation, bounded rationality hinders decision makers from identifying the best alternative. Therefore, they must engage in sequential search processes, which is similar in many processes of human problem solving (March and Simon, 1958). Individual-level search involves learning about and discovering alternatives, to find solutions that are superior to those currently known (Baumann, Schmidt, and Stieglitz, 2019). The second research question focuses on these micro-processes that happen at the individual-level and help to enlarge the understanding on macro-behavior. Thus, the second research question of this dissertation asks:

(2) How do micro-processes help to explain organizational adaptation?

Taking a closer look at the micro-process may not only enlarge our understanding of how organizations adapt, but also on why they may fail. Failing to adapt may occur from two sides: due to under-exploration (i.e., sticking with an existing strategy for too long) and of over-exploration (i.e., abandoning an attractive opportunity too early) (Levinthal and March, 1993). In both cases it is the decision maker, who makes inferences from experience, which creates the problem of making incorrect inferences and consequential decisions.

This thesis examines reasons why organizations adapt differently and focuses on microfoundations to enlarge our understanding of organizational adaptation. To approach the first research question, *Paper I* of this dissertation analyzes *how* organizations adapt to the consequences of climate change and *why* they adapt differently. Our review of existing cases shows that there are substantially different ways that organizations, respond to the increased pressure to reduce carbon emissions. Our analysis reveals notable factors and forces at the

institutional-, organizational- and individual-level that drive the different organizational responses and limit transitions between them. To address the second research question on how micro-processes help to explain organizational adaptation, *Paper II* and *III* in this dissertation explicitly examine individual-level search in the process of adaptation. *Paper II* aims to enlarge our understanding on how organizations can facilitate and guide the search of their organizational members, which is crucial for value creation. The paper focuses on different distributions of costs among organizational members as one potential organizational design feature. *Paper III* analyzes the effect of performance feedback from colleagues within an organization, which is referred to as social performance feedback, on individual exploration decisions. Both papers examine a micro-process and provide relevant insights on the process of organizational adaptation.

In this general introduction, I will continue by providing the theoretical foundation of this dissertation, before I present the experimental approach, which I apply in two of the three papers to examine micro-processes. Then, I summarize the core chapters of this dissertation and highlight the overall contribution of this dissertation.

Theoretical Foundation

A Behavioral Theory of the Firm (Cyert and March, 1963) is after *Administrative Behavior* (Simon, 1947) and *Organization* (March and Simon, 1958) the third of three Carnegie School cornerstones. The Carnegie School is strongly committed to three premises: "organizations as the ultimate object of study, decision making as the privileged channel for studying organizations, and behavioral plausibility as a core principle underlying theory building" (Gavetti, Levinthal, and Ocasio, 2007, p.523). The theoretical foundation for all three papers of this dissertation is the behavioral theory of the firm and a Carnegie School of thought perspective.

A central idea is that organizations learn from their past performance, which conditions subsequent actions (Cyert and March, 1963; Levitt and March, 1988). One important idea in this stream of research is that decision-makers' actions differ depending on whether the assessment of performance creates success or failure (Greve, 1998; Levinthal, 1997). While failure is assumed to lead to an explorative search for new alternatives, success is often associated with exploitation and reinforced strategic persistence (Greve, 2003). Finding the right

balance of incremental refinements of existing competencies with the discovery of radically novel ones is, however, challenging (March, 1991). Firms that manage to adapt are more likely to survive longer and perform better (Helfat and Winter, 2011).

Understanding the origin of heterogeneity in firms' ability to adapt is relevant for theories explaining adaptation to change (Henderson and Clark, 1990; Tushman and Anderson, 1986) as well as for the theory of inter-firm performance heterogeneity (Barney, 1991; Helfat and Peteraf, 2003; Penrose, 1959). The reasons why organizations adapt differently may emerge from different levels (Aggarwal, Posen, and Workiewicz, 2017). The strategy literature mainly focuses on drivers at the institutional-, organizational- and individual-level that explain inter-firm performance heterogeneity, and the factors underlying heterogeneity in the capacity of firms to adapt to change.

First, reasons, why organizations adapt differently, may lie at the institutional-level, which is often analyzed in work on organizational ecology. Population-level dynamics such as selection forces are reasons driving heterogeneity in organizational adaptation (Hannan and Freeman, 1984). As selection forces and processes favor reliability in performance, it provides advantages for survival (Levinthal and Posen, 2007; Yi, Knudsen, and Becker, 2016). While initially started as two diverging perspectives organizational adaptation and environmental selection have reconciled as complementary perspectives over time (Levinthal, 1991). Selection forces may, thus, serve as a reason why organizations adapt in a certain way.

Second, organizational-level reasons may help to explain firm heterogeneity. For a long time, the firm's resources, knowledge, and capabilities served as the primary source to explain heterogeneity in organizational performance (Barney, 1991; Dierickx and Cool, 1989; Peteraf, 1993). Especially, capabilities, as developed by Penrose (1959), offer a foundational understanding of heterogeneity in performance and, thus, became a cornerstone of strategic management research. Interestingly, while traditionally seen as stable over time and exhibiting low variance in actions and in performance, organizational routines may also serve as a source of organizational variation, as routines themselves are able to adapt in dynamic settings (Feldman and Pentland, 2003; Yi *et al.*, 2016).

Third, recent literature focuses on reconceiving microfoundations for example of capabilities development (Gavetti, 2005). The mechanisms that are intrinsic - for example to the

capability creation process itself - are sufficient to explain heterogeneity (Jacobides and Winter, 2012). Individuals in organizations make decisions that are essential for organizational adaptation (Maggitti, Smith, and Katila, 2013). Compared to organizations, for individual decision-making, psychological factors play a role, which needs to be considered to understand the aggregated behavior at the organizational-level (Posen *et al.*, 2018). For individual decision-making, cognitive (Gavetti and Rivkin, 2007; Schilling, 2018) as well as motivational factors (Audia and Brion, 2007; Jordan and Audia, 2012) may account for a lot of variation in decision-making and the consequential outcomes. While the behavioral theory of the firm has many influences from psychology and builds on analogies to the individual-level (as for example aspirations, a construct with a clear origin in psychology (Lewin *et al.*, 1944)), our understanding of individual influences driving organizational adaptation and performance is yet rather limited (Posen *et al.* 2018). To examine individual influences experimental methods can help to provide more detailed insights on individual decision-making in organizational adaptation.

Experiments in Strategy and Organization Research

In this thesis, two of the three papers are laboratory experiments. Yet, experimental methods seem not as established in strategy and organization research and widely diffused skepticism exists (Croson, Anand, and Agarwal, 2007). There are mainly two common critiques to the use of experiments: (1) experiments take a micro-perspective, which may not explain organizational-level outcomes and (2) experiments may lack external validity (Di Stefano and Gutierrez, 2018). On the other hand, experimental methods two major advantages (1) to clearly assess causality and (2) to shed light on mechanisms that we would not be able to measure in other ways (Baldassarri and Abascal, 2017; Falk and Heckman, 2009). In this section, I will address the main potential criticism and highlight the opportunities experimental methods offer to research in strategy in organization theory. Then, I show how I try to cope with potential disadvantages in this dissertation, and how this thesis makes use of the advantages of experiments.

Micro-perspective and external validity

In the field of strategy and organization theory, the level of analysis is mainly organizational or inter-organizational. Laboratory experiments take a more micro-perspective.

As suggested by the Carnegie school, experiments may still aim to follow the premises that organizations are the ultimate object of study, decision making is the privileged channel for studying organizations, and behavioral plausibility is a core principle (Gavetti *et al.*, 2007). It is thus relevant that even if the processes studied happen at the individual-level, the effects should be relevant for the interaction or cooperation of individuals in organizations or for organizational-level outcomes such as performance. While the emphasis in lab experiments is on individual-level decision-making, it is important that the choices made have relevance for the organization and, thus, for strategy and organization research.

At first glance, the issue of external validity appears especially prevailing in criticism against lab experiments. Even though external validity is not a criticism that applies exclusively to experiments (Brutus, Aguinis, and Wassmer, 2013), the abstract decision task in lab experiments may appear particularly artificial. Arguments about realism as an effective critique against lab experiments, potentially discourage lab experimentation. The issue of realism, however, is not a distinctive feature of lab versus field data. The real issue is determining the best way to isolate the causal effect of interest (Falk and Heckman, 2009). To study an isolated effect and controlling for potential confounds, experimental settings need to abstract from reality (Billinger, Stieglitz, and Schumacher, 2014). Instead of giving individuals too much contextual information abstract settings can help to examine one pure effect. Thus, a benefit that emerges from the potential criticism of missing realism, is that lab experiments do not jeopardize the internal validity of a study. The internal validity is key to uncover causal effects and makes experiments so indispensable for strategy and organization research.

Assessing causality and shedding light on mechanisms

In the field of strategy, empirical studies are often confronted with problems of endogeneity (Hamilton and Nickerson, 2003), as strategy choice is based on firm's attributes and industry conditions and thereby endogenous and self-selected (Shaver, Mitchell, and Yeung, 1997). Experiments improve the ability to isolate the relationship under examination and establish causal inference (Cook and Campbell, 1979). A key feature of experiments is an exogenous treatment, which assures that self-selection is not an issue. By randomizing the assignment to such an exogenous treatment, randomized experiments enable researchers to

make causal inferences that are simply not feasible in observational studies (Baldassarri and Abascal, 2017; Falk and Heckman, 2009).

The second large advantage of experiments is that they shed light on mechanisms behind the relationships, which may not be overserved without using experiments. In this sense, the focus on micro-processes in experiments helps to increase the understanding of certain phenomena. As shown above, different research streams whose interest is to decompose macro-level constructs (Foss and Pedersen, 2016). Common to different approaches – may it be strategy research (Felin *et al.*, 2012) or institutional theory (Schilke, 2018) - is an interest in a more micro approach perspective to strategy, where macro-level phenomena are reduced to their foundations. Examples in recent research on the foundations of managerial decision-making are studies where cognitive (Levine, Bernard, and Nagel, 2017), or even neuro-biological drivers of choices (Laureiro-Martínez *et al.*, 2015) are under examination.

Experiments in this dissertation

In this dissertation, *Paper II* and *Paper III* use laboratory experiments and take a micro-perspective. In both cases, the effect of a fundamental organizational measure that occurs based on interdependencies between individuals is studied. They use experimental tasks that abstract from reality: *Paper II* uses the 'Alien Game' (Billinger *et al.*, 2014), where participants could not draw any inferences to preferences or taste of the 'Alien'. Similarly, in *Paper III* participants are confronted with a decision that abstracts away from any confounding effects. In both experiments, participants are exogenously treated with different costs (*Paper I*) and different level of relative performance feedback (*Paper II*), which enables us to examine a causal effect. Further, the papers in this dissertation unravel insights that could not be observed in other ways: In *Paper II* we use eye-tracking technology to measure individuals visual attention, which gives us more information about the decision making process. *Paper III* elicits an individual's beliefs about the market conditions they operate in, which helps us to understand the basis upon which they make their decisions.

Overall, experiments can greatly contribute to the development of the field of strategy and organization in establishing causal effects between variables that are precisely measured. They can also help us identify the micro-level mechanisms behind observed effects, which is crucial for theory building and for contrasting competing theories that offer alternative

explanations (Agarwal *et al.*, 2012). In the following section, I will highlight the insights of this dissertation's papers, how they answer the two main research questions and contribute to the literature on microfoundations of organizational adaptation.

Summary of the Three Core Chapters

Paper 1: Different Reasons for Different Responses: Heterogeneity in Organizational Responses to Climate Change

This first paper builds the point of departure, by analyzing *how* organizations adapt to the consequences of climate change and *why* they adapt differently. This paper addresses the first research question by examining reasons for heterogeneity in organizational adaptation. While recent studies on organizational adaptation provide important insights into different organizational responses (Battard *et al.*, 2017; Eggers and Park, 2018; Vergne and Depeyre, 2016), our understanding of *how* organizations respond and *why* they respond differently is yet limited and fragmented.

Climate change is one of the grand challenges of the 21st century and imposes large consequences for organizational practices and performance (Howard-Grenville *et al.*, 2014). In the context of carbon emissions, prior studies often map organizational responses on a single dimension such as a continuum between reactive and proactive (Aragon-Correa and Sharma, 2003). Slawinski and Bansal (2012) point out that understanding different organizational responses on such a single dimension has important limitations. In this paper, we attempt to fill this gap by reviewing and analyzing the related cases of the incumbents in carbon-intensive industries, which have been studied in the literature.

Our review of the cases clearly shows that there are substantially different ways that organizations, even in a single industry, respond to the increased pressure to reduce carbon emissions. Our analysis suggests three dimensions along which organizational responses vary: *strategy* (more sustainable or less unsustainable), *speed* (proactive or reactive), and s*cope* (focused or integrated). This more fine-grained categorization to map organizational responses helps enhance our understanding of different responses and the reasons behind them. Through the lens of these three dimensions, we identify five different organizational responses. Response 1 and 2 are very popular responses: Response 1 follows a strategy to become *less unsustainable*,

in a *reactive* manner and with a *focused* scope of activities; Response 2 follows a strategy to become *more sustainable*, in a *proactive* manner and with an *integrated* scope of activities. Responses 3, 4 and 5 are more exceptional cases that deviate at least on one dimension from the popular responses 1 and 2. Notably, the positions on the three dimensions tend to be correlated so that the diversity of organizational responses is somehow limited. To explain this limited heterogeneity, our analysis proceeds to identify the reasons behind the observed heterogeneity and clustering in organizational responses.

Our analysis reveals notable factors and forces at the institutional, organizational and individual-level that drive the different organizational responses and limit transitions between them. The primary ones with theoretical implications are as follow. First, survival or selection pressure, a yet overlooked institutional factor in prior studies, tends to drive organizations to pursue a strategy to become more sustainable. This possibility of more exploration under less slack has not been yet explored well in the corporate sustainability literature. Second, own experience – even if unrelated to the reduction of carbon emissions – is more influential than others' experience in directing organizational responses and developing necessary capabilities. This finding and the related cases would contribute to the discussions on what kind of experience is helpful, and when, in organizational adaptation. Third, at the individual-level, not only motivational but also cognitive factors in the attribution of causation (e.g. where the competitive advantage comes from) are found to be relevant in explaining the observed heterogeneity in organizational response. This finding suggests that it would be fruitful to examine how cognitive and motivational factors interact with each other in driving organizational responses – a central problem recognized in prior studies.

Paper 2: How Costs Shape Attention and Search: An Experimental Study on the Process of Search

The second paper of this dissertation takes a more micro perspective in analyzing individual search. It addresses the second overall research question on how micro-processes can help to explain organizational adaptation and how organizations can shape these micro-processes. The aim of this paper is to better understand how organizations can facilitate and guide the search of their organizational members, which is crucial for value creation. Existing research mainly focuses on performance incentives and largely distinguishes between no, low and high

incentives. However, the role of cost, which resembles a close neglected sibling of incentives, constitutes a defining economic baseline of strategic choice in organizations (Simon, 1947) and is currently not well understood, especially in empirically grounded investigations of search.

For individual decision-making and search in organizations, cognition is critical (Gavetti and Rivkin, 2007; Schilling, 2018) and, surprisingly, extant research has largely black-boxed the actual search process (Baumann, Schmidt, and Stieglitz, 2019; Posen *et al.* 2018). Especially for search processes in which information is present, the cognitive process of attention accounts for a large part of choice variance (Kahneman and Tversky, 1973; Weber and Johnson, 2009). While these studies, often building on the attention-based view (Ocasio, 1997) provide valuable insights into attention patterns in different empirical settings, they do not provide a systematic micro-level account of attention in search processes.

Using a laboratory eye-tracking experiment, we build on a combinatorial multi-attribute decision task using the *Alien Game* (Billinger *et al.*, 2014) in which six binary choice attributes jointly create a performance outcome. To examine the influence of different distributions of cost, we build on the economic literature which suggests that differences occur depending on whether costs appear to the decision maker or other individuals and whether costs are concentrated on one person or diffused (i.e. shared) among several people. Building on these two conceptual distinctions, we establish three treatment groups, in which selecting one particular choice attribute is associated with (a) private cost for the decision maker (*Own Cost*), (b) costs shared among all participants from the experimental session (*Shared Cost*), (c) cost borne by one other random participant from the experimental session (*Other's Cost*), or (d) no cost (*Control*). Eye-tracking technology allows for the observation of individual attention allocated to the choice attributes and to performance feedback as a direct and objective measure. 113 participants were randomly assigned to the treatment groups, participated in the experiment over 12 rounds, and were incentivized financially based on the highest achieved performance.

We contribute to the literature on performance incentives that differentiates between the effects of no, low, and high incentives by demonstrating how cost guides behavior. Secondly, by showing that individuals do not only use costly alternatives less often but also pay less attention to these alternatives, our results contribute to the literature on managerial attention. Third, we contribute to the debate on individual-level search and on how organizations may

shape individual search. If organizations introduce private costs, individuals search less exploratively, which is relevant for avoiding the trap of excessive exploration and suggests that introducing cost shapes the process of search and attention therein.

Paper 3: Social Performance Feedback and the Role of Self-Enhancement

The third paper also focuses on the second overall research question on how micro-processes help to explain macro-behavior and how organizations may shape an individual's decisions. This paper analyzes the effect of social performance feedback - performance feedback from colleagues within an organization that individuals receive - on individual exploration and whether individuals respond differently if social feedback is above or below own performance. Thus, it examines a micro-process that influences organizational adaptation.

Theoretical research has convincingly that social performance feedback shapes overall organizational adaptation and performance (Baumann, Eggers, and Stieglitz, 2018). Yet, the role of individual factors is often beyond the scope of theoretical modeling. This experimental study provides empirical insights on how social performance feedback affects an individual's exploration decision and whether social performance feedback above or below one's own performance affects this decision differently.

Individuals in organizations make decisions that are essential for organizational adaptation (Maggitti, Smith, and Katila, 2013). Compared to organizations, for individual decision-making, psychological factors play a role, which needs to be considered to understand the aggregated behavior at the organizational-level (Posen *et al.*, 2018). In the context of social performance feedback, psychological factors such as motives, influence how individuals assess performance feedback (Jordan and Audia, 2012). While the interpretation of performance feedback is essential for resulting behavior, our understanding of the process is rather limited.

Existing research suggests that providing individuals with social performance feedback encourages competition (Charness, Masclet, and Villeval, 2013). While competition increase effort and performance (Kuhnen and Tymula, 2012), it may also decrease overall performance (Kacperczyk, Beckman, and Moliterno, 2015). Baumann *et al.* (2018) highlight a balancing effect at the organizational-level due to social performance feedback. Here, providing decision makers with social feedback encourages those who perform above average to allocate more

resources to exploitation and below the average to exploration (Baumann *et al.*, 2018). However, if individuals perform below social performance feedback, motivation problems may determine individual decision-making to explore.

The literature on individual motivations in the context of learning from performance feedback highlights the importance of self-enhancement (Jordan and Audia, 2012). Self-enhancement reflects a desire to see oneself in a positive light (Audia and Brion, 2007; Jordan and Audia, 2012). While mainly rooted in psychological literature (Festinger, 1954; Wood, 1989), it has, similarly, been shown in the economic literature that concerns about self-image largely determine individual behavior (Benabou and Tirole, 2002; Köszegi, 2006; Kuhnen and Tymula, 2012). While in classic organizational theory, the process of performance assessment is based on the assumption that the primary motive of a decision maker is to self-assess their own performance accurately (Cyert and March, 1963), self-enhancement broadens the perspective on how individuals respond to feedback. Greve (1998) suggests that if decision-makers can compare their performance feedback to two different sources they may follow a *self-enhancing rule* comparing to the lower benchmark.

In a laboratory experiment, this paper investigates the influence of social performance feedback on an individual's search behavior building on a design by Kuhnen (2015). Over six periods, participants allocate resources to an exploitation or an exploration alternative. After allocating the resources, participants get performance feedback based on their own decision in every round. Depending on the treatment are in, they get *high*, *low* or *no* social performance feedback from another participant. Further, they are randomly allocated to two different markets that differ in the payoff function underlying the exploration alternative. As they do not know, in which market they operate, participants may attribute their (relatively) low performance to the external market condition. After every round, they have to provide a probability estimate on whether they operate in the bad market, to better understand participant's beliefs upon which they base their decision. For both, the exploration decision, as well as the probability estimate, there always exists an objectively correct choice to which participant's decisions can be compared.

The results offer two main findings. First, individuals exposed to *high* social feedback form overly pessimistic beliefs about the market conditions that are also less accurate compared

to the Bayesian posterior. Second, compared to the control group without social feedback individuals exposed to social performance feedback explore significantly less in bad market conditions, compared to good market conditions. This paper, thus, contributes to the literature on intra-organizational comparison (e.g. Baumann, Eggers, and Stieglitz, 2018) by showing an asymmetric reaction to high versus low social performance feedback. This suggests that providing individuals with social performance feedback, may not necessarily balance exploration and exploitation behavior at the organizational-level. Second, this study contributes to the literature on self-enhancement (e.g. Jordan and Audia, 2012) by providing empirical evidence that individuals attribute their relative failure in the *high* social performance condition to external market conditions, compared to accurately self-assessing their performance.

Contribution and Avenues for Future Research

This dissertation provides insights on the micro-foundations of organizational adaptation, which is important to enlarge our understanding of how organizations adapt and why organizations may fail to adapt. I structure the contribution to the literature along my two research questions of this dissertation.

The first research question addressed in this dissertation is on *why organizations adapt differently*. By providing insights on reasons at the institutional-, organizational-, and individual-level, this dissertation contributes to recent literature on organizational adaptation that shows how diverse organizations adapt (Battard, Donnelly, and Mangematin, 2017; Eggers and Park, 2018; Vergne and Depeyre, 2016). Understanding the origin of heterogeneity in firms' ability to adapt is not only relevant for theories explaining adaptation to change (Henderson and Clark, 1990; Tushman and Anderson, 1986), but also for theory of inter-firm performance heterogeneity (Barney, 1991; Helfat and Peteraf, 2003; Penrose, 1959). The reasons we identify in *Paper I* – namely selection pressure, experience and motivational and cognitive factors – advance our understanding on the source and persistence of heterogeneity in organizational adaptation among firms. While these factors may facilitate adaptation in some cases, they can also help to explain why organizations fail to adapt in other cases. Missing selection pressure, lack of experience and inaccurate perception of what constitutes competitive advantage hinder the transition of one organizational response to another organizational response.

The second research question of this dissertation is on how *micro-processes help to explain organizational adaptation.* While the notion of microfoundations received much interest in strategy and organization research (Gavetti, 2005; Lippman and Rumelt, 2003), empirical research on how individual-level actors impact organization-level outcomes is scarce yet (Di Stefano and Gutierrez, 2018). *Paper II* and *Paper III* of this dissertation explicitly provide experimental evidence on individual-level search and how this helps to explain organizational adaptation. By showing the relevance of the cognitive process of attention (*Paper II*) as well as the motivational factors of self-enhancement (*Paper III*) these experiments contribute to the literature on insights of the search process (Posen *et al.*, 2018). The combination of the papers enlarges our understanding of the microfoundations of search, by providing empirical evidence on cognitive and motivational factors influencing individual search activities that help explain how organizations adapt and why some organizations fail.

Moreover, answering the second research question, this dissertation contributes to the literature on organization design (e.g. Baumann and Stieglitz, 2014; Lee and Puranam, 2017), by showing how firms can organize to adapt in turbulent environments. As individuals may not be able to oversee interdependencies, organizations need to guide collective search behavior to ensure they continue innovating along new paths and fully exploiting their existing competencies. Here, organizational design measures – related to structure, hierarchy or incentives – can help organizations to balance individual adaptation efforts. In particular, this dissertation highlights how costs (*Paper II)* and social performance (*Paper III)* serve as effective organization design measures to guide individual-level search. Examining the effect by exogenously varying these factors in a very controlled setting, enables us to provide detailed insights of their impact. By providing a better understanding how costs and relative performance feedback may encourage exploration, we propose two organization design measures to shape individual search.

Paper III of this dissertation, shows that experiments are well suited to elicit individual's belief formation, and how beliefs about a certain alternative may change over time. This dissertation further contributes by specifying future research avenues to advance the understanding of micro-foundations of organizational adaptation. Promising future avenues pertain to research on the aggregation of individual behavior, as microfoundations also refer to

processes of how individuals interact (Aggarwal *et al.*, 2017). Research on organizational adaptation suggests that cognitive representations (Eggers and Kaplan, 2009; Gavetti and Levinthal, 2000) and the evaluation of alternatives (Knudsen and Levinthal, 2007) play an important role in guiding search. Additionally, the idea of collective interpretation (Gavetti and Warglien, 2015) and belief synchronization (Denrell and Le Mens, 2017), as well as mental representation of organizations' environment, gained attention in recent years (Csaszar and Levinthal, 2016; Martignoni, Menon, and Siggelkow, 2016). Thus, an avenue for future is to examine the synchronization of beliefs of groups in organizations, as a better understanding the emergence and persistence of beliefs in groups, may help to explain why some organizations fail to adapt by making bad strategic decisions.

Further, while the papers of this dissertation emphasizes isolating effects in the laboratory, future studies may make use of empirical settings in the field. As in the case of quasi-(Flammer, 2015; Gubler, Larkin, and Pierce, 2016; Obloj and Zenger, 2017) natural experiments (Lee and Puranam, 2017; Nagaraj, 2018; Zhang, 2018) and field experiments (Burbano, 2016; Døskeland and Pedersen, 2016; Gneezy *et al.*, 2012) the exogenous treatment still enables the isolation of an effect and excludes the possibility of self-selection. A particular feature of field experiments is the opportunity to assess processes and activities within organizations, where empirical data sources are typically rare (Chatterji *et al.*, 2016). Using this approach has great potential to analyze the effect of certain organization design features and to reveal insights into why organizations adapt differently and how micro-processes help to explain organizational adaptation.

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Paper I

DIFFERENT REASONS FOR DIFFERENT RESPONSES

AN ANALYSIS OF INCUMBENTS' ADAPTATION IN CARBON-INTENSIVE INDUSTRIES

with Sangyoon Yi

DIFFERENT REASONS FOR DIFFERENT RESPONSES

AN ANALYSIS OF INCUMBENTS' ADAPTATION IN CARBON-INTENSIVE INDUSTRIES

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Abstract

Organizations often respond in different ways to common external shocks. To advance theories on organizational adaptation and performance heterogeneity, it is essential to understand different reasons for different organizational responses. In this study, we examine how incumbents in carbon-intensive industries adapt to the heightened environmental pressure to reduce carbon emissions. By reviewing and analyzing the cases explored in the related literature, we find that organizational responses could be mapped on the three dimensions: strategy, speed, and scope. Notably, the positions on the dimensions are not independent but correlated, so that the heterogeneity in the organizational responses is somehow limited. Our analysis proceeds to identify factors and forces behind the observed heterogeneity in organizational responses. We conclude with discussions on the theoretical and empirical implications of our findings for research on organizational adaptation and sustainability.

Keywords: Organizational Adaptation, Organizational Heterogeneity, Climate Change, Carbon-intensive Industry, Sustainability

INTRODUCTION

Organizational adaptation to environmental change is critical for survival and prosperity. Therefore, it has been an important topic in organization and strategy research to understand different organizational responses and the reasons behind the differences (Durand, Hawn, and Ioannou, 2017; Oliver, 1991; Raaijmakers *et al*., 2015). Climate change is one of the grand challenges of the 21st century and imposes large consequences for organizational practices and performance (Ferraro, Etzion, and Gehman, 2015; Howard-Grenville *et al*., 2014; Jarzabkowski *et al*., forthcoming). Increased environmental pressure to reduce carbon emissions has generated threats and opportunities for many businesses, and thus increasingly attracted academic attention and scholarly efforts (Wittneben *et al*., 2012). The primary focus of prior research has been on the performance implications of policy changes and institutional measures, such as carbon emission trading (Cadez and Czerny, 2016; Gasbarro, Rizzi, and Frey, 2013; Okereke and Russel, 2010). However, empirical studies have found that the results are often mixed (Orlitzky, Schmidt, and Rynes, 2003). To better explain the performance implications and heterogeneity therein, we need a better understanding of the reasons and differences behind the incumbents' adaptation to the environmental change.

While recent studies on organizational adaptation provide important insights into different organizational responses (Battard, Donnelly, and Mangematin, 2017; Eggers and Park, 2018; Vergne and Depeyre, 2016), our understanding of how organizations respond and why they respond differently is yet limited and fragmented. In the context of carbon emissions, in particular, prior studies often map organizational responses on a single dimension such as a continuum between reactive and proactive (e.g. Aragon-Correa and Sharma, 2003; Kolk and Pinkse, 2005; Sharma and Vredenburg, 1998). Slawinski and Bansal (2012) point out that understanding different organizational responses on such a single dimension has important limitations. In this paper, we attempt to fill this gap by reviewing and analyzing the related cases of the incumbents in carbon-intensive industries, which have been studied in the literature.

Our review of the cases clearly shows that there are substantially different ways that organizations, even in a single industry, respond to the increased pressure to reduce carbon emissions. Our analysis suggests three dimensions along which organizational responses vary: strategy (more sustainable or less unsustainable), speed (proactive or reactive), and scope

(focused or integrated). This more fine-grained categorization to map organizational responses helps enhance our understanding of different responses and the reasons behind them. Through the lens of these three dimensions, we identify five different organizational responses. Response 1 and 2 are popular ones: Response 1 follows a strategy to become less unsustainable, in a reactive manner and with a focused scope of activities; Response 2 follows a strategy to become more sustainable, in a proactive manner and with an integrated scope of activities across the boundaries inside and outside of the organization. Responses 3, 4 and 5 are more exceptional cases that deviate at least on one dimension from the popular responses 1 and 2. Notably, the positions on the three dimensions tend to be correlated so that the observed diversity of organizational responses is somehow limited. To explain this limited heterogeneity, our analysis proceeds to identify the reasons behind the observed heterogeneity and clustering in organizational responses.

Our analysis reveals notable factors and forces at the institutional, organizational and individual-level that drive the different organizational responses and limit transitions between them. The primary ones with theoretical implications are as follow. First, survival or selection pressure, a yet overlooked institutional factor in prior studies, tends to drive organizations to pursue a strategy to become more sustainable. This possibility of more exploration under less slack has not been yet explored well in the corporate sustainability literature (e.g. Jeswani *et al*., 2008; Lee, 2012). Second, own experience – even if unrelated to the reduction of carbon emissions – is more influential than others' experience in directing organizational responses and developing necessary capabilities. This finding, and the related cases, would contribute to the discussions on what kind of experience is helpful, and when, in organizational adaptation (Boh, Slaughter, and Espinosa, 2007; Haunschild and Sullivan, 2002; Hoang and Rothaermel, 2005). Third, at the individual-level, not only motivational but also cognitive factors in the attribution of causation (e.g. where competitive advantage comes from) are found to be relevant in explaining the observed heterogeneity in organizational response. This finding suggests that it would be fruitful to examine how cognitive and motivational factors interact with each other in driving organizational responses – a central problem recognized in prior studies (e.g., Kaplan and Henderson, 2005; Kc *et al*., 2013). In the last section, we will discuss more in detail.

The rest of this paper is organized as follows. After describing the increased environmental pressure to reduce carbon emissions, we develop the three dimensions of organizational response. Based on the dimensions, we derive five categories of organizational responses, with examples of popular organizational responses in detail. In the following section, the different reasons behind the different responses are discussed. We conclude with theoretical implications of our findings and ideas for empirical research.

ENVIRONMENTAL PRESSURE TO REDUCE CARBON EMISSIONS

The consequences organizations may face from climate change are diverse: Besides reputational and regulatory risks, organizations, especially incumbents from carbon-intensive industries face massive business risks (Backman *et al*., 2017; Lenox and Eesley, 2009; Slawinski *et al*., 2017). They largely depend on carbon-based resources, and reducing carbon emissions will require large transformational change (Ferraro *et al*., 2015). Additionally, selection forces, such as private and governmental funds, increasingly divest from carbon-intensive industries and competitive dynamics may accelerate as low-carbon entrants enter the market (Dahlmann and Brammer, 2011; Geels and Schot, 2007; Kapoor and Furr, 2015). Such elevated environmental pressure to reduce carbon emissions could be perceived as a common external shock to competing firms in various sectors. We study different organizational responses and various reasons for such heterogeneity.

Much of the research examining firms' environmental strategies, in general, and carbon strategies, in particular, differentiate organizational response on the continuum between being reactive and proactive (Aragon-Correa and Sharma, 2003; Hart, 1995; Kolk and Pinkse, 2005; Sharma and Vredenburg, 1998). While reactive strategies are associated with conformance to regulations and standard industry practices, proactive is seen as more voluntary actions for environmental preservation (Sharma, 2000). Our review and analysis on the related cases of incumbents in carbon-intensive industries, however, suggest that organizational responses to the environmental change to reduce carbon emissions are so diverse that we need various dimensions to map them out. In the following sections, we present the dimensions along which organizational responses may vary. We analyze and integrate ideas from the existing categorizations (Kolk and Pinkse, 2005; Weinhofer and Hoffmann, 2010), the case studies (Gulbrandsen and Stenqvist, 2013; Slawinski and Bansal, 2012; Wahyuni and Ratnatunga,

2015), as well as the studies on large data set (e.g. Jeswani *et al*., 2008; Sprengel and Busch, 2010).

DIMENSIONS OF ORGANIZATIONAL RESPONSE

Our interest is in understanding the consequences of the increased environmental pressure to reduce carbon emissions by examining differences in organizational responses to such a common environmental change. For our review and analysis, we have searched for case firms in prior studies in the related literatures by using the search criteria outlined in the Appendix A. The studies and cases reviewed are shown in Table 1, and a summary of our review and analysis is provided in Appendix B. In this study, we examine incumbents in carbon-intensive industries because these firms are particularly prone to the heightened environmental pressure to reduce carbon emissions (e.g., regulations on large firms). Our review and analysis of the related cases of incumbents in carbon-intensive industries find that organizational responses to such a common pressure are more diverse than simply being either proactive or reactive (Slawinski and Bansal, 2012). With an inductive approach, we identified three dimensions from the existing cases along which organizational responses vary: strategy (more sustainable vs. less unsustainable), speed (proactive and reactive), and scope (focused or integrated).

No.	Firms / Group	Study
1	Beta	Wahyuni and Ratnatunga (2015)
1	Norske Skog	Gulbrandsen and Stenqvist (2013)
1	Corus, BHP-Billiton, Scottish Power, and Centrica	Okereke and Russel (2010)
1	Cluster 1	Backmann *et al*. (2017)
1	Emission Trader	Kolk and Pinkse (2005)
1	Cluster of Compensators, Preservers	Weinhofer and Hoffmann (2010)
1	Indifferent	Jeswani, et. al (2008)
1	Wait and See	Lee (2012)
1	Minimalists , Reg. Shapers, Pressure Manager	Sprengel and Busch (2010)
2	Integrated Firm	Slawinski and Bansal (2012)
2	Active, Emerger	Jeswani, et. al (2008)
2	Emission Avoiders	Sprengel and Busch (2010)
2	Alpha	Wahyuni and Ratnatunga (2015)
2	SCA	Gulbrandsen and Stenqvist (2013)
2	BP and Shell	Okereke and Russel (2010)
2	Cluster 3	Backmann *et al*. (2017)
2	Vertical Explorer	Kolk and Pinkse (2005)
2	All-Round Enhancer, All-Round Explorer	Lee (2012)
2	All-Rounder, Reducer, Sub. Reducer, Sub. Compensators	Weinhofer and Hoffmann (2010)

3	Cluster 2	Backmann *et al*. (2017)
3	Focused Firm	Slawinski and Bansal (2012)
3	Hor. Explorer, Int. Explorer, Emer. Planner, Caut. Planner	Kolk and Pinkse (2005)
3	Cautious Reducer, Prod. Enhancer, Emer. Explorer	Lee (2012)
4	Beginner	Jeswani, et. al (2008)
5	Ceramic tile industry	Gabaldón-Estevan, *et al*. (2014)

Table 1 . Categorization of Organizational Responses to Climate Change in the Prior Studies

Strategy: to be more sustainable or less unsustainable?

Along this dimension, organizational responses vary by the strategic goal. Organizations may aim to be more sustainable and thereby may generate a competitive advantage, whereas others may only aim at being less unsustainable and may obtain less competitive disadvantage. The motivation of the latter one may lie in reducing risks of reputation loss or regulation (Berkhout, Hertin, and Gann, 2006). One main difference between the organizational responses along this dimension are whether they aim to reduce or to compensate for carbon emissions (Kolk and Pinkse, 2005; Weinhofer and Hoffmann, 2010). When firms compensate, they may decrease the pressure to reduce their own emissions but do not resolve the underlying cause of such pressure (Weinhofer and Hoffmann, 2010). We refer to this strategic goal as trying to be less unsustainable. On the other hand, companies aiming at reducing carbon emissions may change the product design or the production system and processes to reduce or remove the sources of carbon. Further, companies may even take measures that transform business operations towards achieving independence from fossil resources, i.e. they substitute carbon resources with non-carbon resources such as renewable energies. Companies following the goal of carbon reduction or independence are therefore clustered under the strategy of being more sustainable.

Speed: proactive or reactive?

Organizational responses may vary by the time organizations spent to adapt to environmental change. Those organizations having already conducted carbon management activities for a long time are proactive ones, whereas others that started such activities more recently when regulatory and reputational pressures increased are reactive ones. Often those proactive organizations have been among early movers in the field. Reactive organizations are not as committed as proactive ones, but try to follow those environmental leaders (Jeswani *et al*., 2008). They are those who just started some operational activities, especially to enhance energy efficiency. This kind of response is often referred to as a ‘wait and see’ approach (Berkhout *et*

al., 2006; Lee, 2012). In a similar vein, the corporate greening matrix by Winn and Angell (2000) classifies firms into two groups, environmental innovators (those with high commitment and proactive action) and environmental followers (those with low commitment and reactive planning). This dimension of proactive versus reactive responses has often been used in the research on environmental performance, often in relation to the quality of environmental management (Aragon-Correa and Sharma, 2003; Hart, 1995).

Scope: focused or integrated?

Organizational responses may or may not involve integration of diverse activities (as opposed to being focused on certain activities), cooperation with other firms (as opposed to self-focused) (Backman *et al*., 2017; Berkhout *et al*., 2006; Gilli, Mancinelli, & Mazzanti, 2014; Lee, 2015), and exertion of influence on the institutional context (as opposed to conforming to it) (DiMaggio and Powell, 1983; Dorado, 2005; Pinkse and Kolk, 2007).

The scope of the organizational response may vary by the number of organizational activities involved and whether the activity is at the core or periphery of the organizational activity system (Backman *et al*., 2017). (Gilli *et al*., 2014) distinguish between radical and incremental changes: radical changes involve environmental processes, products, and organizational innovations to reduce carbon emissions, whereas incremental changes are those made at one part or one level. The strategy types suggested by (Lee, 2012) also vary by the scope of organizational activities involved: the 'cautious reducer' implements carbon reduction measures for specific production processes within the company, the 'product enhancer' additionally develops more energy-efficient and less carbon-intensive products, and the 'all-round explorer' engages in a range of different carbon-reducing activities with diverse organizational processes involved. The scope of organizational response, both for reducing or compensating for carbon emissions, may or may not involve other firms (Kolk and Pinkse, 2004; Weinhofer and Hoffmann, 2010). Firm-focused reduction activities often improve the technological assets and competencies of the focal firm. With a broader integrated scope, other firms can be involved vertically (e.g. suppliers developing new energy-efficient products or technologies) or horizontally (e.g. a strategic alliance) (Kolk and Pinkse, 2005). Compensation could be organized internally, or with other firms involved, for example when transferring carbon emissions vertically along the supply chain.

The scope of organizational responses to climate change risks may or may not involve the influence on the institutional context - as opposed to conforming to it. Organizations may conform to institutional constraints as a 'conformer' or exert influence on their institutional contexts as 'institutional entrepreneurs' (DiMaggio and Powell, 1983; Dorado, 2005). By adding to carbon-reducing pressures, the EU ETS may largely influence how organizations respond. They face or expect to be facing this high institutional constraint on carbon emissions, such as the cap of an emissions trading scheme (Pinkse and Kolk, 2007). Pinkse and Kolk (2007) make use of this setting and categorize organizational responses whether they conform to institutional pressures and accept the institution as it is or seize the opportunity to change the institution in a way that alleviates the pressure. Cadez and Czerny (2016) define carbon trading as a typical conformer action, which is at the same time widely applied.

HETEROGENEITY IN ORGANIZATIONAL RESPONSE

In this paper, we aim to enhance the understanding of how organizations respond and why they respond differently to a common external shock. This will help better understand the performance implications of different organizational responses. Reviewing prior studies and cases covered in the related literatures (see Appendix B for a summary), we find that organizational responses vary on the three dimensions discussed above - strategy, speed, and scope. Notably, our analysis shows that organizational responses are not as diverse as the number of dimensional combinations. Rather, there seem to be a few common combinations among the dimensions of organizational response. That is, we could observe clustering of certain positions on the dimensions of organizational response. Moreover, these places are quite distant from each other. In this section, we describe these common combinations of the dimensions of organizational response.

	STRATEGY	SPEED	SCOPE
Response 1	less unsustainable	reactive	focused
Response 2	more sustainable	proactive	integrated
Response 3	more sustainable	proactive	focused
Response 4	more sustainable	reactive	focused
Response 5	more sustainable	reactive	integrated

Table 2. Five Organizational Responses Observed in the Reviewed Case Studies

Our analysis suggests five distinct organizational responses, as summarized in Table 2. In the following subsections, we discuss the two, most popular organizational responses in detail with the examples of the relevant cases. Further, we discuss the reasons or drivers of the responses at the institutional, organizational and individual-level that we identified from our review and analysis. We then discuss the three, more exceptional organizational responses.

Response 1: Less unsustainable, reactive and focused

Organizations responding unsustainability-reducing, reactive and focused, often compensate carbon emissions through trading systems, have not managed carbon emissions for a long time, and set themselves to one particular activity. Okereke and Russel (2010) describe firms in their study that see the only way of generating a competitive advantage in compensating for their carbon emissions through the EU ETS system. They have followed this unsustainability-reducing strategy only since the regulatory pressure increased and focused on compensation activities only. Similarly, Beta (Wahyuni and Ratnatunga, 2015) argues that they could not generate a competitive advantage by reducing carbon emissions and try to reduce their competitive disadvantage by following what is required by law. Beta is complying with what is required and thus is an 'environmental follower' that has recently started and operates with a focused scope of activities. Another example is Norske Skog (Gulbrandsen and Stenqvist, 2013) that reduces carbon emissions by reducing their total production, which is unsustainability-reducing. For Cluster 1 firms in Backman *et al*. (2017), mitigating climate change impact is not a strategic priority and firms completed only the minimal legal reporting. Compared to others they are lagging behind and do not develop new products or practice kind of widespread involvement. Very similar organizational responses are exhibited by Emissions Traders and Horizontal Explorers (Kolk and Pinkse, 2005), Cluster of Compensators and Preservers (Weinhofer and Hoffmann, 2010), Indifferent (Jeswani *et al*., 2008), Wait-and-See (Lee, 2012), Minimalists, Regulation Shapers and Pressure Managers (Sprengel and Busch, 2010).

Institutional-level reasons: Regulation and stakeholder pressure

These firms were often subject to low regulatory pressure, weak regional policies (Weinhofer and Hoffmann, 2010), and low stakeholder pressure (Jeswani *et al*., 2008; Sprengel and Busch, 2010). Weinhofer and Hoffmann (2010) argue that the US-based companies in their sample are not exposed to strong nationwide regulations of carbon emissions, neither to

significant financial incentives for investment in renewable energy (as compared to the European companies) and therefore did not engage that much into carbon reduction measures. Jeswani *et al*. (2008) argue that often correlated with lower environmental regulations or enforcement of regulations, is the public's awareness of environmental topics such as carbon emissions. In some regions, little information and knowledge about potential opportunities for carbon emissions reduction are available. Due to low awareness of the relevance of carbon emissions reduction, the stakeholder pressure from groups such as shareholders and customers tends to be low (Jeswani *et al*., 2008). Sprengel and Busch (2010) suggest that firms that perceive lower stakeholder pressure do engage less in carbon reduction measures. Or firms like Norske Skog (Gulbrandsen and Stenqvist, 2013) were included in the EU ETS regulation later than their counterparts and therefore has been under less regulatory pressure for a longer time.

Organizational-level reasons: Resources, performance feedback

In addition to different regulatory pressure, Norske Skog also had organizational reasons for their response: Norske Skog had limited access to human resources and factors of production to reduce their carbon emissions and thus compensated for them through emission trading (Gulbrandsen and Stenqvist, 2013). Similarly, Beta (Wahyuni and Ratnatunga, 2015) saw the reason of their response (Response 1) mainly in the lack of resources. And Backman *et al*. (2017) find that firms responding unsustainability-reducing, reactive and focused have limited governance, information management and systems capabilities to reduce carbon emissions. In addition to the lack of internal capabilities to audit carbon reductions, these firms (Response 1) often didn't have clear targets for reducing their carbon footprint (Backman *et al*., 2017). Similarly, Jeswani *et al*. (2008) observe that the group of indifferent firms does not have any formal environmental management system. Due to such weak data tracking, lack of ex-ante targets, and ex-post verification, these firms do not get enough performance feedback urging them to reduce carbon emissions. Consequently, firms in this response often do not follow any carbon reduction measures (Lee, 2012; Sprengel and Busch, 2010). They lack experiences in implementing new technologies and successfully reducing carbon emissions or related costs.

Individual-level reasons: Motivational factors and perception

Wahyuni and Ratnatunga (2015) find that if organizations see fewer options to reduce carbon emissions from its energy transmission and thus cannot generate a competitive advantage

through carbon emission reduction, they are more likely to respond in an unsustainability-reducing, reactive and focused way. Similarly, the response of Scottish Power (Okereke and Russel, 2010) was caused by different perceptions of what would give them a competitive advantage as compared to BP or Shell taking Response 2 (explained below). Scottish Power thought that its competitive advantage emerges from compensating for carbon emissions or even expanding into new markets (Okereke and Russel, 2010). The differences mainly lie in the perception of available opportunities for coupling emission reduction measures and services with cost savings and improved market performance in a carbon-constrained economy.

The social psychology literature suggests two kinds of reasons for different attribution of causation (e.g. where competitive advantage comes from): motivational or cognitive factors (Tetlock and Levi, 1982). For Response 1, we observe several motivational factors: Backman *et al*. (2017) point out lack of support from the senior management and incentives for lower-level management to reduce carbon emissions, and Jeswani *et al*. (2008) find lack of management commitment and corporate targets. Further, (Lee, 2015) argues that economic factors such as cost savings, energy tax, capital budget, beneficial loans for energy efficiency investments are essential to generate motivation for certain decisions and activities. If these motivational factors are missing, individuals may not perceive opportunities in reducing carbon emissions, resulting in Response 1.

Response 2: More sustainable, proactive and integrated

Another popular organizational response is characterized by a strategy to be more sustainable, responding proactively, and an integrated scope. SCA (Gulbrandsen and Stenqvist, 2013) for instance, is investing and implementing actions to reduce carbon emissions. Their goal is to complete it before the next EU ETS starts to receive more favorable allowances. SCA has extended their search for new biomass-based energy solutions and formed a new business unit to coordinate all the related activities. The responses of BP and Shell (Okereke and Russel, 2010) are characterized by large investments to achieve the goal of reducing carbon emissions because both companies see the potential value of such investments. They engaged in internal emission trading schemes before the first organized trading scheme even affected them. Their scope is integrated, as they engage in a broad range of different approaches and activities. Other good examples of Response 2 include Alpha (Wahyuni and Ratnatunga, 2015), the Vertical

Explorer (Kolk and Pinkse, 2005), All-Rounder, Reducer, Substituting Reducer, and Substituting Compensators (Weinhofer and Hoffmann, 2010), Actives (Jeswani *et al*., 2008), All-Round Enhancer (Lee, 2012), and Emission Avoiders (Sprengel and Busch, 2010).

Institutional-level reasons: Regulation and stakeholder pressure

Weinhofer and Hoffmann (2010) compare organizational responses across geographical regions with respect to climate change policies. They find that firms are more likely to exhibit Response 2 in Europe or Japan, than in US, where carbon emissions are regulated or carbon emission disclosure is mandatory. This might be because firms want to comply with existing and potential future regulations. Further, there seems to be not only governmental focus on reducing carbon emissions but also increasing shareholder and stakeholder pressure in Europe and Japan (Weinhofer and Hoffmann, 2010). Higher stakeholder pressure (Jeswani *et al*., 2008) and stronger incentives (e.g. through the EU ETS system) may further drive firms toward Response 2 (Rogge, Schneider, and Hoffmann, 2011). Large companies often make above-average carbon emissions and, thus are more exposed to the related risks (Sprengel and Busch, 2010). In addition, organizational size may also moderate the influence of institutional pressure (Lee, 2012).

Organizational-level reasons: Path-dependency and pre-adaptation

Several studies find that pre-existing structure and organizational size shape organizational responses to escalated institutional pressure to reduce carbon emissions (Lee, 2012). Weinhofer and Hoffmann (2010), as well as Okereke and Russel (2010), argue that larger organizations tend to undertake carbon strategies with a broader scope because they have the resources to execute various carbon reduction measures in parallel as well as more slack resources and better management systems. Further, firms that engaged in a wide range of carbon reduction measures have been in a mature state of carbon management when the regulatory pressure increased (Lee, 2012). Without radically changing processes or products, these firms incrementally expanded their scope of the related activities over time (Cadez and Czerny, 2016). This is in line with the notion of path dependency and myopic learning in the literature on organizational learning (e.g. Levinthal and March, 1993). Organizations tend to continue following their current path as long as it is not problematic. Therefore, proactive firms as compared to reactive ones are more likely to have already engaged in carbon emissions

reduction for a long time, and to have an integrated scope of many activities involved. As noted above, BP and Shell (Okereke and Russel, 2010) engaged in internal emission trading schemes even before the first organized trading scheme affected them. They were able to steadily accumulate what is necessary to reduce carbon emissions because they engaged earlier in these activities than other competitors (Okereke and Russel, 2010).

Further, Gilli *et al*. (2014) argue that innovation is a crucial driver for environmental performance. High complementarity between 'eco-innovations' and other techno-organizational activities would make it more effective to cut carbon emissions. Similarly, having a high level of technical capabilities (Gulbrandsen and Stenqvist, 2013) or strong engagement in R&D (Dahlmann and Brammer, 2011) facilitates specific innovative and investment solutions, thereby resulting in Response 2. Explaining the reasons for Response 2, the notion of pre-adaptation (Cattani, 2006) is particularly useful. Pre-adaptation captures the importance of a firm's prior experience that is accumulated without anticipation of subsequent uses. Cattani (2006) found that preadapted firms that consistently leveraged their prior experience achieved higher levels of performance than firms that did not leverage that experience or did not have prior experience. Regarding organizational adaptation in carbon-intensive industries, technological skills or investment in R&D that was initially not developed to reduce carbon emissions may turn out to be helpful in building and maintaining responses to be more sustainable. This mechanism of pre-adaptation, in conjunction with path dependency, helps understand why a strategy to be more sustainable and integrated scope are often associated with being proactive.

Individual-level reasons: Preferences and time perspective

Individual-level preferences have been shown to influence organizational adaptation substantially (e.g. March, 1981). In their study on organizational response to the pressure of reducing carbon emissions, Slawinski and Bansal (2012) identify time perspective based on risk preferences as one factor that explains different organizational responses. In a similar vein, Weinhofer and Hoffmann (2010) argue that some climate-related investments have a short-term impact, while most represent a longer-term solution. Slawinski and Bansal (2012) argue that the organization's long-term perspective drives Response 2, which mainly depends on their tolerance of risks. These firms tend to make more connections between the past, present, and

future. Referring to Jost *et al*. (2003), Slawinski and Bansal (2012) argue that firms with a focused scope typically have linear time perspectives, which are often related to the socio-cognitive motives such as uncertainty avoidance, low tolerance of ambiguity and the need for cognitive closure. They argue that firms with a focused scope tend to seek for immediate solutions (Slawinski and Bansal, 2012) – i.e., reactive response on the speed dimension. In contrast, firms with a more integrated scope tend to have a more cyclical time perspective and, by making more connections between the past, present, and future, and often to be more willing to engage in several carbon activities simultaneously that look relevant in the future.

Other Organizational Responses

In addition to the two organizational responses discussed so far, our analysis also identified three, relatively exceptional organizational responses, Response 3 to 5. They deviate from the two, frequently observed responses on one or two dimensions. Note that we could identify these distinct organizational responses because we used the three dimensions rather than just one as in most prior studies.

Response 3: More sustainable, proactive and focused. In this Response 3, the focused scope is maintained on purpose (Slawinski and Bansal, 2012). Slawinski and Bansal (2012) argue that the firms exhibiting such a response tend to have very low risk tolerance. As noted above, their study builds on the work of Jost *et al*. (2003) that found several socio-cognitive antecedents of the low risk tolerance, which includes uncertainty avoidance, intolerance of ambiguity, and decreased openness to experience. Having low tolerance for uncertainty and preferring to avoid risks is reflected in a linear time perspective focusing on the present. For such firms, the focused scope of activities helps them to mitigate risks by enabling to control their environments. The self-centric approach, without others involved, allows for more control and reduces the sense of uncertainty. Keeping a focused scope, these firms want to remain very responsive and seek technology-based solutions. Notably, Slawinski and Bansal (2012) show that being proactive is not necessarily associated with an integrated scope, and a focused scope may also enhance responsiveness in the long run. This contradicts the observation discussed above that proactive responses tend to involve a broad, integrated scope of activities across departmental or organizational boundaries (Response 2). Whereas most organizations tend to accumulate resources and capabilities to reduce carbon emissions by enlarging their

organizational scope, some organizations stay focused to become better specialized in their current scope of technologies for reducing carbon emissions (Slawinski and Bansal, 2012).

Response 4: More sustainable, reactive and focused. To reduce carbon emissions, firms taking this response exhibited tendencies such as preparing carbon inventory, setting emission targets or preparing for policy changes. They adopted environmental management systems but have not necessarily certified them by authorities externally. Their aim was to reduce their GHG emissions in the long run. These organizations are not usually the first movers but try to follow the leaders while maintaining a stable financial situation (Jeswani *et al*., 2008). They don't make radical changes but innovate in an incremental manner. Their response may be characterized by path dependency and myopic learning as they become specialized in what has been successful (e.g. Levinthal and March, 1993). Some of these firms, however, gradually switched to Response 2 by enlarging their scope of involved activities over time (Backman *et al*., 2017; Kolk and Pinkse, 2005; Lee, 2012).

Response 5: More sustainable, reactive and integrated. This is the least observed response because aiming to become more sustainable, a broad range of activities need to be involved in a reactive manner. We observe this response in the Spanish ceramic tile industry (Gabaldón-Estevan, Criado, and Monfort, 2014). Due to escalated regulatory pressure form the EU, the incumbents in this industry took a strategy to become more sustainable. They have not been concerned about carbon emissions for a long time, and only started to engage in reducing carbon emissions as the regulatory pressure was rising. Unlike those who took Response 4, these firms found that the only way to survive in the industry is reducing carbon emissions across a broad range of activities and processes in their organization. They made changes to their production, promotion and distribution processes, hoping for more 'green' ceramic tiles. Their current products and processes did not look sustainable to them, and they were in a bad financial situation due to their current business model losing competitiveness. As the behavioral theory of the firm predicts (Levinthal and March, 1981), their perception of failure (i.e., performance below aspiration level) seemed to induce explorative, distant search. They did not seem to fear the risk of radical changes in a broad range of activities as they would be otherwise unable to survive in the industry. Put differently, the heightened selection pressure drove them away from,

e.g., Response 1 and toward Response 5. This response is very exceptional as the other reactive responses (Response 1 and 4) are associated with a focused scope and incremental changes.

The other three, theoretically possible responses are not observed in the cases we reviewed and analyzed. This would be because of the factors and forces that drive the five responses discussed above, which limits the observed heterogeneity in organizational response to the increased environmental pressure to reduce carbon emissions.

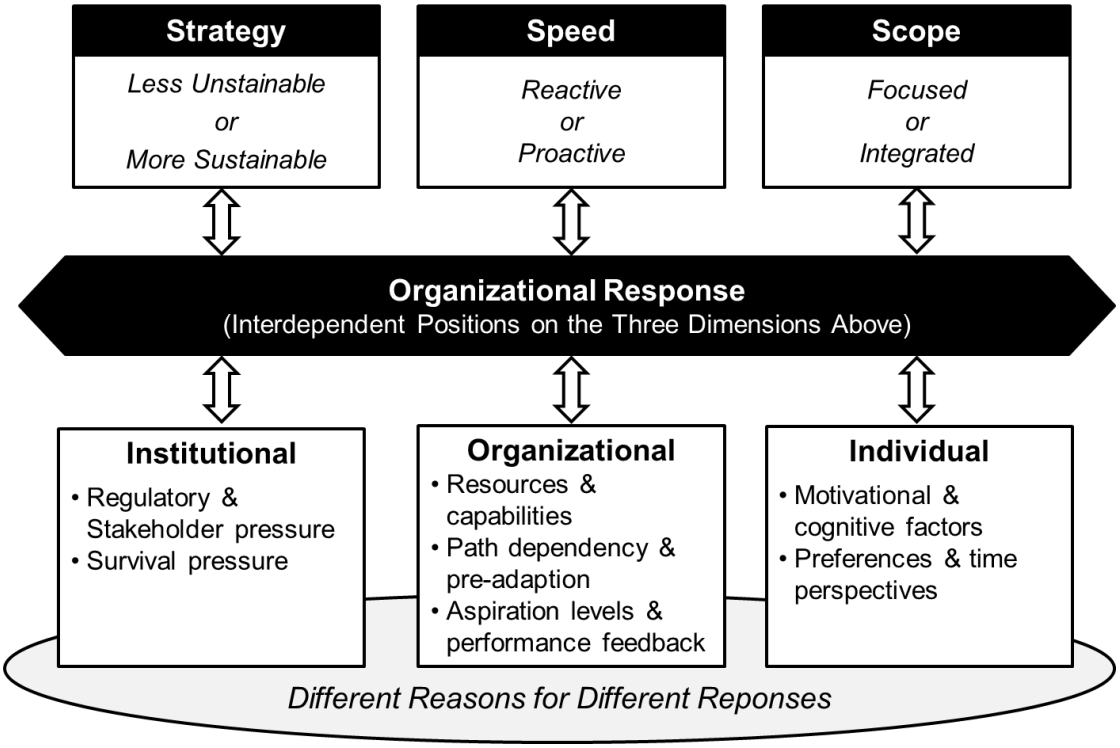

Figure 1 The Dimensions of Organizational Response and the Reasons for Different Responses.

CONCLUSION AND DISCUSSIONS

To integrate and deepen the understanding of how incumbents in carbon-intensive industries adapt to the heightened environmental pressure to reduce carbon emissions, we reviewed the related cases explored in the literature. Examining differences in organizational responses to such a common environmental change, we found that organizational responses could be mapped on the three dimensions: strategy (more sustainable or less unsustainable), speed (proactive or reactive), and scope (focused or integrated). Through the lens of the three dimensions, we could identify five distinctive organizational responses from our analysis. Two of them, Response 1

(less unsustainable, reactive, focused) and Response 2 (more sustainable, proactive, integrated), were more frequently observed, whereas the other three, Response 3 (more sustainable, proactive, focused), Response 4 (more sustainable, reactive, focused) and Response 5 (more sustainable, reactive, integrated), were more exceptional. The results show that the observed heterogeneity in organizational response is somehow limited. Our investigation into the case firms to understand why organizational responses diverge suggests that there are different reasons for different responses, and that certain factors and forces at the institutional, organizational and individual-level generate correlations between the positions on the three dimensions of organizational response (Figure 1). Among others, the following are notable.

At the institutional-level, regulatory and stakeholder pressure mainly drive the observed organizational responses, especially Response 1 and 2. In the presence of strong survival or selection pressure, the incumbents' responses deviated from Response 1 or 2 toward Response 5 (Gabaldón-Estevan *et al*., 2014). This is an interesting observation because the corporate sustainability literature often claims that lack of financial resources prevents firms from pursuing to become more sustainable (Jeswani *et al*., 2008; Lee, 2012). Taking Response 5, firms attempt to become more sustainable even though they are suffering from declining revenue and profits due to increased selection pressure and uncertainty. This possibility of more exploration under less slack has not been yet explored well in the corporate sustainability literature.

At the organizational-level, our analysis shows that own experience – even if unrelated to the reduction of carbon emissions – is more influential than other firms' experience in directing organizational responses and developing organizational capabilities. The literature on organizational learning distinguishes between experiential learning (from own experience) and vicarious learning (from other's experience) (Huber, 1991; Levitt and March, 1988). And existing studies discuss when and what kind of experience is helpful for the development of capabilities and organizational adaptation (Boh *et al*., 2007; Haunschild and Sullivan, 2002; Hoang and Rothaermel, 2005). We observe that if organizations have little experience with carbon reduction measures (Response 1), they tend not to engage in reducing carbon emissions, even other firms in their industry do (Lee, 2012; Sprengel and Busch, 2010). These firms with lack of related experience do not attempt to replicate other's success and thereby learn from

other's experience (Okereke and Russel, 2010). On the other hand, firms in Response 2 tended to invest in R&D and gain experiences of developing technologies that were unrelated to carbon reductions (Dahlmann and Brammer, 2011; Gulbrandsen and Stenqvist, 2013). These firms made use of the unrelated experience and engaged in carbon reduction measures.

At the individual-level, relevant in driving organizational response is the role of both motivational and cognitive factors in the attribution of causation (e.g. where competitive advantage comes from). It is relevant to consider these individual-level factors because attribution of causation may differ at the individual and organizational-level (Kc, Staats, and Gino, 2013). The social psychology literature (e.g. Tetlock and Levi, 1982) suggests two main sources of differences in the attribution of causes: motivational and cognitive factors. Our review shows that several studies examine motivational factors such as economic incentives (Lee, 2015) or targets (Jeswani *et al*., 2008), which are the main drivers of Response 1 or 2. Our review and analysis, however, show that motivational factors alone do not fully explain the observed heterogeneity in organizational responses, and that cognitive limitations of managers may lead to different perception of what generates competitive advantage (Okereke and Russel, 2010; Wahyuni and Ratnatunga, 2015). The literature on organizational routines similarly distinguishes between cognitive and motivational truces of routines (Nelson and Winter, 1982; Zbaracki and Bergen, 2010), and highlights the entanglement of motivational and cognitive dimensions (Becker *et al*., 2005; Kaplan and Henderson, 2005; Lazaric, 2005). Studying the context of carbon emissions, we see great potential in disentangling motivational and cognitive factors at the individual-level because the observed heterogeneity in the attribution of causation (e.g. where competitive advantage comes from) seems substantial. Moreover, as pointed out by Kaplan and Henderson (2005) as a central problem in understanding organizational adaptation, it would be fruitful to examine how cognitive and motivational factors interact with each other in driving organizational responses.

Implications for Empirical Research

Prior studies on corporate environmental strategies often mapped organizational responses to environmental or carbon issues on the single dimension of being reactive and proactive (Hart, 1995; Kolk and Pinkse, 2004; Sharma and Vredenburg, 1998). As Slawinski and Bansal (2012) pointed out, this simple view limits our understanding of the rich heterogeneity in organizations'

responses and their performance. The suggested three dimensions of organizational response will enable more fine-grained categorization of organizational responses and help enrich empirical investigation into the observed heterogeneity in response and performance. For instance, while prior studies tend to map organizational responses on a single dimension and focus on extreme cases (e.g., either highly proactive or reactive), future empirical studies can investigate more diverse organizational responses (e.g., Response 3 to 5 as well as Response 1 and 2) and associate them with the observed performance differentials. In so doing, one may reconcile competing empirical findings in the literature. For example, studying the performance implications of proactive response to increased pressure for sustainability, one may pay attention to certain factors and forces that foster proactive or reactive moves, or examine how the conclusion depends on the strategy (to be more sustainable or less unsustainable) and the scope (to involve focused or integrated activities) of organizational response. In sum, to better understand the observed performance heterogeneity among the incumbents in an industry, we need to identify their different responses to environmental change and understand the different reasons for the different responses.

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APPENDIX A. Criteria of Search for the Prior Studies Reviewed

In the process of search for the prior studies to review, we started by searching at *EBSCO – Business Source Complete* and analyzed the abstract, title and keywords. The table below shows the terms we used to make up the search queries. A search query may consist of several terms that are connected either by "OR" or "AND" depending on whether they are from one of the two columns (e.g., "Carbon" OR "Greenhouse Gas") or from both columns (e.g., "Carbon" AND "organizational change").

Carbon-intensive industries	**Organizational responses**
Carbon	Organizational change*
Greenhouse Gas	Organizational respons*
GHG	Organizational adapt*
Emission*	Strateg*
Sustainab*	
Ecologic*	
climate change	
global warming	
Cement	
Pulp and Paper	
Steel	
Power	

APPENDIX B. Review and Analysis of the Related Cases in the Literature

Response	Description of direction	Firms	Study
Case Studies			
Response 2	**More sustainable:** invested in offsets, renewable energy projects with the goal to substantially reduce carbon emissions **Proactive:** have a long-term time perspective, which is reflected in a higher tolerance for short-term uncertainty, the broad range of activities they are engaged in have been developed over a long period of time (especially since 1997, when the Kyoto Protocol negotiations took place) **Integrated:** invested in a broad range of activities to reduce carbon emissions such as emission management, carbon capture and storage, investing in offsets, renewable energy projects (wind, solar or biofuel) and collaborated extensively across sectoral boundaries to find solutions	Integrated	Slawinski & Bansal (2012)
Response 3	**More sustainable**: aiming to mitigate risks by purchasing offsets and modeling carbon prices, focus especially on energy-efficiency technology **Proactive:** quick and efficient in reducing carbon emissions; industry leaders in innovative technologies that reduce energy consumption used economic models to forecast future developments and to inform their climate change-related decisions **Focused:** limited collaboration with stakeholder groups, no renewable energy projects (such as wind, biofuels or solar), concentrate on a narrow range of activities and internal operations, searching for innovative solutions especially in energy-efficiency technology	Focused	
Response 2	**More sustainable:** aims to be less carbon intensive than the competition and to create a financial advantage; has highly diversified power generation portfolio that includes traditional thermal inputs and renewable sources (e.g. hydro, wind, landfill gas and biomass) **Proactive:** aims to build long-term shareholder value by reducing risks related to carbon pollution, Alpha can generate competitive advantage by becoming less carbon intensive, thus may go beyond any requirements from legislation, the company is concerned about the consequences of climate change for almost 20 years, made the first large investment to reduce carbon emissions in 2005 **Integrated**: Alpha includes carbon reduction measures as an integral part in its business strategy and uses two key performance indicators that measure average carbon emission intensity of various assets; they follow different approaches (e.g. carbon price mechanism, renewable energy target) to achieve their carbon-related goals	Alpha	Wahyuni & Ratnatunga (2015)

Response 1	**Less unsustainable:** cannot generate competitive advantage through reduction of carbon emissions; try to reduce competitive disadvantage by following what is required by law **Reactive**: complying with what is required by law; large parts of its assets are regulated; Beta is an environmental follower that has recently started to consider carbon issues in its business operations **Focused:** fewer options to reduce carbon pollution from its services, in a sustainability report the impact of climate change on the company is mentioned, there are no activities outlined to mitigate its carbon emissions, nor were any company policies that specifically address the issue of climate change available in the public domain	Beta	Gulbrandsen & Stenqvist, (2013)
Response 2	**More sustainable:** investing in and implementing carbon-lean actions, SCA made a group-wide commitment to reduce carbon emissions from fossil fuels in relation to production levels **Proactive:** aim to reduce emissions largely before the next EU ETS starts in 2020, to receive more favorable allowances; announced their first goal on the group-wide commitment already in 2001, reinforced it in 2008 by stating that they want to reduce carbon emission intensity by 2020 **Integrated:** sought to reduce emissions through new biomass-based energy solutions, formed a new business unit (SCA energy) to coordinate different activities (bio-fuel and wind power)	SCA	
Response 1	**Less unsustainable:** although the absolute carbon emissions were reduced, Norske Skog achieved this by reducing total production (not by aiming to reduce carbon emissions); the decision was based on production surplus not on a climate change concern; the industry standard is to have production-related targets **Reactive:** Norwegian mills were only included in the EU ETS trading system in the second phase; by reducing total production instead of becoming more efficient they may not be prepared properly for future regulations **Focused**: reports on interaction with stakeholders and conducts studies in several mills; while SCA made large investments in reduction of energy use, Norske Skog has refrained from such investments as they did not see long-term stability in the segment	Norske Skog	Okereke & Russel, (2010)
Response 2	**More sustainable:** set the goal of reducing carbon emissions; is optimistic about the possible added value of carbon-reducing investments, and thus made large investments **Proactive:** internal schemes to trade emissions are developed (BP from 1998 to 2001 and Shell from 2000 to 2002 and then participated in the UK emission reduction program); both before before there was regulation **Integrated:** engaged in a variety of different approaches, including making production processes more efficient, finding new markets for their products and developing new technologies and products; especially carbon capture and storage (CCS) technology gained significant market advantage while also reducing their carbon emissions; also tried to cooperate with external entities (e.g. government)	BP and Shell	

Response 1	**Less unsustainable**: Corus, Scottish Power, BHP Billiton and Centrica are limited by their reliance on the inherently carbon-intensive legacy of fossil fuel energy production in their efforts to make production processes more efficient; Corus was the most skeptical about the potential of value creation through climate actions that reduce carbon emissions **Reactive:** primary goal of expansion into new markets through slow development and phasing in of greener, renewable technologies, but later than competitors – e.g. Centrica feared that the competition was ahead with the implementation of renewables and may establish a competitive advantage; for Scottish Power the EU ETS was the main regulation that moved them to get them involved in climate change prevention **Focused:** had a surplus of carbon allowances, only a few activities in carbon reduction; Scottish Power, Corus and BHP Billiton all reported being actively engaged with relevant government departments	Other four firms	
Response 5	**More sustainable:** making production more efficient and sustainable, even beyond legal requirements, or shifting production, procurement and marketing towards lower-carbon products and processes is seen as the only way that will guarantee survival in the long run **Reactive**: production capacity increased rapidly since the 1990s, with rising carbon emissions; only due to EU ETS regulation, ceramic tile firms started to reduce carbon emissions relatively late with no prior experience **Integrated**: engaged in several different areas: production, promotion and distribution of 'green' ceramic tiles, which require search for alternatives far from their status quo, radical changes in different parts of the firm; idea of cooperation within the sector (e.g. to form an umbrella organization capable of producing ecological innovations that would help differentiate the sector from its competition)	Ceramic Tile industry	Gabaldón et al., (2014)
Response 2	**More sustainable**: follow the goal of effectively reducing carbon emissions; reporting and controlling of internal carbon emissions has caught the attention of senior management and reflects the high-level relevance of climate change issues **Proactive:** invested in governance and information management; technology-related investments reduce the company's carbon footprint relatively early, which makes them a forerunner in the field **Integrated**: used "greener" inputs produced by other firms or made non-reversible investments to generate "greener" outcomes, modify existing products and introduce new ones	Cluster 3	Backman, et al. (2017)
Response 3	**More sustainable**: attempt to reduce the firm's carbon emissions by investing in process improvements **Proactive:** well developed carbon management: the firm has a general understanding of its carbon emissions through the development of internal controlling measures, yet lacks accounting details on how exactly these impact its value chain; also started to introduce company-wide carbon reduction targets; did not start as early as Cluster 3, but do not lag as much behind as Cluster 1	Cluster 2	

	Focused: made investments especially in systems for measuring and managing carbon emissions, but mainly rely on purchasing low-carbon inputs from outside suppliers to reduce their carbon emissions; could enhance the scope of their activities by reducing carbon emissions internally		
Response 1	**Less unsustainable:** reducing carbon emissions was not a strategic priority, Cluster 1 firms only completed the minimal legal reporting; internal reporting and controlling of carbon emissions are not relevant at the senior governance levels of the firm, where strategic direction and resource allocation are decided **Reactive:** lagging behind, minimal legal reporting; no incentives for decision-makers to reduce carbon emissions and achieve energy efficiency; have neither targets for the reduction of their carbon footprint nor internal capabilities to audit carbon reductions **Focused:** they purchase inputs from suppliers that are active in carbon reduction, beyond that no changes in their internal routines; do not develop new products – no incentives, no widespread involvement within the firm	Cluster 1	
Large Dataset Analysis			
Response 2	**More sustainable:** saw an opportunity for the development of energy-efficient products and dialogue with suppliers to decrease carbon emissions; business model reliant on natural resources and mostly agricultural inputs, thus vulnerable to extreme weather events like floods and long-term drought, **Proactive:** regardless of any regulation, these companies saw upstream and downstream potential to reduce carbon emissions and already improved their products for their customers; encouraged their suppliers to adopt environmental standards and considered collaborating with them **Integrated:** different improvements at the same time: strategic alliance or similar forms of collaboration with other companies; reducing carbon emissions along the value chain, but also in own activities such as product development	Vertical Explorer	Kolk & Pinkse (2005)
Response 3	**More sustainable:** takes action to reduce carbon emissions and become more sustainable in the future; Stora Enso, a Finnish paper producer, used try to enter a new markets by using by-products of initial production and low-carbon electricity for own energy production (also sold externally), and developed energy-saving equipment **Proactive**: started relatively early – e.g. Nippon steel introduced energy-efficient technologies into its production processes relatively early on; these companies are well prepared for carbon reduction in the coming years, not everything realized yet, but have concrete plans **Focused:** their activities are of a focused scope, both internally and externally – e.g. FirstEnergy expands natural gas capacity but does not see realistic ways of reducing carbon emissions from coal-fired plants, so actions still focused on expanding other market options; BMS, a pharmaceutical company, has set detailed targets, but has no structured system to follow up on these goals	Horizontal, Internal Explorer, Cautious, Emergent Planner	

Response 1	**Less unsustainable:** only compensate for carbon emissions which leaves the company's technology unchanged; they trade certified carbon emissions reductions (either by themselves or as intermediary); **Reactive:** started emissions trading as external pressure increased; compensation for carbon emissions is not enough to prepare for the future, but did not change processes or products **Focused:** trading carbon emissions as the only approach – e.g. Mitsubishi Corporation, a Japanese trading company, focused on emissions trading	Emission Trader	
Response 2	**More sustainable:** aim to reduce carbon emission or even become independent of it; e.g. EVN, an electricity producer that reduces carbon emissions from its carbon-based power plants through efficiency enhancements and co-firing biomass; EVN works towards carbon independence through investment in its wind and hydro power facilities and additionally purchases EU ETS allowances. **Proactive**: aim to become independent of carbon – e.g., Xcel energy who built a large solar facility station are ahead of other companies in their field with the commitment to carbon independence, seem well prepared for any kind of future regulation **Integrated:** conducts a broad range of activities (with multiple goals or time horizons) – e.g., EVN compensates and reduces carbon emissions in the short run while pursuing carbon independence in the long run	All-Rounder Reducer, Substitu-ting Reducer	Weinhofer & Hoffmann (2010)
Response 1	**Less unsustainable:** focus on compensation rather than reduction of carbon emissions through allowances for or participation in offsetting projects (e.g. PowerTree and UtiliTree that plant trees as carbon sinks) **Reactive:** with these activities firms in this cluster did not yet really start to adapt to the consequences of climate change and are not well prepared in case of stronger regulation, they do not mention any plans for the future **Focused:** in the *Carbon Disclosure Project* reports very few activities are outlined; focused mainly on one area of carbon compensation such as offsetting projects	(Substituting) Compensator, Preservers	
Response 2	**More sustainable:** aim to reduce carbon emissions, substituting part of fuel consumption with solar, wind, biomass or other renewable energy sources **Proactive**: fully developed an environmental management system; prepared carbon inventories, conducted energy assessments and identified improvement opportunities relatively early on **Integrated:** carried out a wide range of operational activities including making changes in the products or input specifications to reduce their emissions, substituting a part of their fuel consumption with solar, wind, biomass or other renewable energy sources etc.; engaged actively with external stakeholders (e.g., regulatory bodies, industry associations, suppliers and research companies) and also participated in voluntary programs	Active	Jeswani et al. (2008)
Response 3	**More sustainable:** aim for energy efficiency and to reduce carbon emissions in the long-run **Proactive:** not the first movers but try to follow the leaders	Emerger	

	Focused: no company-wide management system, but have not necessarily used external certificates, are aware of their energy-efficiency options but actions are generally limited, prepare carbon inventory, benchmark emissions, set carbon targets and prepare policy response, they want to do more in the future, yet not many measures to actually reduce emissions		
Response 4	**More sustainable:** aim for energy efficiency and to reduce carbon emissions in the long-run **Reactive:** most environmental and energy management activities in early stages **Focused:** no company-wide management system; only internal activities such as better housekeeping for internal carbon emissions reduction, encouraging employees to take initiatives to reduce energy consumption, and focusing on energy-efficiency projects with low cost but relatively high impact	Beginner	
Response 1	**Less unsustainable**: unconcerned or apathetic about environmental issues and regulations; management with a low level of awareness of environmental issues and climate change impacts; few activities and no target to reduce carbon emissions **Reactive:** few activities yet required for reducing carbon emissions such as monitoring, preparing inventory of carbon emissions, etc. **Focused**: not involved in external activities but only in some internal activities for energy efficiency, mainly to cut costs	Indifferen t	
Response 2	**More sustainable**: focus on maintaining and enhancing their competitiveness in their current markets; need to constantly monitor and analyze climate change issues; very strategic in addressing the challenges posed by climate change **Proactive:** already implemented a relatively high level of reduction measures; constantly monitored and analyzed how climate change issues could influence their existing business; made preparations for the future with well developed and implemented plans; achieved a mature state of organizational change **Integrated:** high scores on carbon-related activities such as emissions reduction commitment, product/process improvement, and new market/business development; Emergent Explorer mostly focusing on business development and external activities; integrated reward and performance systems of carbon-related issues	All-Round Enhancer All Round Explorer Emergent Explorer	Lee (2012)
Response 3	**More sustainable**: aim to reduce carbon emissions and become more energy efficient; improve products and/or processes; develop products that are more energy-efficient and less carbon-intensive **Proactive:** moderate level of carbon-related activities, such as carbon emissions reduction and process improvement; Cautious Reducer who took initial steps by setting emission targets and implemented carbon reduction measures for specific production processes; acquired labels or certificates for their products before it was required **Focused**: focus on carbon emissions reduction or process management; especially focus on specific production processes within the company or on the activities related to a single product	Cautious Reducer Product Enhancer	

Response 1	**Less unsustainable**: little interest in climate change issues; difficulties considering and implementing activities to reduce carbon emissions, often due to lack of awareness and information **Reactive:** did not seriously take climate change issues into account, even though the business model is energy intensive **Focused**: low scores on carbon management activities; not involved in external relations to reduce carbon emissions	Wait and See	
Response 2	**More sustainable**: aim to become independent of carbon while trying to substantially reduce carbon emissions; reduce the production of carbon-intensive products; have set targets for carbon emissions reduction based on carbon intensity measures; reducing carbon emissions at the top of the management agenda **Proactive:** go beyond the minimum response of increasing carbon efficiency; given high intensity of carbon emissions, a bold move was needed **Integrated**: high overall levels of carbon emissions-reducing activities; took various measures and engaged with stakeholders by informing them of their efforts to reduce carbon emissions; activities to reduce the production and sales of carbon-intensive products; activities to foster independence from carbon emissions	Emission Avoiders	Sprengel & Busch (2010)
Response 1	**Less unsustainable**: a minimum level of response; no strategic goals to substantially reduce or become independent of carbon emissions in the long run; mostly not orientated on carbon intensity measures; no reduction of the production of carbon-intensive products **Reactive:** low stakeholder pressure, or trying to reduce it, so no proactive engagement in reducing carbon emissions; Pressure Managers tried to explore new markets with lower stakeholder pressure instead of reducing carbon emissions; likely to be strongly affected by carbon-related regulations in the future **Focused**: activities, if any, to engage with stakeholders, such as engagement in the political process in order to influence possible future regulations (especially the regulation shapers)	Minimal-ists, Regul. Shapers, Pressure Managers	

Paper II

HOW COSTS SHAPE ATTENTION AND SEARCH: AN EXPERIMENTAL STUDY ON THE PROCESS OF SEARCH

with Stephan Billinger

HOW COSTS SHAPE ATTENTION AND SEARCH

AN EXPERIMENTAL STUDY ON THE PROCESS OF SEARCH

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Abstract

We use a laboratory eye-tracking experiment to examine how three different distributions of cost shape individual attention and search: Cost that one individual has to bear privately, cost that is shared with others and cost that another person has to bear. We find that individuals avoid costly search alternatives and narrow their search when they have to bear their own cost, as well as when costs are shared with other individuals. In addition, when facing own or shared cost, individuals whose attention is guided by a performance focus search significantly less exploratively. Overall our results suggest that costs that entail a private component shape attention and search. We discuss implications for organization design and management theory.

Keywords: search, attention, exploration-exploitation, experiment, eye-tracking

INTRODUCTION

How organizations facilitate and guide the search of their organizational members is crucial for value creation. Specific performance incentives are effective (Gneezy, Meier, and Rey-Biel, 2011) since they significantly alter search to become more explorative or exploitative. At the same time, performance incentives can easily also have detrimental effects on an organization if they are vague or unsuitable within a given context (Baumann and Stieglitz, 2014; Ederer and Manso, 2013; Lee and Puranam, 2017). Existing research on performance incentives largely distinguishes between no, low and high incentives. However, the role of cost, which resembles a close neglected sibling of incentives, constitutes a defining economic baseline of strategic choice in organizations (Simon, 1947) and is currently not well understood, especially in empirically grounded investigations of search. Modeling work has convincingly shown that cost can structurally guide decision-making, for example when interdependencies exist between decision-makers (Siggelkow and Rivkin, 2006) and substitution (and not complementary) effects occur between choices (Siggelkow, 2002). How this happens, and what the role of cost is, has not yet been studied and we, therefore, ask: How do costs shape individual search?

For individual decision-making and search in organizations, cognition is critical (Gavetti and Rivkin, 2007; Schilling, 2018) and, surprisingly, extant research has largely black-boxed the actual search process (Baumann, Schmidt, and Stieglitz, 2019; Posen, Keil, Kim and Meissner, 2018). Especially for search processes in which information is present, the cognitive process of attention accounts for a large part of choice variance (Kahneman and Tversky, 1973; Weber and Johnson, 2009). Studies building on the attention-based view (Ocasio, 1997) illustrate that managerial focus of attention influences managers' strategic choices (Nadkarni and Barr, 2008), which leads to organizational-level outcomes such as market-entry (Eggers and Kaplan, 2009; Li *et al*., 2013) or positive effects on performance (Singh and Terwiesch, 2011; Woolley, 2011). Yet, on the level of the individual decision-maker, most prior empirical studies base their measures of attention on interviews (Dahlander, O'Mahony, and Gann, 2016) or annual reports (Maula, Keil, and Zahra, 2013), both of which are self-reported. While these studies provide valuable insights into attention patterns in different empirical settings, they do not provide a systematic micro-level account of attention in search processes.

Using a laboratory eye-tracking experiment, we build on a combinatorial multi-attribute decision task using the Alien Game (Billinger, Stieglitz, and Schumacher, 2014) in which six binary choice attributes jointly create a performance outcome. To examine the influence of different distributions of cost, we build on the economic literature which suggests that differences occur depending on whether costs appear to the decision maker or other individuals (Bénabou and Tirole, 2011) and whether costs are concentrated on one person or diffused (i.e. shared) among several people (Bartling, Valero, and Weber, 2017). Building on these two conceptual distinctions, we establish three treatment groups, in which selecting one particular choice attribute is associated with (a) private cost for the decision maker (Own Cost), (b) costs shared among all participants from the experimental session (Shared Cost), (c) cost borne by one other random participant from the experimental session (Other's Cost), or (d) no cost (Control). Eye-tracking technology allows for the observation of individual attention allocated to the choice attributes and to performance feedback as a direct and objective measure. 113 participants were randomly assigned to the treatment groups, participated in the experiment over 12 rounds, and were incentivized financially based on the highest achieved performance.

Our results show that individuals avoid the costly choice attribute in their search process the more they have to bear the cost privately. Further, we analyze the search process itself and find that individual attention to performance and choices shapes search decisions. More specifically, individuals who are exposed to cost that they have to bear alone (Own Cost), pay less attention to costly search alternatives. Individuals exposed to private cost (i.e. Own and Shared Cost) search less exploratively and having a performance focus facilitates a less explorative search.

We contribute to the literature on performance incentives that differentiates between the effects of no, low, and high incentives (Baumann and Stieglitz, 2014; Lee and Puranam, 2017; Zenger and Lazzarini, 2004), by demonstrating how cost guides behavior. Secondly, by showing that individuals do not only use costly alternatives less often but also pay less attention to these alternatives, our results contribute to the literature on managerial attention (Eggers and Kaplan, 2009; Li *et al*., 2013; Maula *et al*., 2013; Walrave *et al*., 2017). Third, we contribute to the debate on individual-level search (Audia, Locke, and Smith, 2000; Vuculescu, 2017) and on how organizations may shape individual search (Baumann *et al*., 2018; Lee and Meyer Doyle,

2017). If organizations introduce private costs, individuals search less exploratively, which is relevant for avoiding the trap of excessive exploration (Levinthal and March, 1993) and suggests that introducing cost shapes the process of search and attention therein.

The remainder of the paper is structured as follows: In section 2, we review the related literature and develop our hypotheses. The experimental design is outlined in section 3 before the results are presented in section 4. In section 5, we discuss our results and their potential implications for practice and research.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Search in organizations

Search is of great importance for organizational survival as it facilitates adaptation to changing environments (Cyert and March, 1963; March and Simon, 1958) by adjusting to performance feedback (Levinthal and March, 1981) and fostering organizational learning (e.g. Baum and Dahlin, 2007; Greve, 2003). The literature highlights the role of individuals for organizational search activity (Maggitti *et al*., 2013; Mom *et al*., 2009; Raisch *et al*., 2009). Search activity may be classified into broad or narrow search: making marginal changes compared to the status quo refers to narrow search or exploitation while making changes to several decision attributes refers to broad search or exploration (Gavetti and Levinthal, 2000; Stuart and Podolny, 1996). Narrow vs broad search can be measured using search distance, i.e. the number of attribute changes between the best performing configuration and the current configuration (Hamming, 1950). Experimental research on individual search has shown that positive performance feedback narrows down the search to the neighborhood of an existing alternative, whereas negative performance feedback promotes progressively more exploratory search (Billinger *et al*., 2014; Tracy *et al*., 2017; Vuculescu, 2017).

If search leads to failure, organizations may become trapped in excessive exploration (Levinthal and March, 1993), as failure leads to additional search for new technologies, and a subsequent increase in the risk of failure (Maslach, 2016). This excessive search or over-exploration mostly occurs in complex environments, in which innovative firms keep searching for new products without fully exploiting their existing competencies (He and Wong, 2004). Organizations may, therefore, regulate over-exploration to prevent situations in which unsuccessful exploitation leads to excessive risk-taking. This can, for example, be regulated by

introducing social comparisons between business units which may have a balancing effect and thereby reduce the risk of excessive exploration (Baumann *et al*., 2018). Similarly, one would expect that cost might help to prevent over-exploration if individuals have specific information about the cost of their decision – either in terms of consequences for themselves or consequences for others in the organization. In other studies, it has been shown that cost can structurally guide decision-making at the organizational-level (Siggelkow and Levinthal, 2003). In a process of organizational adaptation, implementing change and reorganization – for example through different organizational forms – may come at a cost (Siggelkow and Levinthal, 2003; Siggelkow and Rivkin, 2006). These costs structurally guide search behavior on the organizational-level. Individual-level search in organizations is similarly characterized by interdependencies that occur between decision-makers or departments (Siggelkow and Rivkin, 2006). In this paper, we examine how costs shape individual decision-makers' search behavior to determine whether it offers an effective organizational design measure to prevent over-exploration.

The search process and attention

Posen *et al*. (2018) propose in their review on problemistic search that the role of cognition is essential for developing a better understanding of the actual search process and how organizations may affect search behavior. Weber and Johnson (2009) argue that, especially for decisions from description where the decision maker is explicitly provided with all relevant information, attention is of crucial importance. The concept of attention has a long history in organizational research (March and Simon, 1958; Simon, 1947). Prior research on attention suggests that attention will typically be directed towards tasks that are directly related to the goals that are defined by the organization or an individual (Corbetta and Shulman, 2002; Ocasio, 2011). Given the processing limitations of bounded rational individuals, selectivity is a central component of goal-directed behavior (Weber and Johnson, 2009). If attention is more rational, decisions in organizations are affected by the way decision makers selectively and strategically attend to alternatives and the consequences of their actions (March, 1994). Most research on attention in organizations invokes top-down processes driven by goals (Cyert and March, 1963; Greve, 2003b), identity (Hoffman and Ocasio, 2001) or cognitive models (Kaplan, 2008) to explain behavior.

A growing strand of literature examines individual attention in organizations. These studies often measure attention indirectly by analyzing CEOs' communication in letters to shareholders (Eggers and Kaplan, 2009; Yadav, Prabhu, and Chandy, 2007), or by analyzing the centrality of a concept in annual reports (Nadkarni and Barr, 2008; Walrave *et al*., 2017). Another set of studies measures attention based on interviews, for instance, by asking decision-makers where and how to search for information to develop new products (Li *et al*., 2013), or how much attention is allocated to certain organizational units (Bouquet and Birkinshaw, 2008). By analyzing how organizational members interact with internal and external sources, Dahlander *et al*. (2016), find that how individuals allocate their attention to search activities can be critical for innovation outcomes. Of particular interest for this study is the analysis of Maula *et al*. (2013) on how inter-organizational relationships guide managerial attention to or away from technological discontinuities, as we are interested in how inter-organizational interdependencies guide attention.

The existing studies have made significant progress in showing that attention plays an important role in managerial decisions in organizations. However, extant research heavily relies on self-reported measures of attention from interviews, surveys or annual reports. Furthermore, it often equates positive performance with attention, while neglecting attention given to alternatives that were not selected or that turned out to be unsuccessful. Attention is also often defined after a decision was taken, which neglects the attention employed during the process of search and actual decision-making. As a result, we know little about the attention that is given to alternatives before they were chosen and, more generally, the underlying mechanisms concerning the allocation of attention and the corresponding search behavior. In our study, we wish to complement existing research using an approach that alleviates some of these concerns. We are particularly interested in how attention helps not only to explain, which attributes are selected, but also the allocation of attention during the search process.

Hypotheses

We aim to examine how organizations may shape individual search by distributing cost differently. Search in organizations is characterized by interdependencies that occur between decision-makers or departments (Siggelkow and Rivkin, 2006). The organization provides the individual with the fundamental premise that all decisions have to be oriented towards

organizational objectives (Simon, 1947). Simon (1947) emphasizes the criterion of efficiency to be the most relevant for organizations, and he points to "the cost element in decisions" (p. 251). In our study, we, therefore, examine how costs shape attention and search.

To improve performance, individuals may avoid costly choice alternatives as costs have a direct negative impact on performance (Rothschild, 1974; Stigler, 1961). Costs have been shown to prevent individuals from neglecting specific alternatives, e.g. in contexts such as consumer decisions (Brynjolfsson, Hu, and Simester, 2011). However, we know little about (a) how costs shape individual decision making in an organizational setting, where costly interdependencies exist between individuals, and (b) the role of attention in this process. We hypothesize that costs lead individuals to consider costly choice alternatives less in their search and to pay less attention to them.

H1a: Individuals exposed to cost consider costly choices less often in their search decision compared to the control group.

H1b: Individuals exposed to cost pay less attention to costly attributes in their search decision compared to the control group.

Cost may affect either the decision maker directly or other individuals, depending on the interdependence between organizational members. Simon (1947) argues that there might also be costs for the community, all of which can be characterized by different ways of distributing cost. Regarding individual behavior, the economic literature suggests that whenever others have to bear the cost, moral considerations and moral identity largely shape behavior (Bénabou and Tirole, 2011). Bartling, Valero, and Weber (2017) argue that it may influence the decision maker whether a negative effect affects one person in a concentrated way or if cost is shared and diffused among several organizational members. We build on these two conceptual distinctions, specifically whether costs appear to the decision maker or others (Bénabou and Tirole, 2011) and whether costs are concentrated or diffused (Bartling *et al*., 2017). Thus, we aim to observe whether (a) private versus other's cost and (b) concentrated versus diffused cost shape attention and search. We manipulate the distribution of cost by whether the decision maker bears cost privately and concentratedly (Own Cost), whether costs are diffused and shared among all participants from the experimental session (Shared Cost), or whether one other random participant from the experimental session has to bear it (Other's Cost). We hypothesize that the

extent to which costs affect private earnings will influence an individual's attention and search behavior:

H1c: The more individuals have to bear concentrated cost privately, the less attention they pay to costly choices and the less they consider costly choices in their search decision.

After examining how the distribution of cost influences the selection of costly attributes, we are further interested in whether the level of exploration is affected as well. We measure exploration as search distance, i.e. the number of attribute changes compared to the most successful (Hamming, 1950). The above argument suggests that choice alternatives that include a costly choice attribute are considered less by individuals, who then develop search strategies based on alternatives without the costly attribute. This leads to a limited choice set, and the search space is reduced, which may hinder more a distant search [1]. Further, costly search, which exists, for instance, when substitutive interactions occur (Siggelkow, 2002), might make individuals stick closely to what was successful in the past, refrain from more distant choice alternatives and engage in more local search. We are interested in whether cost thereby constitutes a measure to prevent over-exploration. In a first step, we aim to test whether individuals that are exposed to cost search with a lower average search distance. Further, we would like to understand the role of attention in the search process. Goal-driven attention directs attention towards choice attributes with higher task relevance and impact on positive outcome (Meißner and Oll, 2017; Ocasio and Joseph, 2018). We hypothesize that paying more attention to performance feedback, which we refer to as having a performance focus, is associated with a lower search distance for individuals exposed to cost. In terms of search behavior, one would then expect that search is less explorative, thereby preventing possible over-exploration if costs are prevalent and if these costs have to be carried privately:

H2a: Individuals exposed to cost have a lower average search distance compared to the control group.

H2b: Individuals exposed to cost have a lower average search distance when having a performance focus compared to those without performance focus.

[1] If one choice attribute is avoided, the remaining search space is reduced. In our setting, six symbols allow for a total of 64 combinations and 32 combinations when only five symbols are used.

Again we build on the two conceptual distinctions, namely whether costs appear to the decision maker or to others (Bénabou and Tirole, 2011), and whether costs are concentrated or diffused (Bartling *et al*., 2017). Building on our three treatments (Own Cost, Shared Cost, and Other's Cost), we expect that individual search decisions are influenced by the distribution of cost in distinct ways, i.e. the more the individual has to bear the cost privately and the more concentrated the costs are, the less the individual explores:

H2c: The more individuals have to bear concentrated cost privately, the lower their average search distance and the lower their average search distance when having a performance focus.

EXPERIMENTAL DESIGN

Experimental Setup

Our goal is to examine how costs shape individual attention and search in an organization. To study the search process, the experiment builds on combinatorial multi-attribute decision-making using the Alien Game (Billinger *et al*., 2014). Subjects are engaged in a product design task in which multiple product attributes are combined into a product configuration. The payoffs for each possible product configuration are generated based on the NK model (Levinthal, 1997), thereby creating performance landscapes that subjects can explore through experiential search. Participants are asked to design a painting for an alien, i.e. a customer with unknown art preferences. Every painting is composed of six different geometric symbols representing N attributes (N=6) that the individual can freely select or choose not to select. We further set the task complexity (parameter K – it regulates the ruggedness of the performance landscape) to medium-low (K=2), and we hold the number of choice attributes (parameter N) constant[2].

A laboratory experiment enables us to measure attention directly and objectively by means of an eye-tracking device and thereby elicit the cognitive process of attention from a decision made in the search process. The experimental interface was specifically developed to facilitate the measurement of attention with eye-tracking devices. In the experimental task,

[2] We use one NK landscape for all treatments: It has one global maximum, one global minimum, two local peaks, two local minima; values are drawn from a uniform distribution values between 0 and 1, and are multiplied with a multiplier (17.68), which the participants do not know; they also do not know the performance of the global maximum. The costly attribute is interdependent with non-costly choice attributes.

participants saw a screen with six geometric symbols that were arranged vertically in a 6-cell column. Each geometric shape could be toggled on or off, thereby making a binary choice for each attribute; the set of all six choice attributes in one column constituted a multi-attribute decision (i.e. a painting for the alien). The entire search space consisted of 26 = 64 combinations, out of which each participant could only sample a subset over 12 rounds. In the task setting, there was free exposure time, and there was no limit to how many symbols could be changed within one round. In addition, the screen always displayed all previous combinations including the payoff that was generated with prior combinations. The payoff was shown in experimental currency units (Token). A screenshot of the interface can be found in the instructions (Appendix).

Treatments

In the treatment groups, we manipulate the distribution of cost for the usage of one particular choice attribute. One of the six choice attributes is associated with a cost. We aim to observe whether differences in (a) private versus others cost, and (b) how concentrated versus diffused cost shape attention and search. We manipulate the distribution of cost by whether the decision maker bears cost privately and concentratedly (Own Cost), whether costs are diffused among all participants from the experimental session (Shared Cost), or whether one other random participant from the experimental session has to bear it (Other's Cost):

Table 1 Treatment Groups and number of subjects

Usage of costly attribute creates cost for the participant	Usage of costly attribute creates cost for all other participants	Usage of costly attribute creates cost for one other random participant	Control Group (a costly attribute does not exist)
[own cost] 28 subjects	**[shared cost]** 28 subjects	**[others cost]** 30 subjects	**[control]** 27 subjects

While performance feedback is only known ex-post to the decision, costs are known ex-ante to the decision and should, therefore, influence attention. The cost will occur at the moment of choosing the particular costly attribute. Configurations including the costly choice attribute

on average perform lower than configurations without the costly attribute. The costly choice attribute is needed for the best performing configuration.

Eye tracking

The eye tracking setup and the experimental design followed the standards in the field (Orquin and Holmqvist, 2018). Visual attention plays a crucial role in decision-making since it limits the information processed for a given decision to the fixated stimuli (Orquin and Mueller Loose, 2013). This allows for the accurate tracking of attention relevant in a combinatorial multi-attribute search task. In most of the research studying the psychological construct of attention and counting the number of fixations to quantify attention, the analysis is based on the "eye-mind assumption" (Just and Carpenter, 1980; Orquin and Holmqvist, 2018). This assumption posits that information that is seen is also cognitively processed, which is the case in financially incentivized choice tasks that have a limited duration. Our study also builds on this assumption.

Eye movements were recorded with a remote binocular Tobii Pro 32-60 eye tracker using a screen with a resolution of 1920 x1200 pixels and a size of 20.3x12.8 inches. The tracking distance was 50-80 cm. Data was gathered at a sampling rate of 60 Hz (about 16.67 ms) with an accuracy of 0.4 degrees and a precision of 0.34 degrees; a standard five-point calibration was applied, and a maximum of two recalibrations was conducted. No chin rest was used. Fixation durations exceeding 60 ms were included in the analyses (Komogortsev *et al*., 2010; Salojärvi *et al*., 2005). To analyze the length of the fixation duration on a specific stimulus, non-overlapping areas of interest (AOIs) were defined prior to data collection based on the information about performance and attribute choices that were displayed on the experimental screen in each round (a screenshot of the software can be found in the experimental instructions in the Appendix).

Data

The experiment took place in a university computer laboratory with 113 participants[3]. The subjects were randomly distributed across the three experimental treatment groups and the control group, with the latter having subjects engage in search without bearing any cost. Every

[3] For the recruitment of participants the software h-root (Bock, Baetge, and Nicklisch, 2014) was used, the software of the experiment is z-tree (Fischbacher, 2007).

participant engaged with the 12-round experiment once and participated in one session. The instructor read out loud the instructions in the laboratory. To ensure that subjects understood the experimental task, we used comprehension questions that had to be answered correctly before proceeding with the experiment. The task was followed by a questionnaire with demographic and control questions. Several instructors were in the room to help individual requests to ensure that participants could raise questions without distracting other participants. The instructors then presented the Alien game, information on the number of trials and sessions, standard rules for behavioral experiments and information on the eye tracking procedure.[4] At the beginning of every session, an instructor described the general task. All of the subject's decisions during the experiment could determine their payout since final earnings were based on the best performing round in all treatments and the control group. Subjects' payoffs in Token were converted to Euro based on a known exchange rate of three Tokens being equal to one Euro. While this conversion rate was stated in the instructions, the value of the global maximum was not communicated to eliminate reference points and facilitate search under uncertainty. The experiment lasted about 45 minutes (including check-in and check-out) and on average participants earned 10.23€. 54 (48%) of the participants were male; the average age was 25.34 years. For 67 participants the high school degree was their highest achieved degree, 43 held a bachelor's or master's degree, and 3 held 'other degrees'.

Variables

All attributes, including the costly attribute, can be freely chosen in every round. Using Costly Attribute is a binary variable and can take the values zero and one. It describes the costly attribute usage in the current round. Attention to Costly Attribute is a relative measure of the visual fixation duration on the costly attribute in relation to the visual fixation duration on all other attributes in that round (all measured in milliseconds). The Performance Focus measures the attention paid to performance feedback in relation to the attention paid to all choice attributes. In addition, for H2b, we distinguish between individuals with a performance focus and those with a choice focus using a median split: Those above the median are referred to as individuals having a Performance Focus and the others as having Choice Focus. Search Distance

[4] Subjects with corneal irregularity or other eye disease as well as with diopter strength exceeding +/- 2.8 were excluded from participating.

measures the number of attribute changes between the best performing configuration and the current configuration. It resembles the Hamming distance (Hamming, 1950) and has discrete values ranging from one (i.e. change of one attribute) to six (i.e. change of all attributes). For each trial, the search distance allows a clear analysis of search behavior, with low search distances resembling narrow search and high search distances resembling broad search. The control variable Round is the given trial in which a participant makes the decision. Age is the subjects' age measured in years. Gender is a dummy variable, which is equal to one if a subject is male. Risk is the subjects' risk tolerance, measured based on a lottery; the values lie between 1 and 10, where 10 is risk seeking (Holt and Laury, 2002). Table 2 reports the summary statistics.

Table 2 Summary Statistics of Participants

This table contains the summary statistics of the experimental subjects. Age is subjects' age, measured in years; Male is a dummy variable which is equal to one if a subject is male; Risk is subjects' self-assessment of their risk tolerance in general matters, measured on a scale from 1 (lowest) to 7 (highest); HL switching point is the switching point from the Holt and Laury (2002) lottery task.

	Mean	**Min**	**Max**
Male	0.48	0.00	1.00
Age	25.35	18	58
Risk	4.02	1	7

RESULTS

This section reports our main results and is organized along our hypotheses. First, we test whether any and if so, which, type of cost distribution leads individuals to use the costly attribute less often. Then, we study whether individuals consider certain choice alternatives while neglecting others by paying less attention to the costly attribute/choice. In a second analysis, we examine how the search distance is influenced by cost distribution, and whether the focus of attention helps to explain differences in search distance.

Costly Attribute

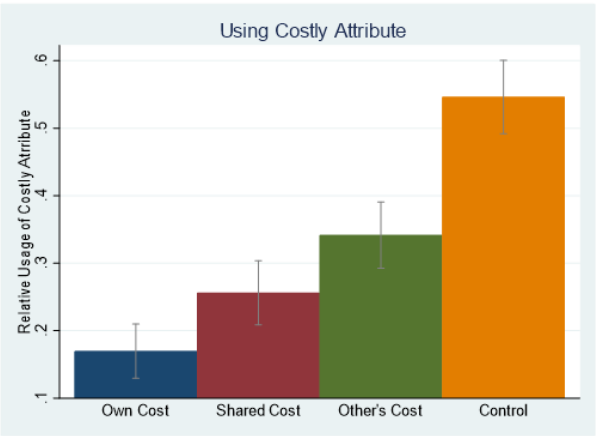
We examine whether individuals exposed to cost consider costly search alternatives less often compared to the control group. Figure 1a displays the difference in mean of participants' usage of the costly choice attribute. In line with H1a, we observe that in the control condition, where no cost is induced, the attribute is used on average in 6 out of 12 rounds (i.e. 50%), which is

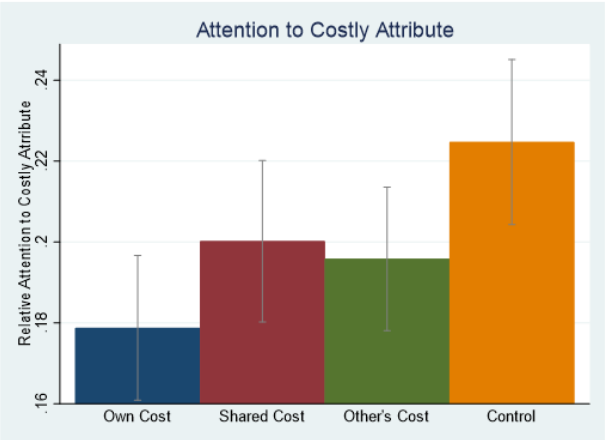
expected for the control group. The treatment conditions in comparison indicate a significantly lower mean for Using Costly Attribute. While individuals use the attribute in about 34% of the cases on average when others have to bear the cost, they use it in an average of 25% of the cases when cost is shared and only in around 16% of the cases when they have to bear the cost themselves. An ordinary t-test with a confidence interval of 95% shows that the difference between the control group and each of the treatment groups is significant (with $p<0.001$). Accordingly, subjects use the costly attribute less often, the more they have to bear the cost themselves which is in line with H1c.

Figure 1

Figure 1 a and b, display differences in mean between the treatment and control conditions at the corresponding confidence interval (95%). There is a total of 1.356 observations; the number of observations is 336 for Own Cost, 336 for Shared Cost, 360 for Other's Cost and 324 for the Control group. Figure 1a) presents the percentage of how often the costly attribute was on average used in 12 rounds. Figure 1b) presents the attention paid to the costly attribute, which is relative to the attention to all attributes.

a) Using of costly choice attribute ***b) Attention to costly attribute***





We further examine whether individuals exposed to cost pay less attention to costly choices compared to the control group. Figure 1b shows the differences in mean of Attention to Costly Attribute with the first three bars representing the treatment groups (Own Cost, Shared Cost, and Other's Cost) and the last bar representing the control condition, i.e. the condition in which the attribute does not induce any cost. Attention to Costly Attribute reflects the mean in fixation duration on the costly attribute in relation to the mean in fixation duration on another average attribute. We observe that while subjects in the control group focus around 23% of their attention on that attribute, subjects that have to bear the cost themselves (Own Cost) focus only

18% of their visual attention on the costly attribute. In the treatment group in which another random participant has to bear the cost (Other's Cost), participants also pay significantly less attention to the costly attribute ($p<0.0357$). When costs are shared (Shared Cost), participants pay less attention to the costly attribute, but based on an ordinary t-test with a 95% confidence interval the difference to the control condition is insignificant ($p< 0.0927$). Further, as a test of robustness, we ran an analysis of power and the Mann-Whitney U test. Both results are presented in Table 4.

Table 4 Treatment Testing: non-parametric test

Using the Mann-Whitney test, we do find a significant difference, between the first treatment group (Own Cost) and the control group indicated by the p-value of 0.0011. The p-value of 0.0191 (Shared Cost) and 0.027 (Other's Cost) indicate that there is no evidence of a difference in mean of attention to costly attribute between these two treatment groups and the control condition.

	Mann-Whitney test (Using Costly Attribute)	Mann-Whitney test (Attention to Costly Attribute)
Own Cost vs. Control	0.0001	0.0011
Shared Cost vs. Control	0.0001	0.0995
Other's Cost vs. Control	0.0001	0.0552

To test H1a and H1b in more detail, we examine whether cost lead participants to use certain choice alternatives less often using a probit model with Using Costly Attribute as the dependent variable. Table 5a presents the coefficients and robust standard errors in parentheses. Model (1) Own Cost, (2) Shared Cost, and (3) Other's Cost demonstrate a negative, statistically significant effect of all (1) to (3) treatments on Using Costly Attribute. The marginal effects for all three treatments (Own Cost, Shared Cost, and Other's Cost) are presented in Table 5b and present the predicted probability of using the costly attribute when cost is present. These results are very similar to the coefficients we saw in the parametric t-test above, now controlling for several covariates. The predicted probability of using the costly attribute is 17.18 % (Own Cost), 28.47% (Shared Cost), and 35.08% (Other's Cost) compared to around 50% without cost. This again demonstrates that the more an individual is exposed to private cost, the less likely the individual is to use the costly attribute which further supports H1c.

Table 5 Using Costly Attribute

*Table 5a contains the coefficients and robust standard errors (in parentheses) of probit regressions in which the dependent variable Using Costly Attribute is binary. Own Cost, Shared Cost and Other's Cost are the dummy variables, which are equal to one if individuals are treated with cost. Round is the given round, in which a participant makes the decision, and aims to control for different behavior over the time of the session. Age is the subjects' age, measured in years. Gender is a dummy variable, which is equal to one if a subject is male. Risk is the subjects' risk tolerance measured based on a lottery, the values lie between 1 and 10, where 10 is risk seeking. The amount of observations per treatment group vary, as the size of the treatment groups varies. Standard errors are clustered at the subject level. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.*

VARIABLES	(1) Using Costly Attribute	(2) Using Costly Attribute	(3) Using Costly Attribute
Own Cost	-1.104***		
	(0.162)		
Shared Cost		-0.672***	
		(0.200)	
Other's Cost			-0.531**
			(0.169)
Round	-0.041**	-0.020	-0.023+
	(0.014)	(0.015)	(0.013)
Age	Yes	yes	yes
	Yes	yes	yes
Gender	Yes	yes	yes
	Yes	yes	yes
Risk	Yes	yes	yes
	yes	yes	yes
Constant	-0.144	0.850+	0.371
	(0.528)	(0.510)	(0.411)
Observations	636	624	660

Table 5b reports marginal effects for each treatment group and the predicted probability of using the costly attribute when cost is present.

Treatment	Using Costly Attribute	Observations
No Cost	.5542436	636
Own Cost	.171809	
No Cost	.5236369	624
Shared Cost	.2846757	
No cost	.5543486	660
Other's Cost	.3507713	

Next, we study the underlying search process using Attention to Costly Attribute as the dependent variable. Table 6 contains the coefficients and robust standard errors in parentheses of a standard OLS regression. Own Cost, Shared Cost and Other's Cost are dummy variables,

which are equal to one if participants are treated with this cost and zero for the control group. The results show that Attention to the Costly Attribute is lower if individuals are exposed to cost compared to the control group. Looking at the p-values, we observe that the difference is only significant at a 95%-level for Own Cost (0.009) and Other's Cost (0.0357), while the difference is only marginal for Shared Cost (0.0927). Note that by using a relative measure of attention (see above), we account for potential differences between the treatment groups in the overall time of fixation duration. Thus, cost shapes attention only if participants have to bear it privately. These results provide evidence in line with hypothesis 1a, 1b and 1c as all different treatment variations (Own Cost, Shared Cost, Other's Cost) lead participants to use the costly attribute significantly less (1a) and pay less attention to the costly attribute (1b). The costly attribute is used less the more individuals have to bear the cost privately, and less attention is paid to it if individuals have to bear the cost themselves (Own Cost) (1c).

Table 6 Attention to Costly Attribute

Table 6 contains the coefficients and robust standard errors (in parentheses) of OLS regressions in which the dependent variable frequency is Attention to Costly Attribute. Own Cost, Shared Cost *and* Other's Cost *are the dummy variables, which are equal to one if individuals are treated with cost. Standard errors are clustered at the subject level. *, **, and *** denote significance at the 10%, the 5%, and the 1%* level, respectively.

VARIABLES	(1) Attention Costly Attribute	(2) Attention Costly Attribute	(3) Attention Costly Attribute
Own Cost	-0.048**		
	(0.016)		
Shared Cost		-0.020	
		(0.023)	
Other's Cost			-0.030
			(0.020)
Round	0.002	0.004*	0.006**
	(0.002)	(0.002)	(0.002)
Age	0.002	-0.001	0.001
	(0.002)	(0.002)	(0.002)
Gender	-0.012	-0.010	-0.011
	(0.018)	(0.022)	(0.020)
Risk	-0.000	0.007	-0.003
	(0.005)	(0.005)	(0.004)
Constant	0.163**	0.184**	0.192**
	(0.056)	(0.059)	(0.056)
Observations	612	580	634
R-squared	0.022	0.020	0.021

Search Distance

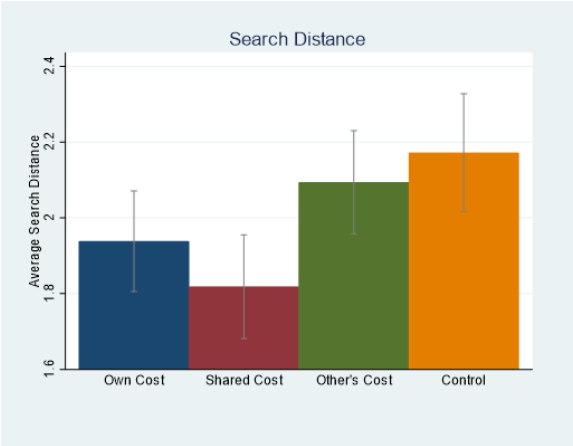
To test H2a, we examine whether individuals exposed to cost show a lower average search distance compared to the control group, and, thus, whether cost may lead individuals to engage less in explorative search. Figure 2 displays the difference in average search distance between the treatments, with a 95% confidence interval. Even though subjects use one out of six choice attributes significantly less in all treatment groups, the search distance is only significantly lower compared to the control group when private costs are present (Own Cost and Shared Cost). As indicated by Figure 2, search distance is significantly lower for Own Cost ($p< 0.0253$) and for Shared Cost ($p<0.009$), while the difference is insignificant for Other's Cost ($p<0.4590$). We thus provide evidence in line with H2a, as search distance is lower when costs are present. We do not find this for the treatment condition Other's Cost, which is in line with the notion that if the individual has to bear cost privately, search distance is lower.

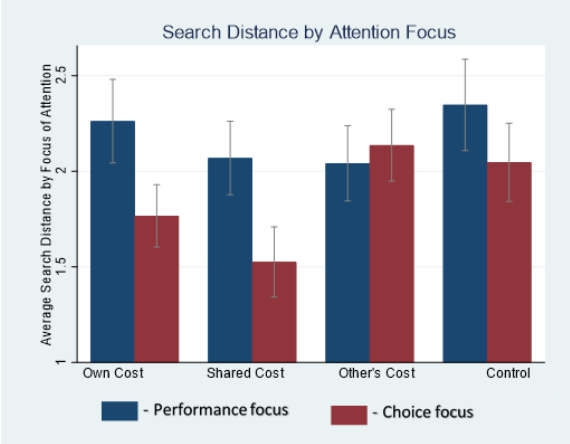
We further study the actual search process by examining whether differences in the focus of attention, i.e. attention to performance feedback vs attention to the choice set (attributes), are associated with lower search distance. First, we analyzed the differences in search distance for individuals paying more attention to performance and those focusing more on the attributes. Figure 3 displays the difference in mean search distance for performance focus (red) and choice focus (blue), each for treatment and control group. The difference in search distance between the performance focus and choice focus groups is significant for the treatments (with $p<0.004$ and $p<0.0001$) in which participants have to bear the cost themselves (Own Cost) or cost is shared among all participants (Shared Cost). For these treatments, paying more attention to performance feedback is associated with lower search distance. For the condition Other's Cost and the control group there is no significant difference ($p=0.4590$) in search distance depending on the performance focus. This provides evidence in line with H2b, as the search distance is lower when participants have a performance focus compared to participants who allocate more attention to the choice set. However, we only find this when private cost occurs. When other individuals have to bear the cost, or if there are no costs, we do not find this effect.

Figure 2 ***Figure 3***

Figure 2 and 3, display differences in mean between the treatment and control conditions at the corresponding confidence interval (95%). The number of observations is 336 (Own Cost), 336 (Shared Cost), 360 (Other's Cost) and 324 (Control), a total of 1.356 observations. Figure 2 presents differences in search distance between treatment and control conditions. Figure 3 presents differences in search distance for different attention focus: blue for a choice focus and red for a performance focus.

Differences in mean in average search distance **Differences in Mean Search Distance with Focus**





In Table 7, we report models with search distance as a dependent variable. We use a Poisson model, as search distance is a count variable and heavily skewed to the left. The independent variable is performance focus, resembling the attention paid to performance feedback. We control for using the costly attribute, as we want to ensure that search distance is not reduced only because one attribute is used less. Further, we control for the highest payoff one achieved in prior periods, as this may influence the search distance, as well as the round in which the participant takes part. Furthermore, as in the previous regression analyses, we control for age, gender, and risk preference. In H2b, we hypothesized that individuals exposed to cost have lower search distance when having a performance focus compared to a focus on the choices. Interestingly, we find that performance focus only has a significant influence on search distance when private costs (Own Cost and Shared Cost) are present (model 1 and 2) and for the overall model 5. For those individuals with a performance focus, the coefficient for search distance was -0.06 (Own Cost) and -0.065 (Shared Cost). In these two treatment conditions, participants whose attention is guided by a performance focus search significantly less exploratively compared to participants whose attention is guided by a focus on the choice set.

Table 7 Poisson Regression with Search Distance as Dependent Variable

Table 7 displays the coefficients and robust standard errors (in parentheses) of Poisson regressions. The model is used, as the dependent variable Search Distance *is a* count variable that is heavily skewed to the left. Search distance refers to the amount of variable changed from the most successful combination. The model 1, 2 and 3 represent the three treatment conditions, model 4 the control condition and model 5 all participants. Using Costly Attribute *is a binary variable Standard errors are clustered at the subject level. *, **, and *** denote significance at the 10%, the 5%, and the 1%* level, respectively

VARIABLES	(1) Search Distance Own Cost	(2) Search Distance Shared Cost	(3) Search Distance Other's Cost	(4) Search Distance Control	(5) Search Distance All
Performance Focus	-0.060*	-0.065*	0.001	-0.015	-0.026*
	(0.025)	(0.032)	(0.007)	(0.019)	(0.012)
Using Costly Attr.	0.030	0.028	0.025	-0.063	0.012
	(0.138)	(0.113)	(0.093)	(0.121)	(0.058)
Highest Payoff	-0.232	0.428	-0.865*	-0.127	-0.052
	(0.531)	(0.630)	(0.337)	(0.330)	(0.291)
Round	0.017	-0.039+	0.026*	0.007	-0.001
	(0.018)	(0.021)	(0.013)	(0.019)	(0.010)
Age	0.007	-0.005	-0.008	-0.006	-0.003
	(0.011)	(0.009)	(0.009)	(0.011)	(0.005)
Gender	-0.196*	0.188	0.112	0.189	0.094
	(0.092)	(0.131)	(0.087)	(0.178)	(0.061)
Risk	-0.041	-0.026	0.013	0.017	0.003
	(0.030)	(0.032)	(0.026)	(0.029)	(0.015)
Constant	0.904	0.803*	1.248***	0.772+	0.767***
	(0.587)	(0.360)	(0.344)	(0.408)	(0.212)
Observations	258	238	283	245	1,024
Deviance	160.3	171.6	169.5	188.1	731.4

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

DISCUSSION AND CONCLUDING REMARKS

How organizations facilitate and guide the search of their organizational members is essential for value creation. Based on an incentivized laboratory experiment, we show that costs shape individual search behavior, as individuals pay less attention to and use costly choices significantly less compared to the control group. Individuals exposed to private cost, i.e. either facing Own Cost or Shared Cost, have a significantly lower search distance. Interestingly, we observe that individuals who are exposed to private costs have a performance focus that facilitates the less explorative search. Paying more attention to performance feedback is, thus, associated with exploitation, which we do not over observe in other settings (Other's Cost and Control). These results suggest that private own cost and shared cost shape attention and search behavior.

The contribution of our findings is threefold: First, we contribute to the literature on performance incentives (Baumann and Stieglitz, 2014; Frank and Obloj, 2014; Lee and Puranam, 2017; Zenger and Lazzarini, 2004), by highlighting that not only incentives but also costs can guide behavior. Individual-level decision-making in organizations often involves interdependencies between decision-makers or departments (Siggelkow and Rivkin, 2006) and critical properties of organizational cost are whether costs appear to the decision maker or to others (Bénabou and Tirole, 2011) and whether they are concentrated or diffused among many people (Bartling *et al*., 2017). We use these two conceptual distinctions of (a) private versus other's costs, and (b) concentrated versus diffused cost for the design of our treatments (Own Cost, Shared Cost, Other's Cost), and compare how these different distributions of cost influence attention and search. Our findings highlight that whether costs affect the decision maker or other individuals is more relevant than whether costs are diffused or concentrated. Thus, similar to incentives systems (Gambardella, Panico, and Valentini, 2015; Obloj and Sengul, 2012), the distribution of cost also necessitates a thoroughly planned design to have the intended effect on organizational members.

Second, by showing that individuals do not only use costly alternatives less often but also pay less attention to these alternatives, our results offer an interesting addition to the literature on managerial attention (Eggers and Kaplan, 2009; Li *et al*., 2013; Walrave *et al*., 2017). Maula *et al*. (2013) have shown that inter-organizational relationships guide managerial

attention to or away from technological discontinuities. Our findings show that costs, as inter-organizational interdependencies, guide attention to and away from certain choice alternatives. Eliciting individual attention thus enables us to suggest a process through which private cost may lead to exploitation. This observation is possible as we use a direct and objective measure for attention (i.e. eye-tracking), and thereby generate insights on the cognitive underpinnings of the decision-making process (Posen *et al*., 2018).

Third, we contribute to the debate on individual-level search (Audia *et al*., 2000) and on how organizations may shape individual search (Lee and Puranam, 2017). As organizations may keep searching for innovation without fully exploiting their existing competencies (He and Wong, 2004), it can be beneficial for organizations to regulate over-exploration at the individual-level (Baumann *et al*., 2018). As we find that individuals with a performance focus engage less in exploratory search if they are exposed to private costs (Own Cost, Shared Cost), we suggest a process in which private cost are associated with exploitation. By introducing cost as an organizational design parameter, we give rise to a discussion with high relevance for research and practice alike.

Our findings give insights into the micro-foundations of search processes and individual decision-making and the role of cost in organizational design. The differences between the treatment groups show that if organizations aim to encourage individuals to consider the cost of their decisions, the decision maker has to bear some cost privately. Organizations are increasingly confronted with the environmental or social impact of their business activities and the need for innovation. On the one hand, if organizations aim for their organizational members to consider potential negative externalities of their decisions, the organizational members need to be confronted with private cost which will hamper search. On the other hand, if organizations aim to foster innovative and explorative ideas, exposing organizational members to cost can lead to getting stuck in local search, especially if the organizational members pay attention to performance feedback.

In many firms, performance evaluations have been challenged, and even a number of Fortune 500 firms have abandoned them altogether. Yet, many consultants and practicing managers also heavily rely on performance evaluations, and there is a fundamental debate concerning their advantages and disadvantages (for a discussion Goler, Gale, and Grant (2016).

Performance evaluations, while having multiple very different effects (Gorbatov and Lane, 2018), introduce a performance focus, which prior research has convincingly shown to raise awareness for outcomes that improve performance on the individual-level (Rosenbloom and Newell, 1981), the team level (Woolley, 2011), the organization level (Argote and Epple, 1990) and even on all three levels combined (Singh and Terwiesch, 2011). Our findings are in line with prior research and point to the importance of cognitive attention-based effects of performance focus that occur for exploration-exploitation behavior.

All research comes with limitations, and one potential limitation of this study is that we analyze individual decision-making processes that may appear problematic as strategy research is primarily interested in organizational-level outcomes (Di Stefano and Gutierrez, 2018). However, individual-level behavior is fundamental as search is eventually carried out, embedded and reproduced by individuals (Maggitti *et al*., 2013). We also contribute to this line of research by using an organizationally highly relevant artefact, namely cost, to motivate our treatment groups. While this current experiment focuses on attention, other channels through which the search behavior is influenced could be further investigated in future studies that aim at testing the influence of cost in an empirical, real-world setting.

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APPENDIX - EXPERIMENTAL INSTRUCTIONS

(translated)

Introduction

Thank you for taking the time to join our experiment. I am leading this experiment and will now guide you through the preparations. Please turn off your mobile phones and other electronic devices now and put them in your pocket. During the experiment, there is an absolute ban on communication. This applies immediately. If you have questions, please hand sign off your cabin. We will come to you to answer your questions. Unfortunately, if you do not follow this rule, we must exclude you from this experiment and all other experiments.

The general explanation for eye tracking:

General Explanation of Eye-Tracking

In this experiment, eye-tracking technology is used to capture their line of sight. Eye tracking is an additional way to collect data that allows us to measure where you are looking at the monitor. The eye-tracking data, like all other data from the experiment, are recorded completely anonymously. Only the data needed to calculate their line of sight is captured. Neither her face nor any other features that could reveal her person are recorded. The measurement is made using the black bar at the bottom of the monitor. For this, your eyes are illuminated with infrared light. This is the faint red light that you occasionally see flashing in the black bar. The illumination of your eyes to measure your line of sight is harmless to health. You can also read this in the consent form that you have. Please read the consent form for eye tracking and sign it. If you have any questions, just let us know and we will come to you. Once you have signed the declaration, please keep it out of the cabin so that we can collect all the consent form. All bows collected and checked. Thank you, all declarations of consent are now available. I will now begin

Alignment and Calibration of the Eye-Tracker

Now we start with the alignment and calibration of your eye tracker. We start with the alignment. You will soon see a window on your monitor. This window displays your eyes as white dots. The goal is to have your eyes positioned in the middle of the window. The bar on the right side of the window, which indicates your distance, should be at 0.5. If you are at a suitable distance from the monitor, this bar turns green. You can move your chair and monitor for alignment. Please make sure that you can still easily reach the keyboard and the mouse If you are aligned, please wait a moment until all participants are aligned. If you need help, just log out of their cabin. We start with the alignment now. *If all aligned:* Thank you very much, now all are aligned correctly. Please stay in this position throughout the experiment so that the eye-tracking measurement can be as accurate as possible. Now we start the calibration for the eye tracking. We ask you to look in the middle of the yellow dot. The yellow dot will appear on your monitor and then jump to four more points on the monitor. We will show you all the calibration points for the sample on your screen. *Test run.* We now start with the actual calibration. For this, we ask you to look in the middle of the yellow dot. *If not all were calibrated correctly.* Some of them could not be calibrated successfully. That is completely normal. Therefore, some of you will now start the second round of calibration. If not all were calibrated correctly. Some of you have not yet been successfully calibrated. That is completely normal.

Thank you, they are now all correctly aligned and calibrated, so we can now start with the experiment. I would like to remind you that you should remain in your current seating position throughout the experiment to produce the best possible measurement results. Thank you and have fun with the experiment!

Introduction to the Experiment

The experiment consists of two independent parts. This experiment serves to investigate individual decisions. Decision situations are simulated in which you can select specific decision variables. The currency in this experiment is "Token". You will receive your payment in euros at the end of the experiment. One euro is equivalent to about 3 Token. The experiment lasts about 45 minutes. If you stop the experiment early, you will not receive a payout. You will receive a payout after the experiment, the amount of which depends on your decisions in the experiment. There is no time limit in both parts of this experiment.

Experimental Task

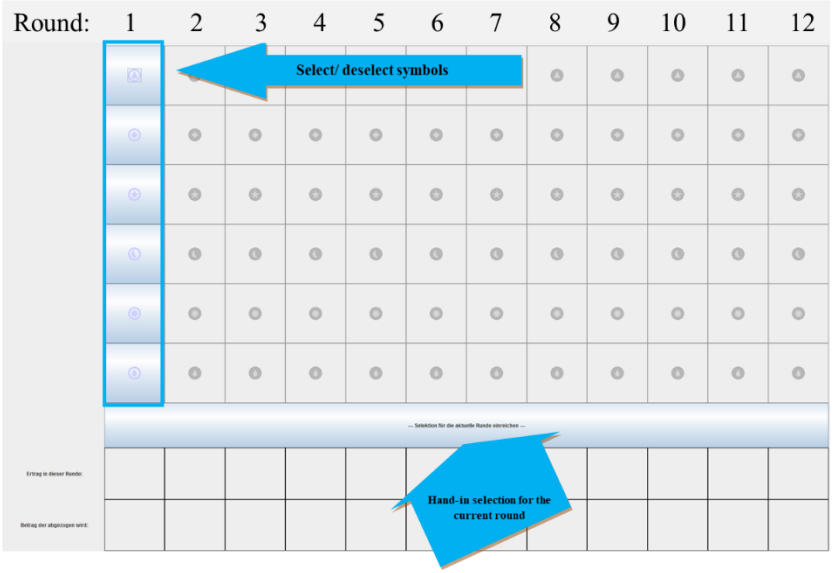
This part of the experiment is relevant to your payout. In this part of the experiment, you complete a total of 12 rounds. In these, your job is to sell a painting to an alien. An alien is a clever creature from outer space. Aliens like paintings with symbols. Aliens are willing to pay different amounts for different paintings. Their task is to create different paintings with different symbols each round. At the end of each round, you will be told what the alien is willing to pay for each painting. This amount is relevant for your later payout. The process is the same in every round:

1) Creation of a painting

At the top of the screen, you will see details of all rounds from 1 to 12. The round in which you are currently located is highlighted and corresponds to one column (in the example below, you would be in the first round). There are 6 different icons that you can use to create paintings. A painting consists of all selected and unselected symbols. You can combine the symbols as you like: in each round, you can select or deselect 0-6 symbols. It is unknown what symbols or combinations of aliens like

2) Submission of the painting

If you have encountered a selection of symbols, i. When you have completed a painting, click on the "Submit selection for the current round" button (see figure below). The return that the alien would be willing to pay for your painting is displayed in the row "Yield in this round". You will only see the yield after you have submitted the selection for the current round. The alien does not negotiate and submitted paintings cannot be withdrawn.
The alien is ready in all rounds to pay the same amount for the same painting. The alien does not change his taste. The paintings of other participants do not affect the income for your paintings.
The highest return you achieve in all 12 rounds serves as the basis of your payout. The proceeds are not added up - the alien buys only a painting.



[Only in the treatment conditions]

3) Cost of creating a painting

The use of the symbol with the shape of a star (the third symbol from the top) will cost one token, which will not be incurred when using the other symbols.

[Treatment 1, Own cost:] The cost that occurs when using the symbol have to be bearded by you personally. In the end, your payout is calculated as follows: From the highest performance, you have earned in the 12 rounds, the accumulated costs are deducted from all rounds.

[Treatment 2, Shared cost:] The cost that occurs when using the symbol are shared among all participants in this session. If other participants use the symbol, their costs are also shared among everyone. Until the end of the experiment, you will not know how often all participants used the costly symbol. In the end, your payout is calculated as follows: From the highest performance, you have earned in the 12 rounds, the accumulated costs of all participants are divided by the number of participants and deducted from the highest return.

[Treatment 2, Other's cost:] The cost that occurs when using the symbol have to be beared by one other randomly chosen participant in this session. The other way round, when the other person uses the symbol, you have to bear her cost. Until the end of the experiment, you will not know how often the other person used the costly symbol. In the end, your payout is calculated as follows: From the highest performance, you have earned in the 12 rounds, the accumulated costs the one participants are divided by the number of participants and deducted from the highest return.

This part of the experiment is not relevant to your payout. After the decisions have been made, you will be asked the final questions. Please answer these at the end of the experiment. Please, press "next" to confirm your entries and go to the next page. Please, remain seated until the experimenter asks you to come to the payout. Now, we would like to ask you to complete the multiple-choice questions on the following page. Please take enough time to answer the questions. Once you have completed this multiple choice test, raise your hand. Your answers will be checked.

Paper III

SOCIAL PERFORMANCE FEEDBACK
AND THE ROLE OF SELF-ENHANCEMENT: AN EXPERIMENTAL STUDY

SOCIAL PERFORMANCE FEEDBACK

AND THE ROLE OF SELF-ENHANCEMENT: AN EXPERIMENTAL STUDY

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Abstract

Performance feedback determines how decision makers in organizations search for new alternatives. To enhance organizational adaptation and performance, organizations may provide individuals not only with their own performance feedback but also with the performance feedback of their colleagues. This paper examines how individuals respond to such social performance feedback and whether the response is different for social performance feedback below or above their own actual level of performance. In a laboratory experiment, this study examines the influence of *high*, *low*, or *no* social performance feedback on an individual's beliefs and decisions. By analyzing the differences in beliefs and the exploration behavior between these three groups, the experiment documents that (a) individuals exposed to social performance feedback above their own performance level form overly pessimistic beliefs about external market conditions and (b) individuals exposed to social performance feedback explore significantly more in good markets than in bad markets, which is more appropriate in this experimental setting. This paper contributes to the literature on intra-organizational comparison by documenting an asymmetric effect of high and low social feedback on individuals' beliefs about external market conditions. Furthermore, by providing empirical evidence that individuals attribute their relative failure to external market conditions in the *high* social performance condition, it also contributes to the literature on self-enhancement.

Keywords: performance feedback, intra-organizational comparison, social aspirations, exploration-exploitation, experiment

INTRODUCTION

Finding the right level of exploration is one major challenge in organizational adaptation and survival. As organizations adjust their behavior to past performance, performance feedback is an important antecedent influencing exploration (Cyert and March, 1963; Gavetti *et al.*, 2012). Theoretical research suggests that not only own (historical) performance feedback but also (social) performance feedback from colleagues shapes overall organizational adaptation and performance (Baumann, Eggers, and Stieglitz, 2018). While existing research has convincingly shown the relevance of such social performance feedback for organizational adaptation, the role of individual factors is often beyond the scope of theoretical modeling. This experimental study provides empirical insights into how social performance feedback impacts individuals' beliefs and exploration decisions and whether social performance feedback above or below one's own actual level of performance affects individuals differently.

Individuals in organizations make decisions that are essential for organizational adaptation (Maggitti, Smith, and Katila, 2013). Compared to organizations, for individual decision-making, psychological factors play a role which needs to be considered to understand the aggregated behavior at the organizational level (Posen *et al.*, 2018). In the context of social performance feedback, psychological factors, such as motives, influence how individuals assess performance feedback (Jordan and Audia, 2012). While the interpretation of performance feedback is essential to the resulting behavior, our understanding of the process is rather limited.

Existing research suggests that providing individuals with social performance feedback encourages competition (Charness, Masclet, and Villeval, 2013; Kilduff, Elfenbein, and Staw, 2010). While competition can increase effort and performance (Kuhnen and Tymula, 2012; Stark and Hyll, 2011), it may also have potentially negative effects on overall performance (Kacperczyk, Beckman, and Moliterno, 2015; Obloj and Zenger, 2017). Baumann *et al.* (2018) highlight a beneficial effect of social performance feedback due to the balancing of exploration and exploitation at the organizational level. Providing organizational members with social feedback, classifies them into groups above and below average social feedback. Based on the assumption that receiving above-average social feedback leads to exploitation and below-average social feedback to exploration, the activities balance out at the organizational level.

However, especially if individuals' social performance feedback indicates below-average performance, motivation problems may determine their decision to explore new alternatives.

The literature on individual motivations in the context of learning from performance feedback highlights the importance of self-enhancement (Audia and Brion, 2007; Greve, 1998; Jordan and Audia, 2012). Self-enhancement reflects a desire to see oneself in a positive light (Audia and Brion, 2007; Jordan and Audia, 2012). While mainly rooted in psychological literature (Baumeister, Heatherton, and Tice, 1993; Dunning, Meyerowitz, and Holzberg, 1989; Festinger, 1954; Wood, 1989), it has, similarly, been shown in the economic literature that concerns about self-image largely determine individual behavior (Benabou and Tirole, 2002; Köszegi, 2006; Kuhnen and Tymula, 2012). While in classic organizational theory, the process of performance assessment is based on the assumption that the primary motive of decision makers is to self-assess their own performance accurately (Cyert and March, 1963), self-enhancement broadens the perspective on how individuals respond to feedback. Greve (1998) suggests that if decision makers can compare their performance feedback to two different sources, they may follow a self-enhancing rule by choosing to use the lower benchmark for comparison.

By means of a laboratory experiment, this paper investigates the influence of social performance feedback on an individual's beliefs and search behavior and whether the effect is different for social performance feedback above or below the individual's own level of performance. The experimental design builds on Kuhnen (2015). Over six periods, participants allocate resources to exploitation or an exploration alternative. After allocating the resources, participants receive performance feedback based on their own decision in every round. Depending on the treatment group they are in, they receive *high*, *low*, or *no* social performance feedback from another participant. Furthermore, they are randomly allocated to two different markets that differ in the payoff function underlying the exploration alternative. As they do not know in which market they are operating, participants have to provide a probability estimate on whether they are operating in the bad market to allow a better understanding of the beliefs upon which participants base their decision. This offers the opportunity for participants to attribute their (relatively) low performance to the external market conditions. For both the probability

estimate as well as the exploration decision, there always exists an objectively correct choice to which participants' beliefs and decisions can be compared.

The results offer two main findings. First, individuals exposed to *high* social feedback form overly pessimistic beliefs about their market conditions that are also less accurate compared to the Bayesian posterior. This study, thus, documents a pessimism bias in individuals' beliefs about external market conditions if the feedback from others is above their own performance level. Second, compared to the control group without social feedback, individuals exposed to social performance feedback explore significantly less in bad market conditions compared to good market conditions. The level of exploration is, thus, more appropriate for the respective market conditions. This paper, thus, contributes to the literature on intra-organizational comparison (e.g., Baumann, Eggers, and Stieglitz, 2018) by demonstrating an asymmetric reaction in individuals' beliefs to high versus low social performance feedback. This suggests that providing individuals with social performance feedback may not necessarily balance exploration and exploitation behavior at the organizational level. Furthermore, this study contributes to the literature on self-enhancement (e.g., Jordan and Audia, 2012) by providing empirical evidence that individuals attribute their relative failure in the *high* social performance condition to external market conditions rather than accurately self-assessing their performance.

The remainder of the paper proceeds as follows. In Section 2, hypotheses are developed based on the existing literature. The experimental design is presented in Section 3 before the results are presented in Section 4. In Section 5, the results and potential implications for practice and research are discussed.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Social performance feedback and intra-organizational comparison

A central idea in the behavioral theory of the firm is that organizations as unitary decision makers learn from their past performance, which conditions subsequent actions (Cyert and March, 1963; Levitt and March, 1988). Existing research reflects interest in how organizations' performance affects the likelihood of different types of action (March, 1988; Miller and Chen, 1994; Ocasio, 1995). One important idea behind such research is that decision makers' actions differ depending on whether their performance is above or below an aspirational level

determined by their own historical performance or the social performance of comparable others (Cyert and March, 1963; Greve, 1998, 2003b; March and Shapira, 1992). Similarly, individuals may be provided not only with own (historical) performance feedback but also (social) performance feedback from colleagues. Individuals can compare their observed performance to both benchmarks (Baum *et al.*, 2005; Greve, 2003a; Mezias, Chen, and Murphy, 2002). Decision makers may combine the information from social and historical performance when interpreting performance feedback (Chuang and Baum, 2003; Cyert and March, 1963; Greve, 2003a). Social performance may, thus, serve as an additional source of information to relatively assess performance.

A consequence of providing individuals with social performance feedback is that they engage in intra-organizational competition (Blanes i Vidal and Nossol, 2011). Competition can increase effort (Kuhnen and Tymula, 2012; Stark and Hyll, 2011) and, thus, have an overall positive effect on organizational performance. However, competition may also have potential negative side-effects, such as excessive risk-taking (Kacperczyk, Beckman, and Moliterno, 2015), and eventually lead to decreased productivity (Obloj and Zenger, 2017). An interesting organizational-level benefit has been put forward by Baumann *et al.* (2018). In their theoretical model, they suggest that social performance feedback classifies groups in an organization into those performing above and those performing below average. Consequently, the above-average group may engage in exploitation, while the below-average group is encouraged to explore more. Thus, at the organizational level, exploration and exploitation activities are balanced.

Decision makers that receive both historical and social performance feedback may combine the information when interpreting performance feedback (Chuang and Baum, 2003; Cyert and March, 1963; Greve, 2003a). While both sources may serve as relevant benchmarks, the literature is rather inconclusive regarding which factor dominates in guiding consequential behavior (Baum and Dahlin, 2007; Greve, 2003b). Mishina et al. (2010) suggest that social performance may have a larger influence; Audia and Brion (2007) highlight the importance of historical performance; while Iyer and Miller (2008) report equivalent importance. These different results appear to be conditional on the industry, economic condition, time period, or selection of the social comparison group (Shinkle, 2012). Moreover, Greve (1998) suggests that it might not only be relevant from which source performance feedback arises (social or

historical) but also whether it is above or below the current level of performance. Greve (1998) suggests that if decision-makers can compare their performance feedback to two different sources, they may compare it with the lower benchmark, which he refers to as a *self-enhancing rule*.

Performance feedback and self-enhancement

According to classical organizational theory, decision makers are assumed to be motivated to improve future performance by rooting out problems and searching for solutions (Simon, 1947). Generally, they appear to increase their emphasis on exploratory search and to be more willing to engage in riskier behaviors with more uncertain outcomes when their performance is below their aspirational level (Audia, Locke, and Smith, 2000; Lant, Milliken, and Batra, 1992; Mezias *et al.*, 2002). However, decision-makers may also "strive rationally to advance their own personal goals, which may not be wholly concordant with organizational goals" (Cyert and March, 1963: 121). Personal strivings outside the assumed motive to improve performance may critically affect the performance assessment process, although they have as yet received little attention in the body of work inspired by Simon (1947) and Cyert and March (1963).

The relatively small strand of literature on self-enhancement provides interesting insights into why performance feedback may not always have its desired effect. Whenever a decision maker feels responsible for performance, performance assessment becomes an evaluation of the self as much as an evaluation of outcomes (Jordan and Audia, 2012). People have various motives when evaluating themselves, including self-assessment, which is the desire to accurately assess the self (Trope, 1986), and self-enhancement, which is the desire to see oneself in a positive light (Pyszczynski and Greenberg, 1987). With their conceptual model, Jordan and Audia (2012) provide a fundamental basis for how learning from performance feedback can be influenced by self-enhancement. First, they propose situations where self-enhancement occurs, in which it is often related to the performance being below an aspirational level. Second, they develop propositions highlighting factors driving self-enhancement, such as the belief that one's own ability is fixed (Jordan and Audia, 2012).

Moreover, there exists empirical evidence highlighting the relevance of self-enhancement. In an experimental study, Audia and Brion (2007) found that decision makers respond to diverging performance indicators in a self-enhancing manner, based on a study in

which the participants received two different performance measures from the hypothetical company for which they made a decision. Kc, Staats, and Gino (2013) show, in the context of cardiac surgery, that individuals learn more from others' failures as they attribute their own failures to external conditions. Attending to the self-enhancement motive is especially important for advancing performance feedback theory since this motive is likely to distort the performance assessment process. Initial empirical evidence of this motive exists in archival data (Baum *et al.*, 2005; Kc *et al.*, 2013) or in the findings of experiments at the organizational-level (Audia, Brion, and Greve, 2015); nevertheless, the role of self-enhancement has received little attention in relation to how it may affect individual exploration-exploitation decision.

The theoretical model of intra-organizational comparison (Baumann *et al.*, 2018) introduced above takes several large steps forward in enlarging our understanding of the effects of social performance feedback. However, different individual motives are beyond the scope of that theoretical model. Building on the literature of intra-organizational comparison and the stream investigating self-enhancement, this study aims to test how social performance feedback impacts an individual's exploration decision. Classical organization theory may predict that social performance feedback that is above one's own level of performance may increase one's level of exploration and risk-taking. Based on the theoretical concept of self-enhancement, the question arises whether social performance feedback above or below one's own level of performance affects this decision differently. If individuals can attribute relative failure to an external factor, they may avoid comparing themselves with better-performing others to avoid self-image concerns. To better understand the role of self-enhancement in individual decision-making, it is relevant to examine the beliefs that individuals form.

Beliefs and decision making

Beliefs and expectations are central to strategic decision making, action, and behavior in organizations. Felin and Zenger (2009) highlight the importance of beliefs as subjective plans or anticipation regarding the potential consequences associated with different opportunities. Managers and organizations develop beliefs about the shape of the environment (Gavetti and Levinthal, 2000), future competition and sources of competitive advantage (Burgelman, 1994), or what will constitute a viable business model (Eggers and Kaplan, 2013; Tripsas and Gavetti, 2000). Tripsas and Gavetti (2000) highlight that firms are sometimes unable to respond

effectively to the potential of a new technology if managers' beliefs are not correctly aligned with the opportunity. Markoczy (1997) explicitly warns that no other managerial characteristics (Hambrick and Mason, 1984) should be used as substitutes for measuring individuals beliefs. Beliefs are formed based on one's own experience and other sources of experience (Felin and Zenger, 2009).

For the purpose of this analysis, beliefs are analyzed as a fundamental basis for forming expectations about external market conditions. As the literature on self-enhancement suggests, if individuals are concerned about their self-image, they may attribute their (relative) failure to external conditions, such as market conditions. Therefore, it is of particular interest whether an individual's beliefs about external market conditions are more pessimistic when social performance feedback is *high* (i.e., above one's own level of performance).

H1: Individuals that receive high social performance feedback form more pessimistic beliefs about market conditions compared to those receiving low or no social performance feedback.

Second, this study aims to examine how individuals' decision to explore is influenced by social performance feedback and whether it is different depending on whether the social performance feedback is above own performance (high) or below own performance (low). For the second part of the analysis it is hypothesized:

H2: Individuals exposed to high social performance feedback search less explorative than the control group without social performance feedback.

The following section presents the experimental design with the experimental setup along with the data and variables to test these hypotheses in detail.

EXPERIMENTAL DESIGN

Experimental setup

To study how different levels of social performance feedback influence individuals' beliefs and search behavior, a setup that meets the following requirements is needed: *(i) an exploration-exploitation decision with performance feedback that is self-relevant, (ii) exogenous variation of social performance feedback that is below and above own performance, (iii) an external*

factor to which individuals can attribute their failure, and *(iv) a context with an objectively correct level of exploration and objectively correct beliefs*. The section below presents an experimental design that meets these criteria. The experimental design builds on Kuhnen (2015).

An exploration-exploitation decision with performance feedback that is self-relevant: all participants allocate their resources to two different alternatives that represent exploitation and exploration over six periods. The alternatives are the refinement of an existing technology (representing exploitation) and the adoption of a new technology (representing exploration). The exploitation alternative captures the fact that the more often a technology has already been refined, the smaller the payoff from this existing technology. The payoff from the existing technology is six Token in each period and declines by a "refinement carryover" *RC* (Baumann *et al.*, 2018), which is set at $RC = 0.9$. Participants know that there is a decline in payoff but do not know the exact decline factor. For the exploration alternative, two key aspects should be captured: the potential gains should be higher as a successful innovation in the market offers higher payoffs than an existing one, and the payoff should come with higher risk as innovation efforts are likely to fail (Baumann *et al.*, 2018). Therefore, the payoff of the new technology is either two Token (low outcome) or 10 Token (high outcome) in each period. The payoff of the new technology draws from two different distributions: a good distribution and a bad one. If the payoff is generated from the good distribution, high outcomes occur with 70 percent probability in each trial, while the low outcome occurs with 30 percent probability. If the payoff is generated from the bad distribution, high outcomes occur with 30 percent probability and low outcomes with 70 percent probability. For all six periods, the computer pays either from a good distribution or from a bad distribution. By allocating their resources toward exploration and exploitation, individuals determine their individual performance feedback. Their final payout is based on their performance for all six periods, which makes it self-relevant. For each trial, they receive performance feedback, which allows them to compare their current performance to prior performance feedback. The performance feedback is disaggregated into the payoff resulting from the existing technology and the new technology. For the performance in each round, the values are drawn from the respective distributions and multiplied by the percentage of resources invested.

Exogenous variation of social performance feedback: participants are provided with the performance feedback of a peer. Individuals are randomly allocated to one of the three groups with (1) *high* social performance feedback, which is mainly above own performance, (2) *low* social performance feedback, which is mainly below own performance, or (3) no social performance feedback (control). Participants know neither which conditions exist nor which condition they are in. As this variation is exogenous, participants do not self-select into a condition, and high-performing individuals are necessarily better than their peers.

An external factor to which individuals can attribute their failure: to test whether individuals attribute low performance to an external factor, as suggested by a self-enhancing attribution, the participants operate in two markets. They are randomly allocated either to the "good market," where the payoff of the new technology is drawn from the good distribution, or to the "bad market," where the values are drawn from the bad distribution. At the beginning of the task, the participants do not know in which market they are operating. After each of the six periods, participants are asked in which market they operated to elicit their beliefs about the market conditions. Table 1 presents the three treatment conditions and the variation in the markets. To rule out the possibility that the order of high or low outcomes has an influence, this experiment uses different choice sets drawn from the respective distributions from which participants receive their performance.

Table 3 presents the three different treatment, the markets individuals operate in and the choice sets their performance feedback is based on. The choice sets 01-40 are the same in every treatment condition, which is beneficial for the between-subject design.

Treatment	Market	Choice set
high social feedback	good market	choice set 01 to 20
	bad market	choice set 21 to 40
low social feedback	good market	choice set 01 to 20
	bad market	choice set 21 to 40
no social feedback/ control	good market	choice set 01 to 20
	bad market	choice set 21 to 40

A context with an objectively correct level of exploration and objectively correct beliefs: to compare individuals' beliefs and exploration decisions to an objectively correct benchmark,

such a context is needed. Based on the information individuals see, there exists a Bayesian correct posterior for every round. At the beginning of the task, the objective probability of being in the bad market is 50 percent. This information is also provided to the participants. By observing the outcomes of the new technology, individuals may update their probability estimate as they learn about their environment. For each round, there exists an objectively correct probability. Participants are asked to provide a probability estimate that they are operating in the bad market after every round by providing a number between 0 and 100. Furthermore, they are asked how much they trust their probability estimate. By eliciting their beliefs about the market conditions and comparing them to an objectively correct probability estimate, the experiment can examine whether the beliefs about the external factors are optimistic or pessimistic.

Data and variables

The experiment took place in a university computer laboratory with 120 participants.[5] The subjects were randomly distributed across two experimental treatment groups and the control condition. Thus, 40 participants were allocated to each condition and then randomly allocated to two different markets. Every participant engaged in the six-round experiment once and participated in one experimental session. The instructor read the instructions aloud in the laboratory (see Appendix C). To ensure that the subjects understood the experimental task, the experiment used comprehension questions that had to be answered correctly before proceeding with the experiment. The task was followed by a questionnaire with demographic and control questions. The experiment was incentivized, and the subjects' decisions during the experiment determined their payout, which was based on performance achieved in all six rounds. Several instructors were in the room to help with individual requests to ensure that participants could raise questions without distracting other participants. Subjects' payoffs in Token were converted into Euros based on a declared exchange rate of five Token to one Euro. Regarding the participants, 37.5 percent were male, and the average age was 27 years. For 66 participants, a high school degree was the highest level of education achieved, 46 had a bachelor's or master's degree, and eight had "other degrees".

[5] For the recruitment of participants, the software h-root(Bock, Baetge, and Nicklisch, 2014) was used; the software used for the main experiment was z-tree (Fischbacher, 2007).

In the following paragraphs, the main variables are described. Individuals were allocated to the three conditions of social performance feedback: *high social performance feedback* (high), *low social performance feedback* (low), or *no social performance feedback* (control). These variables are binary, with *high social performance feedback* and *low social performance feedback* equal to 1 if participants are assigned to either of these treatments and 0 when they are in the control condition. Similarly, *bad market* and *good market* are binary variables that equal 1 if the participant is operating in the equivalent market condition.

First, this experiment examines individuals' *probability estimate* of being in the bad market, which reflects their subjective posterior belief. The *probability estimate* is based on six estimates individuals make after every round and is a number from 0 to 100, where 100 reflects the estimation that they are in the bad market with a probability of 100 percent. The *objective posterior* is the objectively correct Bayesian posterior probability in every round for the respective number of high outcomes (see also Table 6 in Appendix A). *Absolute probability error* reflects the difference between the subjective estimate of the probability that the market is bad and the objective Bayesian probability.

Second, the experiment aims to examine an individual's exploration-exploitation decision. Participants have to allocate 100 percent of their resources toward the existing or the new technology, where the new technology reflects exploration. The variable *exploration*, thus, reflects the amount of resources allocated to the new technology. It is a value between 0 and 100 (intervals of ten). Participants make six decisions, where the first decision is made without any performance information. The analysis includes only observations from the second decision onwards. The control variable *risk* is the subjects' risk tolerance based on a self-reported measure on a scale of 1 to 7, where 7 is risk-seeking. *Locus of control* is based on a nine-item question that participants answered and reports the degree to which people believe that they have control over the outcome of events in their lives, as opposed to being under the sway of external forces beyond their control. *Female* is a dummy variable that is equal to 1 if a subject is female. *Age* is the subjects' age in years.

RESULTS

This section reports the main results. First, we examine whether individuals that receive high social performance feedback form more pessimistic beliefs about the market conditions

compared to those receiving low or no social performance feedback. Second, we test whether individuals exposed to high social performance feedback search less explorative than the control group without social performance feedback.

Beliefs

This experiment examines whether individuals exposed to social performance feedback above their own level of performance form more pessimistic beliefs than do individuals in the control condition without social performance feedback or in the other treatment condition with social performance feedback below their own level of performance. The mean of the *probability estimate* in the bad market is 74.8 for the treatment group *high*, 66.43 for the treatment group *low*, and 66.83 for the control group. The objectively correct posterior in the bad market is 64.87. Similarly for both markets, the mean of the *probability estimate* is 58.23 for the treatment group *high*, 50.86 for the treatment group *low*, and 53.98 for the control group. The *objective posterior* for both markets is 46.62. The results of an ordinary *t*-test suggest that the mean of the *probability estimate* in the treatment group with *high* social performance feedback is significantly higher than the mean of the *objective posterior* (p-value < 0.001). This is also shown in Figures 1a and 1b below.

Figure 2a and 1b Belief about being in the bad market

These figures report differences in mean of the probability estimate, individuals gave about being in the bad market with a 99% confidence interval for the three different conditions high, low and control. Figure 1a shows the probability estimate of participants in that are assigned to the bad market, the total number of observations equals 360 (120 for each treatment), the red line is at 64.87, which reflects the objective posterior for that market. Figure 1b shows the probability estimate of participants in both markets, the total number of observations equals 720 (240 for each treatment), the red line is at 46.62, which reflects the objective posterior for over both markets.

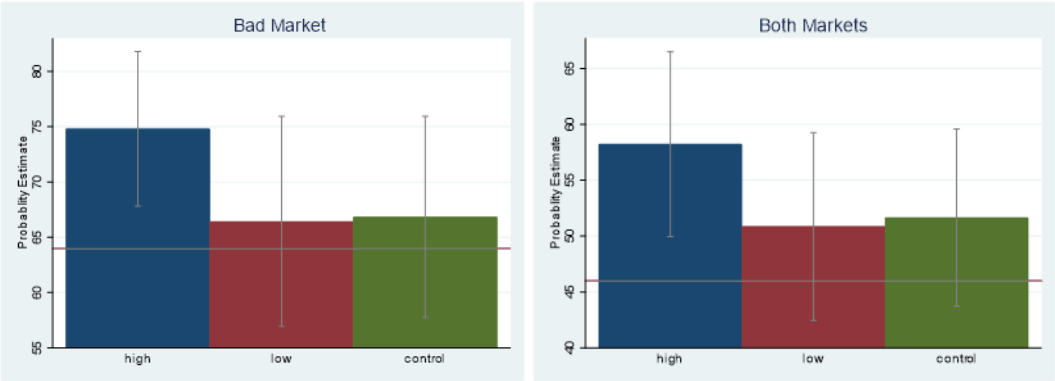


Table 2 shows the results of an ordinary *t*-test, comparing the mean of the *probability estimate* (subjective posterior belief) between the treatment and control conditions. The first row

reports the results for the conditions *high* and *control* in the bad market and for both markets. The differences in the mean of the probability estimate are significant, with a confidence level of 95 percent (p-value < 0.05). The second row reports the results for the *high* and *low* treatment conditions, also showing that the difference in mean is significant (p-values < 0.05). The last row reports the results for the treatment conditions *low* and control, with no significant differences in mean.

Table 4 Differences in Mean Probability Estimate between Treatments

This table reports the mean in probability estimates of the different treatment groups and the p-values for differences between the treatments from a t-test and a non-parametric Mann-Whitney test.

Treatment	**Bad market**	**Both markets**
High vs. control	mean (high)= 74.8 mean (control)= 66.83 p-value (t-test) = 0.0294	mean (high)= 58.23 mean (control)= 53.98 p-value (t-test) = 0.0322
High vs. low	mean (high)= 74.8 mean (low)= 66.43 p-value (t-test) = 0.0185	mean (high)= 58.23 mean (low)= 50.85 p-value (t-test) = 0.0144
Low vs. control	mean (low)= 66.43 mean (control)= 66.83 p-value (t-test) = 0.9168	Mean (low)= 50.85 Mean (control)= 53.98 p-value (t-test) = 0.7931

Furthermore, Table 3 reports the coefficients and robust standard errors (in parentheses) of OLS regressions. The results suggest that being exposed to *high social performance* has a significant influence on the subjective posterior belief of being in the bad market. Controlling for the value of the *objective posterior* that the market is bad, the analysis reveals that beliefs expressed by subjects assigned to the bad market in the *high* condition are, on average, 10.27 percent higher (i.e., more pessimistic) than in the control condition (p-value < 0.01) (Model 1). The treatment effect is similar when both market conditions are analyzed (Model 2). The beliefs expressed by subjects assigned to the *high* condition are, on average, 6.96higher (i.e., more pessimistic) than in the control condition (p-value < 0.05). Moreover, the last two columns in Table 3 show that this effect is not found for the treatment condition *low*. These findings are in line with Hypothesis 1, suggesting that individuals who receive high social performance feedback form more pessimistic beliefs about the market condition compared to those receiving low or no social performance feedback. They seem to attribute their relative failure (compared

to other peers who performed above their own performance) to an external factor, which is the market in this setting.

Table 5. Differences in Probability Estimate

*Table 2 reports the coefficients and robust standard errors (in parentheses) of OLS regression models. The dependent variable the Probability Estimate, which is the subjective posterior belief. High Social Feedback and Low Social Feedback are the dummy variables, which are equal to one if individuals are assigned to the treatment and zero if they are in the control condition. Risk is the subjects' risk tolerance based on a self-reported measure on 1-7 scale, where 7 is risk-seeking. Locus of control is based on a 9-item question, participants answered and reports degree to which people believe that they have control over the outcome of events in their lives, as opposed to external forces beyond their control. Female is a dummy variable, which is equal to one if a subject is female. Age is the subjects' age, measured in years. The amount of observations per treatment group vary depending on whether only the bad market or both markets are analyzed. Standard errors are clustered at the subject level. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.*

Dependent Variable	*Probability Estimate (Subjective Posterior Belief)*			
	(1)	(2)	(3)	(4)
	Bad Market	Both Markets	Bad Market	Both Markets
High Social Feedback	10.269**	6.957*		
	(3.751)	(3.278)		
Low Social Feedback			2.289	-0.030
			(3.846)	(2.878)
Risk	-1.117	0.353	-0.157	0.278
	(1.368)	(1.207)	(1.297)	(1.006)
Locus of Control	6.542*	1.725	2.949	2.820
	(3.278)	(2.243)	(2.884)	(1.994)
Female	-3.538	0.387	-1.622	0.676
	(4.172)	(3.535)	(4.252)	(3.100)
Age	0.643*	0.384+	0.753*	0.264
	(0.270)	(0.212)	(0.309)	(0.239)
Objective Posterior	0.889***	0.904***	0.981***	0.902***
	(0.059)	(0.043)	(0.057)	(0.039)
Constant	-31.587+	-10.970	-29.658	-12.461
	(18.368)	(13.419)	(18.725)	(13.782)
Observations	240	480	240	480
Number of subjects	40	80	40	80

This analysis continues by examining the error in probability estimation to show that the probability estimates are not only higher but overly pessimistic. Table 4 reports the coefficients and robust standard errors (in parentheses) of OLS regressions with the *absolute probability error* as the dependent variable. The results confirm that being exposed to *high social performance* has a significant effect on individuals beliefs. The biggest deviation from the Bayesian posterior happens when individuals are exposed to *high social performance* and

operate in the bad market condition. Interestingly, while being in the bad market and in the *high* condition leads, on average, to 10.5 percent higher estimation error (p-value < 0.01) (Model 1), the estimation error is about 20.92 percent higher (Model 3) in periods during which individuals observe high outcomes (which in this experimental setting is 10 Token for the new technology). Moreover, the last two columns in Table 4 show that this effect is not found for the treatment condition *low*. These findings are in line with Hypothesis 1, that individuals that receive high social performance form more pessimistic beliefs, which are as shown in this analyses also more inaccurate.

Table 6. Differences in Probability Estimation Errors

*Table 4 reports the coefficients and robust standard errors (in parentheses) of OLS regressions. The dependent variable the Absolute Probability Error, which is the difference between the subjective estimate of the probability that the market is bad and the objective Bayesian probability. High Social Feedback and Low Social Feedback are the dummy variables, which are equal to one if individuals are assigned to the treatment and zero if they are in the control condition. Risk is the subjects' risk tolerance based on a self-reported measure on a 1-7 scale, where 7 is risk-seeking. Locus of control is based on a 9-item question, participants answered and reports degree to which people believe that they have control over the outcome of events in their lives, as opposed to external forces beyond their control. Female is a dummy variable, which is equal to one if a subject is female. Age is the subjects' age, measured in years. The amount of observations varies, as model one to six are different sub-groups. Standard errors are clustered at the subject level. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.*

Dependent Variable	*Absolute Probability Error*					
	(1) Bad Market	(2) Both Markets	(3) Bad Market *High Outcome*	(4) Bad Market *Low Outcome*	(5) Bad Market	(6) Both Markets
High Social Feedback	10.567*	7.027*	20.929***	7.733		
	(4.225)	(3.436)	(5.921)	(5.672)		
Low Social Feedback					2.331	0.109
					(3.900)	(2.976)
Risk	-0.914	0.350	-2.248	0.423	-0.129	0.407
	(1.537)	(1.265)	(2.145)	(2.062)	(1.313)	(1.039)
Locus of Control	7.236*	2.342	11.515*	9.230+	3.172	3.410+
	(3.672)	(2.334)	(5.106)	(4.929)	(2.848)	(2.048)
Female	-2.312	0.664	-3.618	2.336	-1.500	0.841
	(4.646)	(3.704)	(6.591)	(6.261)	(4.297)	(3.206)
Age	0.730*	0.422+	0.540	1.177**	0.768*	0.307
	(0.300)	(0.222)	(0.385)	(0.406)	(0.310)	(0.246)
Constant	-46.044*	-19.532	-58.466*	-71.270**	-32.584+	-21.658
	(18.821)	(13.494)	(25.286)	(25.403)	(16.867)	(13.752)
Observa.	240	480	80	160	240	480
Number of subjects	40	80	38	40	40	80

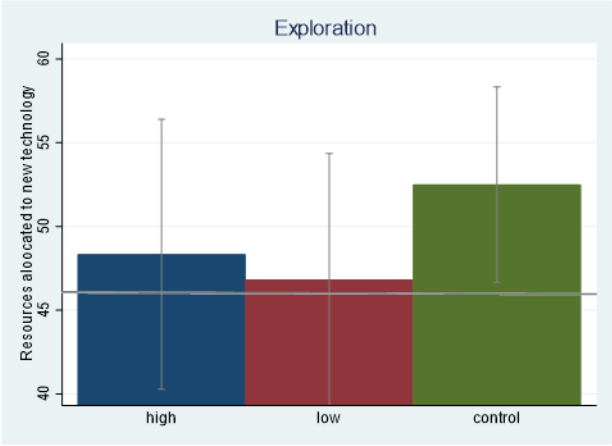
Exploration

Hypothesis 2 suggests that individuals exposed to *high* social performance feedback search less explorative than the control group without social performance feedback. Even though the treatment group exposed to *high* social performance feedback formed overly pessimistic beliefs about the market conditions, on average, they did not search less explorative.

As shown in Figure 2, the mean for exploration (measured by the amount of resources allocated to a new technology) is 49.8 for the treatment group *high*, 47.1 for the treatment group *low*, and 52.6 for the control group. The level of exploration between the groups is, thus, not significantly different. Interestingly, the optimal level of exploration in the bad market condition is 46 on average, as shown by the gray horizontal line. As the error bars in Figure 2 indicate, the level of exploration in the control condition is significantly higher than the optimal level. Similarly, the results of an ordinary *t*-test suggest that the level of exploration in the control group is significantly higher than the optimal level (p-value = 0.0519), while this is not the case for the treatment conditions *high* and *low*. This suggests that individuals in the control condition that do not receive social performance feedback tend to over-explore in the bad market condition. Individuals that are provided with *low* social performance feedback may not see the need of exploring more as they perform better than the other person they receive the feedback from. Individuals in the *high* treatment condition formed overly pessimistic beliefs about the market conditions, which may have led them to not allocate too many resources to the new technology, which is appropriate.

Figure 2 Differences in Exploration between Treatments

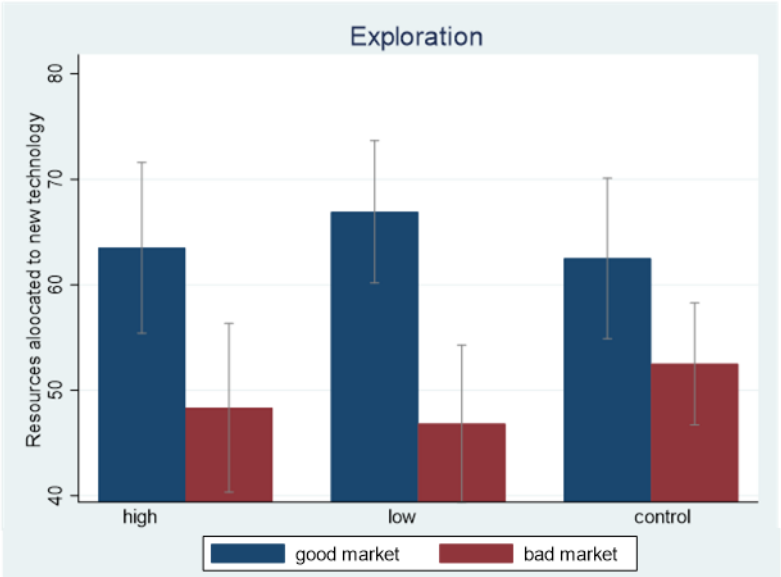
This figure reports differences in mean of allocation in resources to the new technology in the bad market condition, at a 90% confidence interval for the three different conditions high, low and control social performance feedback. The total number of subjects equals 60 (20 for each treatment), the horizontal line is at 46, which reflects the optimal level of exploration in the bad market.



When the level of exploration is compared between the good market condition and the bad market condition, Figure 3 suggests that that the differences between the market conditions are more distinct in the treatment condition than in the control condition. This is also shown by the results of an ordinary *t*-test, which show that the differences in the means in the levels of exploration between the bad market (48.33) and the good market (63.5) are significant (p-value = 0.033) for the *high* treatment condition as well as for the *low* treatment (p-value = 0.021). In the control condition, the difference in the mean of exploration between the good market (62.5) and the bad market (52.5) is non-significant at a 95 percent confidence interval (p-value = 0.09).

Figure 3 . Differences in exploration between treatments and markets

This figure reports differences in mean of the level of exploration at 90% confidence interval for the three different conditions (high, low and control) and the two different market conditions good (blue) and bad (red). The total number of observations equals 720 (240 for each treatment).



The results of an additional analysis reported in Table 5 offer similar insights. Table 5 reports the coefficients and robust standard errors of regression models, where the dependent variable is the amount of resources allocated to the new technology, referred to as *exploration*. The independent variable *bad market* is a dummy variable that equals 1 if participants operate in this market. The results show that individuals that receive *high* social performance feedback allocate an average of 17.02 units less to the new technology (exploration) if they operate in the bad market compared to the good market. The difference in *exploration* is significantly different in the two market conditions (p-value < 0.05). Similarly, in the condition with *low* performance feedback (Model 2), individuals allocate 22.54 units less of their resources to exploration in the bad market condition than in the good market condition (p-value < 0.01). In the control condition, individuals allocate an average of 10.94 units less of their resources to the new technology when they are in the bad market. This difference is not significant at a 95 percent confidence interval (p-value = 0.091).

While the analyses do not provide evidence in line with Hypothesis 2, the level of exploration in both treatment groups is significantly lower, at a confidence level of 95 percent, in the bad market than in the good market, which is more appropriate than in the control group.

This seems to be particularly driven by the lower average level of exploration in the bad market condition illustrated in Figure 2.

Table 7 Being in the Bad Market Exploration

*Table 5 reports the coefficients and robust standard errors (in parentheses) of OLS regressions. The dependent variable is Exploration, which is the amount of resources allocated to the new technology. Bad Market is a dummy variable, which equals one if individuals are assigned to the bad market condition. Risk is the subjects' risk tolerance based on a self-reported measure on a 1-7 scale, where 7 is risk-seeking. Locus of control is based on a 9-item question, participants answered and reports degree to which people believe that they have control over the outcome of events in their lives, as opposed to external forces beyond their control. Age is the subjects' age, measured in years. The amount of observations per treatment group is 40, 20 in each Market. Standard errors are clustered at the subject level. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.*

Dependent Variable	*Exploration (New Technology)*		
	(1)	(2)	(3)
	High Social Feedback	High Social Feedback	Control
Bad Market	-17.017*	-22.538***	-10.941+
	(7.552)	(5.506)	(5.566)
Age	-0.311	-1.565*	0.245
	(0.445)	(0.691)	(0.373)
Risk	3.144	3.206+	4.547*
	(2.532)	(1.714)	(2.030)
Locus of Control	-0.044	7.290+	-1.167
	(5.211)	(3.892)	(3.783)
Constant	60.657*	61.038*	41.237+
	(27.254)	(28.986)	(22.194)
Observations	40	40	40
R-squared	0.164	0.443	0.211

DISCUSSION

In the process of organizational adaptation, finding the right level of exploration is a major challenge for organizations. As search adjusts to performance feedback, not only individuals' own (historical) performance feedback but also (social) performance feedback from colleagues can serve as an important antecedent for exploration decisions. The existing literature suggests that providing individuals with social performance feedback may, overall, lead to better organizational adaptation and resulting performance. The balancing effect describes the idea that exploration and exploitation balance out among organizational members, as some perform above and others below average performance (Baumann *et al.*, 2018).

While individuals' motives are often beyond the scope of theoretical modeling, this experiment provides empirical evidence that individuals may not respond in the same way to social performance feedback above and below their own level of performance. Providing individuals with the feedback of their colleagues is intended to encourage competition. In particular, for those individuals whose performance is below that of their colleagues, providing social performance feedback is aimed at encouraging higher aspirations and efforts. In contrast to the perspective that individuals tend to aim to root out problems and search for better solutions, the literature on self-enhancement suggests that individuals may compare their current performance to lower-level benchmarks in order not to harm their self-image.

The results of this experiment offer two main findings. First, individuals exposed to *high* social performance feedback form overly pessimistic beliefs about market conditions that are also less accurate compared to the Bayesian posterior. Thus, this study documents a pessimism bias in individuals' beliefs about external market conditions if the feedback from others is above their own performance level. Second, compared to the control group without social feedback, individuals exposed to social performance feedback explore significantly less in bad market conditions versus good market conditions. The level of exploration is, thus, more appropriate in the respective market conditions if individuals receive social performance feedback.

This paper contributes to the literature on intra-organizational comparison (e.g., Baumann, Eggers, and Stieglitz, 2018) by demonstrating an asymmetric reaction in individuals' beliefs about market conditions when exposed to high versus low social performance feedback. This pessimism bias when individuals are exposed to high social performance feedback may have significant effects in the context of intra-organizational comparison. Giving individuals the opportunity to attribute their own (relatively) low performance to external market conditions leads, in the case of *high* social performance, to overly pessimistic and inaccurate beliefs about market conditions. Especially in situations where individuals receive information that a new technology achieves a highly efficacious outcome (which is a signal that the probability of being in the good market has increased), their beliefs are not accurately updated and are further distanced from the objective Bayesian belief. In analyzing the exploration decisions of individuals, this experiment was unable to document that individuals in the *high* social performance feedback condition search is significantly less explorative as suggested in

Hypothesis 2. However, neither did they search more explorative as classical organization theory would predict. They did not form higher aspirations, as others who performed better and increased their level of explorative searching; rather, they explored only as much as the control group. This suggests that providing individuals with social performance feedback may not necessarily balance exploration and exploitation behavior at the organizational level. However, as this study does not provide evidence for differences between the treatment groups regarding exploration decisions, future studies may reconsider the operationalization of exploration to draw more precise conclusions on exploration behavior.

Second, this study contributes to the literature on self-enhancement (e.g., Jordan and Audia, 2012), which is as yet a strand of literature mainly built on conceptual studies. This study contributes by providing experimental evidence that self-enhancement plays a role when individuals respond to performance feedback. In this study, individuals receive their own (historical) and another's (social) performance feedback and have the opportunity to attribute failure not only to their own ability but also to an external factor. In situations where others perform better (*high* social feedback), individuals attribute their relatively lower performance to an external factor—instead of their own ability—as they form overly pessimistic beliefs about market conditions. This study, thus, provides empirical evidence that individuals may draw on a self-enhancing rule (Greve, 1998) and mainly refer to their own historical feedback, if that is the lower benchmark, instead of accurately self-assessing their performance. This suggests that not only decision makers' cognitive limitations but also their motivational limitations may influence individuals' performance assessment process. As individuals make exploration decisions themselves, performance assessment becomes an evaluation of the self as much as an evaluation of outcomes. If individuals perform worse than their peers, they can still see themselves in a positive light by attributing a lower level of performance to an external factor.

The findings of this study have important academic as well as practical implications related to strategic organization design. Relative performance appraisals, such as 360-degree feedback, stack ranking, or leader boards, have become features of many workplaces in recent decades (Prewitt, 2007). Generally, companies like Google and Microsoft aim to motivate increased effort through tools like sales leaderboards or stack ranking. Although these appraisals are meant to encourage employee motivation and increase performance, providing such

feedback can also have negative outcomes (Kuhnen and Tymula, 2012). This might be one reason why some companies have recently made changes in their performance management; for example, GE changed its performance measurement system by adding more frequent feedback appraisals (Baldassare and Finken, 2015). Furthermore, Deloitte has reinvented performance management (Buckingham and Goodball, 2015), indicating that it is still unclear what constitutes effective feedback (*Bloomberg Businessweek*, 2006). Here, the present study provides relevant insights on how and why social performance feedback and certain other performance management tools may not work out as initially expected, especially if relative performance is above own performance. As individuals tend to form overly pessimistic beliefs about their situation that are inaccurate regarding actual market conditions, organizations may reconsider which social performance feedback they provide and how they provide it to their organizational members.

Future research is needed to further examine whether and how a pessimism bias, induced by high social performance feedback, leads to under-exploration at the aggregated level. While the present experimental design uses the feedback of another participant from a pre-study, future studies could use dynamic feedback that dyads receive from each other in one experimental session. Additionally, future studies may vary the opportunity to find an excuse for relatively low performance in external market conditions. In this lab setting, the opportunity for self-enhancement led to less accurate beliefs about the market conditions. Future empirical studies may aim to find out whether this also applies in real-life situations where professionals receive feedback from others in an organization. For example, implementing social performance feedback in organizations and giving individuals the opportunity to reflect on the difficulty of their task could be an opportunity. Another fruitful direction might be to understand how the pessimism bias can be undone, for example, whether organizational design helps to change the salience of finding an excuse and thereby the opportunity for self-enhancement. The idea that responding to feedback may be asymmetric in situations of above- or below-average performance may be included in theoretical models to yield novel predictions regarding adaptation and performance at the organizational level.

CONCLUSION

This paper documents the existence of asymmetries in learning from social performance feedback that is above and below one's own level of performance. The findings of the study reveal that when people have the opportunity to attribute relative failure to external factors, they form overly pessimistic beliefs about market conditions. The evidence shows an asymmetry in subjective beliefs between the *high* and the *low* or *no* social feedback conditions. The pessimism in beliefs induced by the *high* feedback condition that this experiment shows can help shed light on differences between responding to feedback above or below one's own level of proficiency. This may serve as an explanation for why social comparison in organizations may not necessarily lead to an overall increase in exploration effort and adaptation at the organizational level.

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APPENDIX A – ADDITIONAL TABLES AND FIGURES

Table 8. Objective Bayesian Posterior

Based on the design of Kuhnen (2015) there exist objectively correct Bayesian posterior that the participant is in the bad market, starting with a 50% to 50% prior. After every trial a new performance outcome (high or low) is revealed and there are six trials. The objective Bayesian posterior that the market is the bad one, after observing t high outcomes in n trials so far is given by: $\frac{1}{1+\frac{1-p}{p}*\left(\frac{q}{1-q}\right)^{n-2t}}$ *, where p = 50% is the prior that the market is bad (before any performance outcomes are observed) and q = 30% is the probability that in a bad market there is high (rather than the low) performance in each trial.*

n Trials So Far	*t* High Outcomes So Far	Probability {market is bad | t high outcomes in n trials}
1	0	70.00%
1	1	30.00%
2	0	84.48%
2	1	50.00%
2	2	15.52%
3	0	92.70%
3	1	70.00%
3	2	30.00%
3	3	7.30%
4	0	96.74%
4	1	84.48%
4	2	50.00%
4	3	15.52%
4	4	3.26%
5	0	98.57%
5	1	92.70%
5	2	70.00%
5	3	30.00%
5	4	7.30%
5	5	1.43%
6	0	99.38%
6	1	96.74%
6	2	84.48%
6	3	50.00%
6	4	15.52%
6	5	3.26%
6	6	0.62%

APPENDIX B – INSTRUCTIONS

Instructions for the laboratory experiment

Welcome to the Experimental Lab, you are now taking part in an experiment.

The duration of this experiment is about 45 minutes. Each participant should have instructions lying on the table in front, if you do not have them, please let us know.

I will now read these instructions out loud and if you want to you will have time to read them again on your own. If you have any questions or problems, please give a sign from your cabin. Asking questions does not mean that you made a mistake, but most often that described something inaccurate or misleading. So, please do not hesitate to ask.

For the duration of the experiment, we ask you to follow a few rules: From now on, there is an absolute ban of communication. If you have questions, please contact us and we will come to your cabin. Please turn off your mobile phones and other technical equipment. The use of these devices is expressly prohibited during the entire experiment. Therefore, we would like to ask you to place your phone in the blue bag, which is attached to the curtain rod of your cabin. Not following this rule will result in immediate exclusion from the experiment and all payments.

The experiment is anonymous, so in the experiment we will ask you some sociodemographic questions, related to your age or gender, but not your name. For the withdrawal of your payment, we will call you individually based on your place numbers. Just one of the experimenters and you will learn what you earned. All decisions in this experiment and the payouts at the end remain anonymous. Please do not discuss this with any of the other participants after the end of the experiment as well.

The experiment has 6 rounds. The result from all 6 rounds is added up and this sum then serves as the basis of your payout. The currency in this experiment is "Token". You will receive your payout in Euros at the end of the experiment. 5 Tokens equal 1 Euro.

The experiment consists of part A and part B. There is no time limit in both parts of this experiment. You can use these instructions throughout the experiment and read up things if you are unsure. If it helps you, you are welcome to take notes on your copy.

Before the experiment starts, you will receive a text on your screen. This information is only relevant to you or parts of the group. Especially, at this time it is very important that you comply with the ban on communication. Then Part A and Part B of the experiment will follow.

Part A. Decisions

This part of the experiment is relevant to your payout.

In this part of the experiment, you complete a total of 6 rounds. In these 6 rounds, the procedure is always the same. It is your job to invest in two different technologies. These 6 decisions affect your outcome in each round and, thus, your payoff at the end of the experiment.

In all 6 rounds, the process is as follows:

1. Allocation of resources

Your task is to **allocate your resources** into two possible technologies. There is an existing and a new technology to choose from. You can redistribute your resources each round (this is always done in increments of 10). Overall, you always have to divide 100% of the resources.

There is an **existing technology** and you know that with this technology you can achieve about 6 Tokens per round. The only problem with this existing technology is that over time, the value of this technology decreases. How much the value decreases from one period to the next period and whether this takes place evenly is unknown.

The second alternative you can invest your resources in, is a **new technology**. With this new technology, you can receive either 10 Tokens or 2 Tokens per round. The likelihood of these results depends on market you are in: all participants are initially randomly assigned to one market and stay in this market for all 6 rounds. There is a good and a bad market:

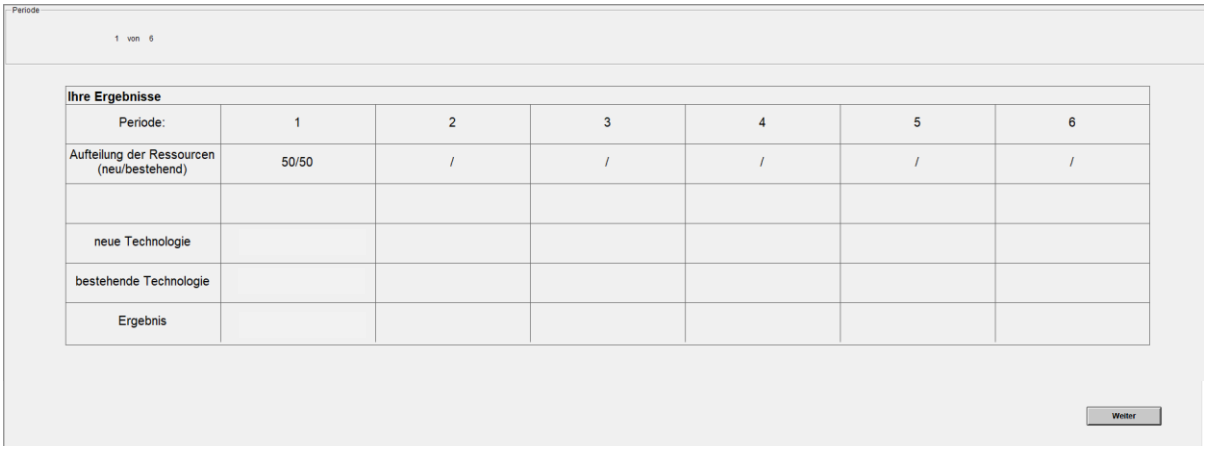
If you are in the **good market**, the following applies to the new technology: The probability of receiving 10 Tokens is 70% and the probability of receiving 2 Tokens is 30%. If you are in the **bad market**, it's the other way around: by 70% you get 2 Tokens and by 30% you get10 Tokens. This means that the new technology offers opportunities for higher profits, but is also riskier.

As stated above, at the beginning you do not know which market you are in. The results of the existing technology are the same in both markets, the results of the new technology differ depending on whether you are in the good or the bad market. All participants are assigned for all 6 rounds to either the good or the bad market. You cannot change the market.

2. Results

After allocating your resources you will see your results (as shown at the example below). You will see the period (from 1 to 6), your allocation of resources (into the new and existing technology), and your result. The result is divided into the result of what you have achieved by investing in the new, in the existing technology and overall.

After taking a look at your results, you can click on "next" to continue.



3. Estimation

Your goal should be to find out in which market you are operating, as this could influence your subsequent decision.

So, after seeing the results, we ask you to do two things:

(1) Estimate in which market you operate:

We would like to know what you think is the likelihood that you are in the bad market (the answer must be a number between 0 and 100 - you need do not need to add % signs, but you can simply enter the value).

There is always an objective, correct probability that you are in the bad market, depending on what the new technology has achieved as a result. An example:

At the beginning of all periods, the probability of being in the bad market is 50% for all participants, and there is no doubt about this value. If you observe the values for the new technology, you can update your estimation of whether the market is bad or not. It could be, for example, that your estimate that you are in the bad market is higher, after the new technology has scored several low scores. You do not have to calculate any value here, it is an estimate that might be useful for your next decision.

(2) Confidence in the assessment

There may be situations where you feel more confident that your probability estimate is right, and situations where you are more insecure. You can express how much you trust your estimate after each estimate.

We ask you to indicate on a scale how much you trust the probability you gave (the scale is from 1 to 9, where 1 means that you have a low confidence level in your estimate, and 9 that you have a high level of confidence in your ability to estimate the probability correct).

The procedure is the same in every round.

Part B. Post Questionnaire

This part of the experiment is not relevant to your payout.

After the decisions made over 6 rounds you will be asked final questions. Please answer the questions shown. Press "Next" to confirm your entries and go to the next page.

Please stay in your seat until the experimenter asks you to pay.

Before the experiment starts we would like to ask you to answer the comprehension questions on the following page. Please take enough time to answer the questions. Please get out of the cabin when you have answered all the questions. Your answers will be checked.

Multiple-Choice-Test

These questions must be completed before the start of the experiment!

No.	Question	Please mark the correct answer
1.)	What is the likelihood that you are in the "bad market" at the beginning of all rounds?	
	a) 50%	a.)
	b) 70%	b.)
	c) 30%	c.)

2.)	With what probability does the new technology gain a 10 in the "good market" and with what probability a 2?	
	a.) 10 to 30% and 2 to 70%	a.)
	b.) 10 to 70% and 2 to 30%	b.)
	c.) c.) 10 to 50% and 2 to 50%	c.)

3.)	How would your probability estimate that you are in the "bad market" change if the new technology achieves a 2?	
	a.) The probability estimate would have to decrease.	a.)
	b.) The probability estimate should remain the same.	b.)
	c.) The probability estimate would have to increase.	c.)

If you have answered these questions, please log out of the cabin. Your answers will be checked.

APPENDIX C - CONTROL VARIABLES

Risk preferences

Participants needed to answer a survey question. Participants rate their agreement with the following statement:

How do you see yourself: Are you a person who is generally willing to take risks, or do you try to avoid taking risks? Please use the scale from 1 to 7 below, where a 1 means you are completely unwilling to take risks and a 7 means you are very willing to take risks. You can also use the values in-between to indicate where you fall on the scale.

completely unwilling to take risks						*very willing to take risks*
1	*2*	*3*	*4*	*5*	*6*	*7*
O	*O*	*O*	*O*	*O*	*O*	*O*

The number of the chosen scale item is an ordinal measure of the risk attitude, with higher numbers indicating higher risk-tolerance**.**

Locus of Control

To what extent do you personally agree with these statements? Please mark your level of agreement at a 7-point scale to each statement. (1: I do not agree with everyone, 7: I totally agree)

(i) *How my life is going depends on me.*
(ii) *Compared to others, I did not achieve what I deserved.*
(iii) *What you achieve is initially a matter of fate and luck.*
(iv) *I often experience others making decisions about my life.*
(v) *Success is achieved through hard work.*
(vi) *When I encounter difficulties in life, I often doubt my abilities.*
(vii) *The possibilities that I have in life depend on the social circumstances.*
(viii) *More important than all efforts are to exercise one's own abilities.*
(ix) *I have little control over the things that happen in my life.*

The results are normalized and the average of all 9 responses is taken as a measure for the locus of control.

Demographics

1) What is your gender?

(i) Male

(ii) Female

(iii) Refusal

We will create a binary variable for this question (male vs female, others are omitted).

2) How old are you in years?

(i) Age in years:_____

(ii) Refusal

This gives us our measure of age in years.

Using the following question, we obtain a measure of level of education.

3) What is the highest level of education you have completed?

(i) Primary

(ii) Preparatory intermediate vocational

(iii) Intermediate vocational

(iv) Secondary pre-university

(v) Higher vocational

(vi) University

(vii) Refusal

4) If you are a student, what is your main subject?

(x) Business Administration

(xi) Economics

(xii) Socioeconomics

(xiii) Other

Appendices

APPENDICES

Overview and Summary of Dissertation Papers

According to § 6 Abs. 5 of the PromO from 24th August 2010, this dissertation needs to include short summaries of the results in English and in German. These are presented in the following tables:

First Paper	
Different Reasons for Different Responses: Heterogeneity in Organizational Responses to Climate Change *Franziska Sump and Sangyoon Yi*	
Status	Invited for revise and resubmit at *Organization & Environment*
Accepted at Peer Reviewed Conferences:	Academy of Management Meeting, ONE division, 2018, Chicago
Summary of Results (English): Organizations often respond in different ways to common external shocks. To advance theories on organizational adaptation and performance heterogeneity, it is essential to understand different reasons for different organizational responses. In this study, we examine how incumbents in carbon-intensive industries adapt to the heightened environmental pressure to reduce carbon emissions. By reviewing and analyzing the cases explored in the related literature, we find that organizational responses could be mapped on the three dimensions: strategy, speed, and scope. Notably, the positions on the dimensions are not independent but correlated, so that the heterogeneity in the organizational responses is somehow limited. Our analysis proceeds to identify factors and forces behind the observed heterogeneity in organizational responses. We conclude with discussions on the theoretical and empirical implications of our findings for research on organizational adaptation and sustainability.	
Summary of Results (German) Organisationen passen sich unterschiedlich an Gegebenheiten ihrer Umwelt an und selbst auf einen einheitlichen externen Schock kann es unterschiedliche Reaktionen von Organisationen geben. Um Theorien zur organisationalen Anpassung und Heterogenität in der Performance voranzubringen, ist es wichtig die unterschiedlichen Gründe für die verschiedenen	

organisationalen Reaktionen zu verstehen. In dieser Studie untersuchen wir, wie sich Unternehmen in CO_2-intensiven Industrien, an den erhöhten institutionellen Druck CO_2-Emissionen zu verringern, anpassen. Durch die Analyse der in der einschlägigen Literatur untersuchten Fälle, stellen wir fest, dass organisationale Reaktionen auf drei Dimensionen abgebildet werden können: Strategie, Geschwindigkeit und Umfang. Die Positionen in den Dimensionen sind nicht unabhängig, sondern sind korreliert, so dass die Heterogenität in den organisationalen Reaktionen begrenzt ist. In unserer Analyse werden Faktoren und Kräfte ermittelt, die hinter der beobachteten Heterogenität der organisationalen Reaktionen stehen. Abschließend diskutieren wir die theoretischen und empirischen Implikationen unserer Ergebnisse für die Forschung zur organisationalen Anpassung und Nachhaltigkeit.

Second Paper	
How Cost Shape Attention and Search: An Experimental Study on the Process of Search *Franziska Sump and Stephan Billinger*	
Method	Lab experiment
Status	Under Review at *Strategic Management Journal*
Accepted at Peer Reviewed Conferences:	Journal of Organization Design Conference, 2018, Sandbjerg Strategic Management Society, 2019, Frankfurt Academy of Management Meeting, STR division, 2019, Boston

Summary of Results (English):

In organizational and strategy research, innovation is often conceptualized as a search process (Cyert and March 1963). Organizations aim to facilitate and guide the search of their organizational members, which is crucial for value creation. Organizations may use different measures to guide search, such as organizational structure and hierarchy or incentives. In this study, it's the aim to highlight the role of costs in guiding individual search in organizations. We use a laboratory eye-tracking experiment to examine how three different distributions of cost shape individual attention and search: (1) cost that one individual has to bear privately, (2) cost that is shared with others and (3) cost that another person has to bear. We find that individuals avoid costly search alternatives and narrow their search when individuals have to bear their own cost, as well as when costs are shared with other individuals. This effect does

not occur when other individuals have to bear the cost or when no cost exist. In addition, when individuals face own or shared cost, a focus of attention on performance facilitates exploitation. Overall our results suggest that cost that entail a private component shape attention and search.
Summary of Results (German): In der Organisations- und Strategieforschung wird Innovation häufig als Suchprozess konzeptualisiert (Cyert and March, 1963). Organisationen verfolgen das Ziel diesen Suchprozess (nach Innovationen) ihrer Mitarbeiter zu erleichtern und zu steuern, da dies für den Erfolg von entscheidender Bedeutung ist. Hierzu können Organisationen verschiedene Maßnahmen ergreifen, wie z.B. durch Organisationsstruktur und -hierarchie oder mithilfe von Anreizen. In dieser Studie ist es das Ziel die Bedeutung von Kosten als Mittel zur Steuerung von Suchprozessen zu beleuchten. Um zu untersuchen wie drei verschiedene Aufteilungen von Kosten den Suchprozess und die Aufmerksamkeit eines Individuums beeinflussen, nutzt diese Studie ein Eye-Tracking basiertes Laborexperiment. Konkret wird zwischen (1) Kosten, die der Entscheidungsträger persönlich tragen muss, (2) Kosten, die mit anderen geteilt werden, und (3) Kosten, die eine andere Person tragen muss unterschieden. Die Ergebnisse dieser Studie zeigen, dass Entscheidungsträger Suchalternativen, die mit Kosten, die sie (1) selbst tragen müssen oder (2) mit anderen teilen, vermeiden und somit das Spektrum ihrer Alternativen einschränken. Dieser Effekt tritt nicht auf, wenn andere Personen die Kosten tragen müssen oder wenn keine Kosten vorhanden sind. Wenn Einzelpersonen mit eigenen oder geteilten Kosten konfrontiert werden, erleichtert ein Fokus auf das Performance-Feedback die Suche nach besseren Alternativen. Insgesamt weisen die Ergebnisse dieser Studie darauf hin, dass Kosten, die den Entscheidungsträger persönlich beeinflussen, Aufmerksamkeit und die Suche nach Alternativen beeinflussen.

Third Paper	
Social Performance Feedback and the Role of Self- Enhancement *Franziska Sump*	
Method	Lab experiment
Status	Working Paper

Summary of Results (English):

Performance feedback determines how decision makers in organizations search for new alternatives. To enhance organizational adaptation and performance, organizations may provide individuals not only with their own performance feedback, but also with the performance feedback of their colleagues. This paper examines how individuals respond to such social performance feedback and whether this is different for social performance feedback below or above own performance. In a laboratory experiment, this study examines the influence of high, low, or no social performance feedback on an individual's beliefs and decisions. By analyzing the differences in beliefs between these groups, the experiment documents that individuals exposed to social performance feedback above their own performance, form overly pessimistic beliefs about external market conditions. Second, individuals exposed to social performance feedback, explore significantly more in good markets than in bad markets, which is more appropriate in this setting. This paper contributes to the literature on intra-organizational comparison by documenting an asymmetric effect of high and low social feedback on individual's beliefs about external market conditions. By providing empirical evidence that individuals attribute their relative failure to external market conditions in the high social performance condition, contributes to the literature on self-enhancement.

Summary of Results (German):

In Organisationen wird Performance-Feedback häufig verwendet, um Mitarbeiter zu motivieren und somit z.B. Innovation zu fördern. Gemäß der *Behavioral Theory of the Firm* beeinflusst Performance-Feedback, ob Mitarbeiter wie bisher weitermachen, um fortzuführen, was bereits erfolgreich ist, oder nach neuen Alternativen suchen, um ihre Performance zu verbessern. Zur Verbesserung der Unternehmens-Performance, können Unternehmen ihren Mitarbeitern nicht nur deren eigenes Performance-Feedback zur Verfügung stellen, sondern auch das Performance-Feedback von Kollegen (*Social-Performance-Feedback*). In diesem Artikel wird untersucht, wie Personen auf solches *Social-Performance-Feedback* reagieren und ob dies unterschiedlich ist je nachdem, ob die Leistung anderer besser oder schlechter ist als die eigene Leistung. Mittels eines Laborexperiments untersucht diese Studie den Einfluss von hohem, niedrigem oder gar keinem *Social-*

Performance-Feedback auf die Erwartungen und Entscheidungen von Personen. Durch die Analyse der Unterschiede in den Erwartungen zwischen diesen Gruppen, zeigt das Experiment, dass Personen, die *Social-Performance-Feedback* erhalten, das besser als ihre eigene Leistung ist, zu pessimistische Erwartungen zu den externen Marktbedingungen bilden. Außerdem wird gezeigt, dass Personen, die *Social-Performance-Feedback* erhalten (hohes oder niedriges), unter guten Marktbedingungen wesentlich mehr nach neuen Alternativen suchen als in schlechten Märkten. Dieses Papier trägt zur Literatur zum organisationsinternen Vergleich bei, indem es einen asymmetrischen Effekt von hohem und niedrigem *Social-Performance-Feedback* zu den Erwartungen über die externen Marktbedingungen dokumentiert. Darüber hinaus werden empirische Belege dafür geliefert, dass Individuen, die *Social-Performance-Feedback* erhalten, das besser ist als ihre eigene Leistung, ihren relativen Misserfolg den äußeren Marktbedingungen zuschreiben. Das Papier trägt somit auch zur Literatur zu *Self-Enhancement* bei, die bereits in konzeptionellen Papieren dessen Rolle für Entscheidungen in Unternehmen aufgezeigt hat.

Statutory Declaration

Erklärung

Hiermit erkläre ich, Franziska Sump, dass ich keine kommerzielle Promotionsberatung in Anspruch genommen habe. Die Arbeit wurde nicht schon einmal in einem früheren Promotionsverfahren angenommen oder als ungenügend beurteilt.

_____ _____

Ort/ Datum Unterschrift

Eidesstattliche Versicherung

Ich, Franziska Sump, versichere an Eides statt, dass ich die Dissertation mit dem Titel: „Microfoundations of Organizational Adaptation: Essays on How Organizations Adapt and Why They May Fail" selbst und bei einer Zusammenarbeit mit anderen Wissenschaftlerinnen oder Wissenschaftlern gemäß den beigefügten Darlegungen nach § 6 Abs. 3 der Promotionsordnung der Fakultät für Wirtschafts- und Sozialwissenschaften vom 24. August 2010 verfasst habe. Andere als die angegebenen Hilfsmittel habe ich nicht benutzt.

_____ _____

Ort/ Datum Unterschrift

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Unterschrift Verwaltung

Self-Declaration

According to § 6 Abs. 2 b. of the PromO of 24.08.2010, for a cumulative dissertation like this one, a list of the papers must be submitted and according to § 6 Abs. 5 a list of the publications already published in this dissertation. Accordingly, the table below contains a list of all three papers of this dissertation as well as the current publication status. In addition, in accordance with § 6 (3) of the PromO for written doctoral theses, which have been developed in collaboration with other scientists, the proportion of the doctoral candidate must be clearly differentiated. In the table below, therefore, I set out to what extent I contributed to the articles contained in this dissertation. The categories used are taken from PromO, the extent to which I contributed are outlined based on the following scale:

- My own contribution is 0-33%: **C**
- My own contribution is 34-66%**: B**
- My own contribution is 67-100%: **A**

Theoretical development: formulation of the fundamental scientific problem
Review of the literature: review and analysis of existing cases from the literature (Paper I)
Empirical part: development of experimental design and empirical analysis (Paper II and III)
Preparation of the manuscript: presentation, interpretation, and discussion of the results in the form of a scientific article

Paper I

Different Reasons for Different Responses: Heterogeneity in Organizational Responses to Climate Change (Franziska Sump and Sangyoon Yi)
Invited for revise and resubmit at *Organization & Environment*

Theoretical development	B
Review of the literature	A
Preparation of the manuscript	B

Paper II

How Cost Shape Attention and Search: An Experimental Study on the Process of Search (Franziska Sump and Stephan Billinger)

Under review at *Strategic Management Journal*

Concept and theoretical development	B
Execution of the empirical part	A
Preparation of the manuscript	B

Paper III

Social Performance Feedback and the Role of Self-Enhancement (Franziska Sump)

Working Paper

Concept and theoretical development	A
Execution of the empirical part	A
Preparation of the manuscript	A

Curriculum Vitae

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ACADEMIC EXPERIENCE

SINCE 2015	**University of Hamburg, Germany** PhD Candidate in Management *Supervisor:* Alexander Bassen
APR – JUN 2019	**University Pompeu Fabra, Spain** Visiting PhD at Department of Economics and Business *Host:* Gaël Le Mens
AUG- OKT 2017	**University of Southern Denmark, Denmark** Visiting PhD at Strategic Organization Design Group *Host:* Stephan Billinger

ACADEMIC DEGREES

expected 2019	Ph.D. (Dr. rer. pol) University of Hamburg
2014	M.Sc. Strategy and Organization, University of Southern Denmark
2012	B.A. Business Administration, Hamburg School of Business Administration

RESEARCH INTERESTS

Behavioral Strategy and Organizational Adaptation

DISCUSSION AND WORKING PAPERS

Dissertation: Microfoundations of Organizational Adaptation

Different Reasons for Different Responses: Incumbents' Adaptation in Carbon-intensive Industries *with Sangyoon Yi, Invited for Revise and Resubmit at Organization & Environment (conceptual)*
Examining differences in organizational responses to a common environmental change, we find that organizational responses differ on three dimensions: strategy, speed, and scope. To understand heterogeneity in the organizational adaption, we identify forces and processes behind the observed organizational responses and the barriers that limit transitions between the positions.

How Cost Shape Attention and Search *with Stephan Billinger, Under Review at Strategic Management Journal (lab experiment)*
We use a laboratory eye-tracking experiment to examine how three different distributions of costs shape individual attention and search. We find that individuals avoid costly search alternatives and narrow their search when individuals have to bear the costs personally. In addition, when individuals face costs personally, a focus of attention on performance facilitates exploitation. Overall our results suggest that cost that entail a private component, shape attention and search.

Social Performance Feedback and the Role of Self-Enhancement, *Working Paper (lab experiment)*
In examining the effect of social performance feedback on individual's beliefs and exploration decision, this experiment highlights two main findings: First, individuals exposed to high social feedback form overly pessimistic beliefs about external conditions. Second, individuals exposed to social performance feedback explore significantly less in bad market conditions. The experiment provides relevant insights to the literature on intra-organizational feedback and self-enhancement.

Other Research:
Fruitful Tension? A Field Experimental Study on Hybrid Role Identities *with Alexander Bassen, Katrin Gödker, and Joern Hoppmann, Work-in-progress (field experiment)*
Corporate Carbon and Financial Performance: A Replication Study *with Timo Busch, Alexander Bassen, Stefan Lewandowski, Working Paper (archival data analysis)*
Corporate Social Responsibility and Financial Analysts: a Review of the Literature *with Anne-Kathrin Hinze,* published in *Sustainability, Acc., Management, and Policy Journal, 2019, Vol. 10(1) (literature review)*

Funded Research Projects

- *Relevance of CO_2-Emissions for Investment Decision,* funded by Union Investment, with Alexander Bassen, Timo Busch and Stefan Lewandowski, 60,000 EUR
- *Environmental Indicators for Investment Decision of Institutional Investors,* funded by the German Federal Environmental Agency, together with PwC and DVFA with Alexander Bassen, 120,000 EUR

Presentations

2019 (Planned)

- Academy of Management (AOM), Annual Meeting, Boston, USA
- Strategic Management Society (SMS), Special Conference, Frankfurt, Germany
- Management and Behavioral Seminar, Pompeu Fabra, Barcelona, Spain

2018

- Academy of Management (AOM), Annual Meeting, Chicago, USA
- Journal of Organization Design Conference (JOD), Sandbjerg, Denmark
- Judgement and Decision Making (EGPROC), Aarhus, Denmark

2017

- Academy of Management (AOM), Annual Meeting, Atlanta, USA
- Research Seminar, SOD Group, University of Southern Denmark, Denmark
- Research Seminar in the Experimental Social Sciences and Humanities, ETH Zürich, Switzerland

2016

- PhD Consortium GRONEN Conference, Hamburg, Germany
- Young Scholars oikos Academy, Henley Business School in Reading, UK
- Sustainability Management Conference, Dresden, Germany

PhD Courses and Workshops

2019 (Planned)

- Self-enhancement and Learning from Feedback, *PhD Seminar with Pino Audia at University of Zurich*

2018

- Field Experiments, *Summer School with Uri Gneezy, University of Copenhagen*
- Field Experiments in Economics, *PhD course with Michael Price, University of Hamburg*

2017

- Academy of Management, *PhD consortium, Annual Meeting, Atlanta*
- Research in Management, *PhD course with Daniel Geiger and Sebastian Späth, University of Hamburg*

2016

- Experimental Design and z-tree, *PhD course with Andreas Nicklisch, University of Hamburg*
- Topics in Experimetrics, *with Peter Moffat, University of Hamburg*

2015

- Experimental Research, Panel Data Econometrics, Working with Stata, Academic Publishing *all PhD courses, University of Hamburg*

Awards

First Prize Case Writing Competition, oikos Sustainable Finance, 5,000 EUR: *'The Case for Divestment: Rockefellers' Fortune?',* with Katrin Gödker, Josua Oll and Julia Frech

Teaching Experience

Since 2015: Finance and Investment (Course Bachelor's Degree, University of Hamburg)
Since 2017: Strategy and Sustainability (Seminar Bachelor Degree, University of Hamburg)
In 2016: Divestment Case Study (Seminar Master Degree, University of Hamburg)
Since 2015: Advisor for Bachelor and Master theses (University of Hamburg)

Computing

- Stata, zTree, LaTeX, Tobii Studio

Personal Information And Interest

- Born 20th February 1990
- Languages: German (native) English (fluent), French (basic)
- Enjoy playing field hockey, running, and snowboarding

REFERENCES

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