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# Organizational routines, creative projects, and their antecedents: Causal evidence from laboratory experiments

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## Abstract

The concept of routines is central to the analysis of organizations and of organizational change. In order to understand how organizations become efficient, researchers explore how organizations develop and enact routines. In order to understand how organizations become innovative, researchers explore how organizations change their routines and how they break out of their routines. However, an ontological divide in the routine literature has obstructed the development of models that enable practitioners to manage routines effectively. The present study contributes to bridging the divide in the routine literature by providing empirical evidence about selected antecedents of routines and their effects. Specifically, in three essays of which all feature experimental methodologies, the present study explores the effects of performance feedback, conflict, and negative emotions on routines. The first essay provides a detailed understanding of the effects of performance feedback on team-level routine change; the second essay suggests that, when teams can freely decide between the enactment of routines or creative projects, conflict increases their tendency to break from routines; and the third essay suggests that sadness in teams promotes the development of comparatively more repetitive, quicker, and reliable routines, whereas fear enables teams to more attentively regulate routines. The three essays make several important contributions to the routine literature and to the management theory. They enhance the established organizational-level perspectives of routines for lower levels of analysis and they enable researchers and practitioners to predict under which conditions routine change is more or less likely to happen. Moreover, they enable managers to manage organizational change more effectively. All three essays reveal some positive effects of negative experiences in organizational change contexts and discuss the implications of this finding extensively.

## Kurzfassung (German abstract)

Routinen stellen ein zentrales Thema in der Erforschung von Organisationen und von organisationalem Wandel dar. Um die Effizienz von Organisationen besser zu verstehen, untersuchen Forscher die Entwicklung und Ausführung von Routinen. Um ein besseres Verständnis davon zu erlangen, wie Organisationen Innovativität sicherstellen, untersuchen Forscher, wie Organisationen ihre Routinen verändern und abstoßen. Die Routineliteratur ist jedoch ontologisch gespalten und diese Spaltung erschwert die Entwicklung von praktikablen Ansätzen zum effektiven Management von Routinen. Diese Dissertation präsentiert empirische Evidenz bezüglich des Einflusses ausgewählter Faktoren auf Routinen und trägt hierdurch zu einer Schließung der „Kluft“ in der Routineliteratur bei. Basierend auf (in drei Essays berichteten) experimentellen Studien werden in der Dissertation die Einflüsse von Performance-Feedback, Konflikten und negativen Emotionen auf Routinen untersucht. Das erste Essay verschafft ein detailliertes Verständnis bzgl. des Einflusses von Performance-Feedback auf Routinewandel in Teams. Das zweite Essay zeigt, dass Teams, die frei zwischen der Ausübung von Routinen oder kreativen Projekten entscheiden können, in Konflikten dazu neigen, aus Routinen auszubrechen. Das dritte Essay zeigt, dass Trauer in Teams die Entwicklung repetitiver, schnellerer und reliablerer Routinen begünstigt, während Angst dazu führt, dass Teams ihren Routinen mehr Aufmerksamkeit schenken. Die drei Essays leisten einen wichtigen Beitrag zur Routinen- und Managementliteratur. Sie erweitern die vorhandenen organisationalen Routineperspektiven um hierarchisch untergeordnete Betrachtungsebenen. Sie verschaffen Forschern und Praktikern ein besseres Verständnis der Bedingungen, unter denen Routinewandel stattfindet oder ausbleibt und ermöglichen es somit, organisationalen Wandel effektiver zu steuern. Zudem zeigen die Essays inwieweit sich negative Erfahrungen im Kontext organisationalen Wandels positiv auswirken können. Dieser Befund wird umfassend diskutiert.

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# Introduction[1]

## 1.1. Motivation

Successful organizations tend to be efficient and innovative at the same time (O'Reilly & Tushman 2008). In order to understand how organizations become and stay efficient, organizational researchers explore how organizations develop and enact routines. The term 'routine' denotes behavioral patterns that store the daily actions of organizational members. They are commonly defined as "repetitive, recognizable patterns of interdependent actions, carried out by multiple actors" (Feldman & Pentland 2003: 95). Routines allow organizations to accomplish their recurring tasks (Cohen & Bacdayan 1994) and they enable organizations to deal with the enormous complexity that they face and to replicate and reproduce their successful capabilities and practices. Yet, at the same time, routines may bring along rigidity and inertia (Gersick & Hackman 1990). In order to understand how organizations may become and stay innovative, organizational researchers explore how organizations change their routines and how they break out of their routines (Obstfeld 2012; Zbaracki & Bergen 2010). Thus, the routine concept, its antecedents, and its boundaries are central to understanding how and why organizations succeed or fail.

The routine concept has been popularized by Nelson and Winter (1982) who in *An Evolutionary Theory of Economic Change* conceptualized routines as an organization's DNA. They suggested that routines may explain why organizations differ from each other, how they operate, and how they change. Over time, more and more researchers have followed Nelson and Winter's (1982) call to shed more attention to routines (e.g., Cohen & Bacdayan 1994; Gersick & Hackman 1990; Pentland et al. 2011). Consequently, the routine concept has been steadily enriched over time. Yet, this enrichment brought along various ambiguities and

[1] This section is partially based on Oehler, Stumpf-Wollersheim, and Welpe (2018), Oehler, Stumpf-Wollersheim, Welpe, and Obstfeld (Under Review), and Stumpf-Wollersheim, Oehler, Welpe, and Spörrle (Reject and Resubmit).

inconsistencies in the routine literature (Becker 2004; Parmigiani & Howard-Grenville 2011), of which some prevail to this day.

The routine literature can generally be separated into two different schools. The *capability perspective* and the *practice perspective* (Parmigiani & Howard-Grenville 2011). Followers of the capability perspective view routines as 'entities' or 'black boxes' that form building blocks of organizational capabilities (Dosi et al. 2000). The capability perspective mostly views routines from a macro point of view and predominantly applies economic methodologies to research the phenomenon (Parmigiani & Howard-Grenville 2011). In contrast, followers of the alternative practice perspective of routines open the black box of the routine. They see routines as generative systems of routine parts that evolve through internal dynamics (Feldman & Pentland 2003). These generative systems constitute organizational practices that are reproduced over time but that may change with each enactment (Feldman & Orlikowski 2011; Pentland et al. 2011). The practice perspective views routines from a micro point of view and predominantly applies sociological research methodologies (Parmigiani & Howard-Grenville 2011). Both perspectives of routines have their merits, and jointly they contribute to a comprehensive view of the evolution of organizations and economic systems.

However, the divide in the routine literature has diminished "the explanatory power of the concept of routines" (Becker 2004: 643) and has obstructed the development of theoretical and practical models that enable organizational members to manage their routines. In fact, more than three decades after Nelson and Winter's (1982) groundbreaking publication, it can be argued that the routine literature has had a rather limited impact on management teaching and common management practices. Whereas we know much about how and why routines develop, how they are enacted, changed, and abandoned, we still do not know much about how routines can be actively managed and changed. While the capability perspective of routines offers precise explanations with regard to why firms develop different routines and how firms change their routines in response to pressures from outside (Greve 1998; Nelson & Winter 1982), its

models are limited to macro-level phenomena that cannot be directly translated into managerial practices (Greve 2008). For instance, the capability perspective provides only very few suggestions how organizational members can actively manage and change routines. In contrast, the practice perspective precisely reveals important micro-level mechanisms of routine development and routine change, but its practical implications are limited by its assumption that routines develop and change heterogeneously and somewhat uncontrollably (Pentland et al. 2011). Accordingly, the practice perspective provides very limited insights with regard to how organizational members may actively manage and change routines. Thus, the present routine research faces a macro-micro divide (Salvato & Rerup 2011) as well as an ontological divide (Parmigiani & Howard-Grenville 2011). While some of the foundations for bridging the macro-micro divide in the routine literature have already been laid (Salvato & Rerup 2011), it has been noted that the ontological differences between the capability and practice perspectives of routines cannot be resolved easily (Parmigiani & Howard-Grenville 2011).

In order to increase the impact of the routine literature and to overcome its divide, Parmigiani and Howard-Grenville (2011) suggest to focus on the similarities between the different perspectives of routines and to focus on empirical phenomena rather than theory. In fact, there have been plenty of calls for more empirical evidence about routines, their antecedents, their outcomes, and the factors that determine how routines are born, changed, and how they die (Becker 2005; Cohen et al. 1996; Parmigiani & Howard-Grenville 2011). Some researchers have specifically called for more experimental routine research (Cohen et al. 1996; Winter 2013).

The present dissertation responds to these calls for more (experimental) empirical evidence about routines and their antecedents. Specifically, the present dissertation researches three ‘low hanging fruits’ in routine research—three promising factors that are likely to enable researchers and practitioners to gain more understanding of and control over routines, but whose effects have been ‘under-researched’ so far. Specifically, the present dissertation comprises

three essays which explore the effects of *performance feedback*, *conflict*, and *negative emotions* on different aspects of the life-cycle of routines. By researching these influences, the present dissertation aims to answer several important research questions, which will be motivated in the following.

### 1.2. Research question 1: The effects of performance feedback on routines

Nelson and Winter (1982) identified performance feedback as a key driver of routine change. In their view, performance feedback—the gap between an organization's performance and its aspirations (Levitt & March 1988)—plays a central role in determining whether and how organizations change their capabilities, which are stored in organizational routines. According to Nelson and Winter (1982), performance feedback directs organizational change through its effect on routines. They propose that organizations change when their genes, i.e., their routines, 'mutate', and that the direction of such mutations is set by top-down performance feedback, which originates outside of organizations and leads to managerial action and change. Followers of Nelson and Winter's (1982) view of routines as capabilities empirically showed that market pressures lead higher-level managers to replace an organization's routines (Greve 1998) and they provided strong support to Nelson and Winter's (1982: 402) notion that performance feedback is "of central concern in guiding the evolution of the economic system". Nelson and Winter's (1982) notion of performance feedback and of routine change through 'mutation' has been successfully applied to predict the evolution of large organizations and of whole economic systems (Greve 1998; 2003; Shimizu 2007), and there have been attempts to apply this perspective to predict changes in routines at lower levels of analysis, e.g., at the team-level (Avery 1996; Greve 2008). Yet, while the capability perspective may precisely predict why, whether, and when routine change is likely to take place, it provides very limited insights with regard to the question how routine change actually unfolds and how it is experienced by the teams and individuals that form organizations.

A whole stream of routine research, which we will denote as the 'practice perspective' of routines, has challenged Nelson and Winter's (1982) notion of top-down performance feedback as the central driver of routine change across all levels (Parmigiani & Howard-Grenville 2011). The practice perspective suggests that routine change takes place largely unpredictably in a bottom-up fashion (Pentland et al. 2011; Rerup & Feldman 2011; Wee & Taylor 2018). That is, routines change in response to (more or less random) errors or problems that teams and individuals face during the enactment of routines and that lead them to question and change their routines (Rerup & Feldman 2011). In this view, routine change tends to start small but may spark substantial changes across whole organizations.

The two contrasting notions of performance feedback and its effects have inhibited the development of practical models of routine change. Whereas the capability perspective suggests that performance feedback affects routine change in a top-down fashion, this perspective provides no clarity with respect to how these effects actually manifest themselves within organizations. The capability perspective might explain why organizations change, but it does not explain how such changes take place and how they affect the routines of individuals and teams within organizations. In contrast, the implications of the practice perspectives of routines are limited by this perspective's conceptualization of routine change as a bottom-up phenomenon that can neither be predicted nor controlled (Rerup & Feldman 2011). Therefore, in order to provide more clarity with respect to the effects of top-down performance feedback on routine change and to allow for the development of better change practices, we aim to answer the following research question in our first essay:

(1) *How does top-down performance feedback affect routine change across different levels of analysis (and specifically at the team level) and how are its effect moderated by contextual factors, such as task complexity?*

### 1.3. Research question 2: The effects of conflict on routines

Nelson and Winter (1982) refer to routines as "a comprehensive truce in intraorganizational conflict" (Nelson & Winter 1982: 110-111). In their view, conflict is an important antecedent of routines, which form in order to avoid conflict or to cope with conflict (Nelson & Winter 1982). Despite Nelson and Winter's (1982) notion that conflict is key to reaching a better understanding of routines, the research that followed Nelson and Winter (1982) shed comparatively limited attention to conflict and its effects on routines. The notion of routines as truces that are established in order to avoid conflict was widely accepted until Zbaracki and Bergen (2010) presented empirical evidence that challenged the notion of conflict as an antecedent of routines. Zbaracki and Bergen's (2010: 956) findings suggest that "describing the routine as truce misses the conflict behind the truce". They find that routines may involve and engender latent conflict and that conflict may put routines at risk and lead to the abandonment of routines.

Yet, while Zbaracki and Bergen's (2010) study provided important insights into the relationship between conflict and routines, there are still open questions. For instance, Zbaracki and Bergen's (2010) methodology does not address causality. At this point, we do not know whether conflict causes routinization (cf. Nelson & Winter 1982) and routine abandonment (Zbaracki & Bergen 2010), or whether routinization and routine abandonment cause conflict. Furthermore, previous routine research has not differentiated task conflict and interpersonal conflict (Guetzkow & Gyr 1954), which generally tend to have very different effects on behavior (Jehn 1995). Despite the high frequency of occurrences of conflicts within organizations (Morrill 1991), not much is known about the circumstances under which teams breach existing truces and abandon routines. Moreover, we do not know much about the behaviors that replace abandoned routines. If conflict leads to the abandonment of routines (Zbaracki & Bergen 2010), then how do teams organize in times of conflict?

In order to understand how conflict shapes routine and non-routine action, we may draw from Obstfeld's (2012) research, who suggests that routines represent just one aspect of a wider behavioral spectrum. In Obstfeld's (2012) framework, actions form action trajectories that can become routines or creative projects. Creative projects represent a counterpart to routines and allow organizations to get "markedly distinct new things […] started" (Obstfeld 2012: 1573). Obstfeld's (2012) action trajectory framework explains how teams may shift between routines and creative projects. Accordingly, it may provide more clarity with respect to how teams organize in times of conflict, i.e., how teams abandon routines in order to act out conflict (Zbaracki & Bergen 2010), or how teams develop routines in order to avoid conflict (Nelson & Winter 1982).

More knowledge about the relationship between conflict and routines and creative projects will lead to important managerial implications, as conflict can be actively managed and thus may be used as a means to shape organizational action from replication towards creative action, and vice versa. Therefore, an improved understanding of this relationship may enable managers to manage organizational change and innovation more effectively. Accordingly, in our second essay, we aim to answer the following research question:

(2) *How does conflict causally affect routines and creative projects?*

### 1.4. Research question 3: The effects of negative emotions on routines

Nelson and Winter (1982) and the researchers that followed on their path have mostly looked at routines through a cognitive lens, while putting less emphasis on the emotional aspects of routines (Adler & Obstfeld 2007). Recent routine research has called for new theory to enhance the extant "theory and research rooted in the cold cognition era of human psychology", which "has laid microfoundations for practices […] that are fundamentally unfit for purpose"

(Hodgkinson & Healey 2014: 1306). This new movement of routine research suggests to not only consider the cognitive aspects of routines but to "also account for emotions […] to complete the microfoundations of our theories" (Laureiro-Martinez 2014: 1130). Following these calls, researchers such as Døjbak Håkonsson et al. (2016) explored the effects of emotions on routines empirically and found that negative emotions generally relate to a lower likelihood of adaption of new routines than positive emotions. Hence, their findings imply that negative emotions may inhibit organizations from changing their routines.

Yet, so far, research on the effects of emotions on routines is scarce. Døjbak Håkonsson et al. (2016) discovered that negative and positive emotions affect routines differently, but they did not differentiate distinct emotions. However, psychological research suggests that distinct emotions (such as sadness or fear) may strongly differ in their effects on behavior (Lerner & Keltner 2000; 2001). Accordingly, any research that aims to develop "new theory and research […] to shed light on the generative mechanisms through which firms might […] harness the […] emotional capacities of individuals and groups" (Hodgkinson & Healey 2014: 1306) should consider the different effects of distinct emotions.

In the context of routine research, the two distinct emotions sadness and fear are particularly relevant. First, sadness and fear are particularly likely to occur in change contexts, in which new routines are developed and old routines are abandoned (Fugate et al. 2002; Kabanoff et al. 1995). At the same time, sadness and fear strongly differ in their effects on individual decision making and on several organizational behaviors, such as risk taking (Lerner & Keltner 2001; Raghunathan & Pham 1999) that are somewhat related to routines. Given these different effects, sadness and fear are likely to differ in their effects on routines. Yet, previous studies that explored the effects of emotions on routines (e.g., Døjbak Håkonsson et al. 2016) did not differentiate between individual emotions, and accordingly, they lack the precision that is required to provide helpful recommendations to practitioners of change. Therefore, in our third essay, we aim to answer the following research question:

*(3) How do sadness and fear differentially affect routines and the processes in which routines develop?*

### 1.5. Research methodology

This thesis employs three lab experiments to provide answers to the three previously stated research questions. It is widely accepted that lab experiments present "an excellent way to address questions of causality" (Bono & McNamara 2011: 658). Although experimental studies are a rare phenomenon in the routine literature, some of the existing previous experimental studies have had a significant impact on the field (e.g., Cohen & Bacdayan 1994), and leading routine researchers have repeatedly called for more experimental research (Cohen et al. 1996; Winter 2013). Specifically Cohen and Bacdayan's (1994) groundbreaking experimental study of routines has been widely recognized as a "promising starting point" for further research (Winter 2013: 127). This study "sketches an explanatory bridge that runs all the way from brain physiology at one end […] to the capabilities of large organizations at the other" (Winter 2013: 126). Cohen and Bacdayan (1994) use a card game to link routines with humans' procedural memory. Over time, this card game has been adapted by other researchers in order to explore the microfoundations of routines and phenomena closely connected to routines (Egidi 1996; Egidi & Narduzzo 1997; Garapin & Hollard 1999; Wollersheim & Heimeriks 2016). We concur with Winter's (2013: 127) notion that "[s]till today, extending the Cohen-Bacdayan line [of research] is a promising path forward". Explicitly, we aim to extend this line of research by addressing three highly relevant research questions by means of three experiments that more or less resemble Cohen and Bacdayan's (1994) initial study in terms of their experimental design and their operationalization of routines.

In the first essay, we assigned 184 participants to teams of two and provided them with either positive feedback, negative feedback, or no feedback at all in order to explore the effects of performance feedback on routine change. We then explored how the performance feedback affected routine change within a computerized version (Wollersheim & Heimeriks 2016) of the card game Target the Two (TTT) that Cohen and Bacdayan (1994) designed in order to explore routines in experimental settings.

In the second essay, we assigned 148 participants to teams of two and induced either task conflict, interpersonal conflict, or a combination of both forms of conflict in order to reveal the effects of conflict on routines. Moreover, we assigned some of the teams to a neutral control condition, in which we did not induce conflict. We then explored how the respective variants of conflict resulted in comparatively more or less routine action in a customized version of the computer game Minecraft.

And in the third essay, we assigned 168 participants to teams of two and primed them on states of sadness and states of fear in order to explore the effects of negative emotions on routines. Again, we assigned some of the teams to a neutral control condition, in which we did not induce any emotions. We then explored how sadness and fear affected the development of routines in a computerized version of the TTT card game (Cohen & Bacdayan 1994).

### 1.6. Main results and contribution

This thesis makes several important contributions to the routine literature and to the management theory. The first essay provides a detailed understanding of the top-down effects of performance feedback on routine change across different levels of analysis and specifically at the team level. Its findings suggest that, when considering moderating factors, such as task complexity, team-level and individual-level routine change can be predicted by organizational-level theories (cf. capability perspective). Accordingly, performance feedback shapes routines not only in a bottom-up fashion (cf. practice perspective) but also in a top-down fashion. The

first essay develops new theory that enables researchers and practitioners to predict routine change and to actively manage routine change within organizations.

The second essay provides a detailed understanding of the relationship between conflict and routines. Its findings suggest that, when teams can freely decide between routine and creative project action trajectories, task conflict and interpersonal conflict increases their tendency to break from routines, while the combination of task and interpersonal conflict increases their tendency to enact routines. The findings oppose the notion that conflict results in the development of routines as truces. In contrast, conflict is identified as a motor of routine change, which can be instrumentalized in order to induce teams to break out of routines and to engage in creative action instead. The second essay develops new theory that enables researchers and practitioners to understand and harness conflict as a driver of organizational change.

The third essay provides a detailed understanding of the relationship between two distinct negative emotions (namely, sadness and fear) and routines. It suggests that sadness in teams promotes the development of comparatively more repetitive, quicker, and reliable operating routines, which receive comparatively less attention. In contrast, fear enables teams to regulate operating routines more attentively and to avoid the 'performance traps' that come along with routine development (Cohen & Bacdayan 1994). The third essay suggests that distinct negative emotions may have distinct effects on different dimensions of routine development. It hence provides a better understanding of how emotions affect change processes in organizations and it suggests that negative emotions are not per se negative for organizations. New theory is developed to enable researchers to predict the effects of distinct negative emotions in change processes and to help practitioners harness the positive effects of negative emotions.

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# 2. Never change a winning routine? How performance feedback affects routine change

**Abstract:**

Performance feedback has been identified as a "master switch" of routine change, but findings concerning its effects have been limited to the organizational level. To account for performance feedback as a multilevel driver of routine change, we employ a multilevel perspective and distinguish between higher- and lower-level components of routines. Employing a laboratory experiment, we find that, moderated by task complexity, performance feedback does differentially affect change in higher-level and lower-level routine components.

**Note:**

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## 2.1. Introduction

Routine change represents an important research object for understanding the evolution of economic systems. Routines—"repetitive, recognizable patterns of interdependent actions, carried out by multiple actors" (Feldman & Pentland 2003: 95)—store the daily work of teams; they explain how things are usually done in organizations. At the same time, routines provide a window to organizational change (Becker 2004), as organizations need to change their routines in response to external pressures for survival. Previous research identifies *performance feedback* as a key mechanism in such change processes. It has been highlighted as an instrumental variable in understanding how organizations succeed (or fail), and how organizational change can be managed (Greve 2008; Nelson & Winter 1982)

Research aimed at explaining the role of performance feedback in the context of routine change can be differentiated into two contrasting streams. The *entity perspective* conceptualizes routines as entities, which can be assembled into hierarchies of higher-level and lower-level (sub-) routines (Dosi et al. 2000). Following the entity perspective, performance feedback in terms of market pressures leads managers to systematically change their organization's higher-level routines—their routinized capabilities (Dosi et al. 2000), which are of strategic importance to the organization (Greve 1998). Additionally, the entity perspective assumes that managers pass on market pressures to lower levels within the organization by giving performance feedback. This top-down performance feedback is expected to result in changes in an organization's lower-level routines—the daily work routines of organizational members (Greve 2008). Yet, while the entity perspective assumes that such top-down effects of performance feedback on routine change exist, these changes remain widely unexplored. This is despite the fact that the concept of routines is predominantly associated with the team level (Gersick & Hackman 1990; Salvato & Rerup 2011) and rooted in individual actions and traits (Laureiro-Martinez 2014).

The *generative systems perspective* of routines explores the individual parts of routines, their interactions, and their dynamics. Just as the entity perspective, the generative systems perspective also assumes that routine change is triggered by performance feedback. In contrast to the entity perspective, it focuses on exploring the effects of bottom-up performance feedback, often denoted as *errors*. This sort of feedback emerges during the enactment of routines, for example, when a team faces an unforeseen problem and reacts to it, and its effects are generally less predictable than the effects of top-down feedback (Rerup & Feldman 2011; Wee & Taylor 2018). From a managerial point of view, the generative systems perspective's concept of bottom-up performance feedback is less promising for managing change than the entity perspective's concept of top-down performance feedback.

It has been noted that the entity and generative systems perspectives of routines are not directly compatible (Parmigiani & Howard-Grenville 2011), and their differing views (top-down vs. bottom-up) might have exacerbated the present micro-macro divide in management research (Salvato & Rerup 2011). As a result, the theory that remains is limited in its implications. Whereas the entity perspective of routines has empirically shown that performance feedback represents a "'master switch' that affects a wide range of organizational behaviors" in a top-down fashion (Greve 2003a: 1069), there is no clear picture of *how* this master switch actually affects top-down routine change across different levels of analysis (Salvato & Rerup 2011). For instance, our knowledge about the effects of top-down performance feedback on team-level routine change is fairly limited. We do not know how and whether the effects of top-down performance feedback are moderated by contextual factors, which are likely to affect reactions to performance feedback (e.g., task complexity). And yet, whereas the entity perspective of routines has provided no empirically validated theory to explain multi-level and lower-level phenomena, the alternative generative systems perspective is bound by its conceptualization of routine change as an unpredictable bottom-up phenomenon (Rerup & Feldman 2011). These limitations result in a research gap, as the extant theory does

not clearly suggest whether or how top-down performance feedback affects routine change across different levels of analysis, specifically at the team level, to which the concept of the routine is predominantly tied (Salvato & Rerup 2011).

If we were to bridge this research gap, a multilevel understanding of how performance feedback affects routine change would contribute to the development of more precise theories of organizational and systemic change that solve the multilevel challenges of routine research (Salvato & Rerup 2011). Further, being able to predict the effects of performance feedback on team-level routine change could enable researchers to derive better feedback practices that allow practitioners to manage change more effectively (Abell et al. 2008).

In this study, we explore the causal effects of top-down performance feedback on routine change from a multilevel point of view. Following the entity perspective of routine research, we differentiate between change in higher-level routine components (i.e., the articulate key capabilities of teams), and change in lower-level routine components (i.e., the less articulate routinized actions that constitute these capabilities). Based on previous literature, we identify task complexity as a potential moderator of the relationship between performance feedback and routine change, and predict how this moderation drives change in higher and lower-level routine components. We test our hypotheses in a laboratory experiment in which we differentiate between changes in teams' higher and lower-level routine components in tasks that feature different degrees of complexity. Our experiment results in three key findings. First, top-down performance feedback differentially affects change in higher and lower-level routine components. Second, task complexity moderates the effects of top-down performance feedback on routine change. Third, not only negative, but also positive top-down performance feedback may trigger routine change. This is of interest as, in general, positive performance feedback suggests to its recipients that the performance of their routines is satisfactory and that no change is required.

Our findings suggest that, to some extent, team-level and individual-level routine change can be predicted by the entity perspective and that change at the team and individual level may take place as a result of top-down feedback. We therefore enhance the established entity perspective of routines in its consideration of lower levels of analysis, specifically for the team level and the individual level. Moreover, we also enhance the generative systems perspective by showing that routine change can be predicted and to some extent managed actively—even by simple means like performance feedback. Thus, our findings result in the development of more precise theories and practices of organizational and systemic change. At the same time, they raise new questions, specifically with regard to the sometimes positive effects of positive performance feedback on routine change. Our findings also open new paths for future research.

### 2.2. Theory

With respect to the relationship between performance feedback and routine change, organizational researchers face a typical example of what Kozlowski and Klein (2000) call a 'micro-macro gap'. We know from the entity perspective of routines that performance feedback triggers organization-level routine change in a top-down fashion (Greve 1998). However, the entity perspective is mostly limited to explaining the effects of performance feedback on organizational-level change (Greve 1998). This is problematic, given that change in so-called 'macro routines' (Greve 2008) represents only one aspect of routine change. As Abell et al. (2008: 491) note, "there are no conceivable causal mechanisms in the social world that operate solely on the macro-level". To close such 'micro-macro gaps', researchers such as Kozlowski and Klein (2000) suggest a need to employ multilevel research models that account for the levels of analysis at which the explored constructs originate. In order to research the effects of performance feedback on routine change, we employ a top-down multilevel model (Kozlowski & Klein 2000), which accounts for the organizational-level origins of performance feedback,

its top-down effects on the multilevel phenomenon of routine change, and contextual factors, specifically the moderating effects of task complexity.

### 2.2.1. Performance feedback and its organizational-level origins

Performance feedback originates from higher levels within the organization, from which its effects disseminate across lower levels of analysis. The entity perspective of routines has mainly linked performance feedback to the organizational level and identified it as an important—if not the most important—influence on routine change (Nelson & Winter 1982). In the entity perspective, performance feedback is usually defined as the gap between an organization's performance and its aspirations (Levitt & March 1988; Nelson & Winter 1982). In other words, feedback indicates a perceived performance deviation from some psychologically neutral point (Kameda & Davis 1990) that divides "the space of outcomes into regions of gain and loss (or success and failure)" (Heath et al. 1999: 82). The entity perspective has shown that performance feedback guides routine changes, inducing high-level decision makers to search for new routines to cope with market pressures (Greve 1998; 2003a).

The concept of performance-aspiration gaps is implicitly mirrored by the alternative generative systems perspective of routines, which focuses on the bottom-up effects of performance feedback. For instance, Rerup and Feldman (2011) refer to gaps between an organization's enacted schema (performance) and its espoused schema (aspiration), which resemble performance-aspiration gaps. In their view, team-level enactments of routines reveal performance-aspiration gaps (problems), which lead to small changes in lower-level routines. Over time, these small changes often result in broader questions about how things are done in the organization. In response, substantial change in higher-level 'key routines' takes place.

Entity researchers, such as Greve (2008) expect that such effects also work in the opposite, top-down direction. Combining Greve's (2008) and Rerup and Feldman's (2011) narratives, we expect that when managers experience a performance-aspiration gap (e.g., due

to missed sales goals), they are likely to ask questions concerning how things are done in the organization. In response to these questions, they are likely to adjust their aspiration levels and to provide top-down performance feedback in order to adjust the aspirations of subordinates. As a reaction to this feedback, organizational members search for concrete problems and modify their routines in order to solve them (Greve 2008). According to this narrative of top-down induced change, performance feedback and its effects might cascade from the top to the bottom of the organization. However, at this point, our knowledge of the top-down effects of performance feedback on routine change is quite limited, in part due to the complex multilevel manifestation of routine change (Salvato & Rerup 2011), which has often been overlooked by those who prescribe to the entity perspective.

### 2.2.2. Routine change and its multilevel manifestation

Routine change bridges several levels of analysis, from the organizational level to the individual level (Salvato & Rerup 2011). Salvato and Rerup (2011) suggest breaking routines across different hierarchical levels into sequences of individual actions and behavioral, cognitive, and emotional components in order to understand their evolution and effectiveness and the role of context. Based on this suggestion, we focus on unfolding routine hierarchies and their behavioral components. Consistent with the entity perspective of routines, we regard routines as systems of higher-level components that consist of lower-level sub-components (Dosi et al. 2000).[2] Specifically, we differentiate between *'higher-level routine components'*, the components of routines that constitute a team's key capabilities (Dosi et al. 2000), and *'lower-level routine components',* the individual action patterns on which these capabilities are based (Cohen & Bacdayan 1994). We assume a hierarchical relationship between these components; specifically, we assume that higher-level routine components relate to comparatively higher

[2] Please note that the idea that routines may comprise subcomponents at hierarchically lower levels is mirrored by the generative systems perspective of routines. For instance, in their empirical study, Rerup and Feldman (2011) identify a higher-level 'larger recruitment routine', which in turn comprises a lower-level 'contracting subroutine'.

levels of analysis (organizational level to team level) than do lower-level routine components (team level to individual level). Over time, routine components at all levels of analysis may be subject to change. Yet, previous research suggests that there might be some differences in how change in higher-level and lower-level routine components takes place. We will explore these differences in depth.

***Change in higher-level routine components:*** Initially, followers of the entity perspective of routines often focused on exploring routines as repositories of 'higher-level routine components' that constitute organizational capabilities (Winter 2003). For instance, Dosi et al. (2000: 4) stress that "some organizational routines might equally well be called capabilities", which are "significantly shaped by conscious decision both in [their][…] development and deployment". Such higher-level routine components store and regulate how actors systematically combine their skills in order to fulfil key organizational tasks. They assign responsibilities and functions and provide 'team maintenance' by bringing individual actions in line with the team or organization (Healey et al. 2015). Higher-level routine components are not necessarily attached to a certain level of analysis, but they are replicable by mechanisms that operate at the organizational level (Abell et al. 2008; Cohen et al. 1996). That is, they are generally not overly sensitive to specific team constellations or individuals (Abell et al. 2008). Due to this characteristic, higher-level routine components may explain not only why organizations differ from each other, but also why organizations perform differently.

Regarding *change in higher-level routine components*, routines have been described as mostly stable, but change when performance feedback generates sufficient top-down pressure (Nelson & Winter 1982). It is often assumed that such changes in higher-level routine components are highly predictable (Levinthal & March 1981). This is due to the fact that higher-level routine components are directly related to performance. Accordingly, they can be effectively adjusted in response to performance feedback (Greve 2008). For instance, when management teams receive negative performance feedback indicating disappointing financial

performance, these teams, irrespective of their specific constellations of members, are likely to act in a predictable way (Greve 1998), for example, by restructuring lower-level units in order to cut costs.

***Change in lower-level routine components:*** In parallel, microfoundational routine research has explored how lower-level routine components—the building blocks of higher-level routine components—evolve (Abell et al. 2008; Cohen & Bacdayan 1994). These lower-level routine components more closely fit the idea of organizational habits rather than organizational capabilities (Gersick & Hackman 1990). Like habits, lower-level components of routines are often highly inarticulate (Cohen & Bacdayan 1994). That is, they form an 'organizational unconscious' that accounts for much that happens in organizations (Cohen & Bacdayan 1994) but cannot be directly connected to organizational performance (Greve 2008).

Such lower-level routine components store and regulate concrete actions and interactions, which actors of routines execute in their efforts to accomplish organizational tasks. They provide 'task maintenance' by "off-load[ing] cognitive coordination onto well-learned patterns of behavior, particularly the cognitively demanding job of selecting actions that are complementary and compatible with teammates' actions" (Healey et al. 2015: 415). Lower-level routine components are not necessarily attached to a certain level of analysis. However, they draw from individual skills, habits, and traits (Gersick & Hackman 1990; Laureiro-Martinez 2014), and as such are more closely connected to the team and individual levels. Compared to higher-level routine components, lower-level routine components are more sensitive to the traits of the specific individuals involved (Laureiro-Martinez 2014). For this reason, lower-level routine components may explain why teams differ from each other and why they behave in certain ways, but not necessarily why they perform differently.

Regarding *change in lower-level routine components*, on one hand, microfoundational research of routines has often highlighted the fact that parts of routines are likely to change in a bottom-up fashion (Wee & Taylor 2018). That is, routine components are adjusted when

concrete problems with the performance of specific routines emerge during the enactment of routines (Rerup & Feldman 2011). On the other hand, some followers of the entity perspective of routines assume that change in lower-level routine components may also be guided by top-down performance feedback, as performance feedback and its effects may reverberate across the whole organization (Avery 1996; Greve 2008). Greve (2008), for instance, assumes that routine change at lower levels in the organization is triggered by performance feedback that originates at higher levels. However, he expects that these lower-level effects manifest themselves in a less predictable way than do higher-level effects, given that performance feedback affects lower-level routine components only in an indirect way across several levels of analysis. He stresses that lower-level routine components are only remotely associated with outcomes at the organizational level, where performance feedback usually originates (Greve 2008). Thus, when performance feedback reaches lower levels in the organization, "it is often not clear whether the [team or] individual will feel responsible for making any specific change, and that the change will be a modification of a routine" (Greve 2008: 199). However, these top-down effects of performance feedback still lack an empirical foundation. Avery's (1996) 'non-findings' with respect to the relationship between performance feedback and group-level routinization support Greve's (2008) expectation that the top-down effects of performance feedback in practice might turn out to be very different than expected (Greve 2008).

### 2.2.3. The moderating effect of task complexity

*Task complexity* is a contextual factor that is likely to moderate the relationship between performance feedback and routine change. We account for task complexity due to Kozlowski and Klein's (2000) suggestion that, in bridging the micro-macro divide, multilevel models should incorporate relevant contextual features and effects. Task complexity is a particularly relevant feature in our research context, as it is likely to affect how teams and individuals interpret and react to performance feedback.

By the term *task complexity*, we refer to the complexity of tasks that the actors involved in routines need to accomplish to achieve satisfactory performance levels. Task complexity increases with the number of possible combinations of (higher and lower-level) routine components that can be applied to accomplish a task (Becker 2005) and the ambiguity and difficulty involved (Akgün et al. 2005; Scott & Tiessen 1999). When task complexity is high, the actions required to accomplish tasks involve high levels of information sharing, cooperation, and coordination among team members (Akgün et al. 2005; Becker 2005). When task complexity is low, information sharing, cooperation, and coordination become comparatively less relevant.

Task complexity is likely to moderate the relationship between top-down performance feedback and routine change. This is due to the fact that task complexity poses "limits to comprehension", leads actors to "lose the overview", and "give[s] rise to a condition of causal ambiguity where it is unclear which of the many elements are important for carrying out a task" (Becker 2005: 830). For instance, when teams that work on rather simple tasks receive top-down performance feedback, it is relatively easy to figure out which behaviors they need to change (or keep stable) in order to fulfill their aspirations. In such situations, performance feedback reveals concrete problems with routines, which can be fixed with routine changes. In contrast, if teams work on more complex tasks, it is harder to connect performance feedback to specific behaviors. In such situations, performance feedback leads to broader questions. Based on Rerup and Feldman (2011), we may expect questions and problems to result in different forms of routine change. Questions are associated with change in higher-level schemata (cf. higher-level routine components) and problems with change in lower-level concepts (cf. lower-level routine components). In the following section, we will adapt this bottom-up model of routine change in order to explain how top-down performance feedback moderated by task complexity guides routine change.

### 2.2.4. A multilevel research model of the relationship between performance feedback, task complexity, and routine change

In order to investigate how top-down performance feedback moderated by task complexity drives routine change, we employ a multilevel model, which accounts for the different levels of analysis at which performance feedback, task complexity, and routine change originate. The focus of our research model lies on the interaction effects of performance feedback and task complexity. This focus is due to the fact that contextual moderators (in our case, task complexity) are often decisive for understanding connections between phenomena that originate at different levels of analysis (Kozlowski & Klein 2000). While we do not derive hypotheses regarding the potential main effects of performance feedback, we nevertheless will test such effects in the results section.

***Performance feedback × task complexity:*** We expect that, when a task involves comparatively more complexity, performance feedback is more likely to lead to broad questions about the team's routines. In contrast, for tasks that involve comparatively less complexity, performance feedback is comparatively more likely to reveal concrete problems with specific routines. Based on Rerup and Feldman (2011), we assume that when performance feedback leads to broad *questions*, we may observe more changes in higher-level routine components. In contrast, when performance feedback leads to concrete *problems* we may observe more changes in lower-level routine components. Thus, when performance feedback is received under conditions of higher task complexity, we expect that there will be more change in higher-level routine components than in lower-level routine components. In contrast, when performance feedback is received under conditions of lower task complexity, we expect comparatively more change in lower-level routine components. Thus, we pose the following hypotheses.

*H1: Performance feedback in combination with higher task complexity results in more change in higher-level routine components than does performance feedback in combination with lower task complexity.*

*H2: Performance feedback in combination with higher task complexity results in less change in lower-level routine components than does performance feedback in combination with lower task complexity.*

***Negative performance feedback × task complexity:*** Previous research suggests that routine change is particularly likely to occur when negative performance feedback is received (Cyert & March 1963; Levinthal & March 1981). That is, performance feedback is specifically likely to raise questions or reveal problems when it suggests performance is below aspirations. In line with our previous expectations, we expect that in complex tasks, negative performance feedback is comparatively more likely to result in broad questions about routines than to reveal concrete problems with specific routine components. In contrast, we expect fewer broad questions and more concrete problems in less complex tasks. Given that we associate questions with change in higher-level routine components and problems with change in lower-level routine components, we may expect comparatively more (less) change in higher-level (lower-level) routine components when negative performance feedback is given under conditions of higher task complexity. Thus, we pose the following hypotheses.

*H3: Negative performance feedback in combination with higher task complexity results in more change in higher-level routine components than does negative performance feedback in combination with lower task complexity.*

*H4: Negative performance feedback in combination with higher task complexity results in less change in lower-level routine components than does negative performance feedback in combination with lower task complexity.*

***Positive performance feedback × task complexity:*** In general, positive performance feedback suggests to its recipients that the performance of their routines is satisfactory. Accordingly, it is often suggested that positive performance feedback is less likely to result in routine change than negative performance feedback (Greve 1998; 2008). Nevertheless, there is some indication that both negative and positive performance feedback may trigger change (Cyert & March 1963). So far, there is no clear indication of when positive performance feedback actually leads to more or less routine change.

For instance, in his study of high-level change in an environment that features a comparatively high degree of task complexity, Greve (1998) finds a negative relationship between positive performance feedback and higher-level change. Another study by Avery (1996) that analyses routines in comparatively less complex tasks generally suggests no clear relationship between positive performance feedback and routines. Yet, some of Avery's (1996) findings point to a positive relationship between positive performance feedback and change in higher-level routine components. In combination, these findings suggest that task complexity might moderate (and potentially reverse) the effects of positive performance feedback on routine change. That is, in complex tasks, teams receiving positive performance feedback might not know which of their (key) higher-level routine components caused the positive performance and tend to keep these components stable while carefully experimenting with lower-level routine components. In contrast, in less complex tasks, teams are comparatively more likely to change higher-level routine components, as they can better assess the consequences of such changes.

An alternative point of view suggests that positive performance feedback may result in 'slack search' (i.e., in a tendency to spend unused (cognitive) resources on the exploration of new higher-level routine components; Cyert & March 1963; Greve 2003a; Simon 1947; Simon 1957). Slack search has mostly been associated with complex tasks (e.g., R&D processes)—that is, tasks that are "beyond what is necessary for the short-term operation and maintenance of an organization" (Greve 2003a: 688). Slack search is undirected and is more likely to correspond to change in higher-level routine components (Cyert & March 1963). Thus, opposed to Greve's (1998) findings, the *"slack search perspective"* suggests that positive performance feedback in combination with higher task complexity results in comparatively more (rather than less) change in higher-level routine components. There is no indication that slack search affects change in lower-level routine components.

Thus, we can derive opposed hypotheses with respect to the effects of positive performance feedback on change in higher-level routine components. Based on Greve's (1998) and Avery's (1996) findings we can predict that positive performance feedback in combination with higher task complexity results in comparatively less change in higher-level routine components than it does in combination with lower task complexity (H5a). At the same time, based on these studies we expect that positive performance feedback in combination with higher task complexity results in less change in lower-level routine components (H6). Based on the 'slack search perspective' we expect that positive performance feedback in combination with higher task complexity results in comparatively more change in higher-level routine components than it does in combination with lower task complexity (H5b). We thus pose the following hypotheses.

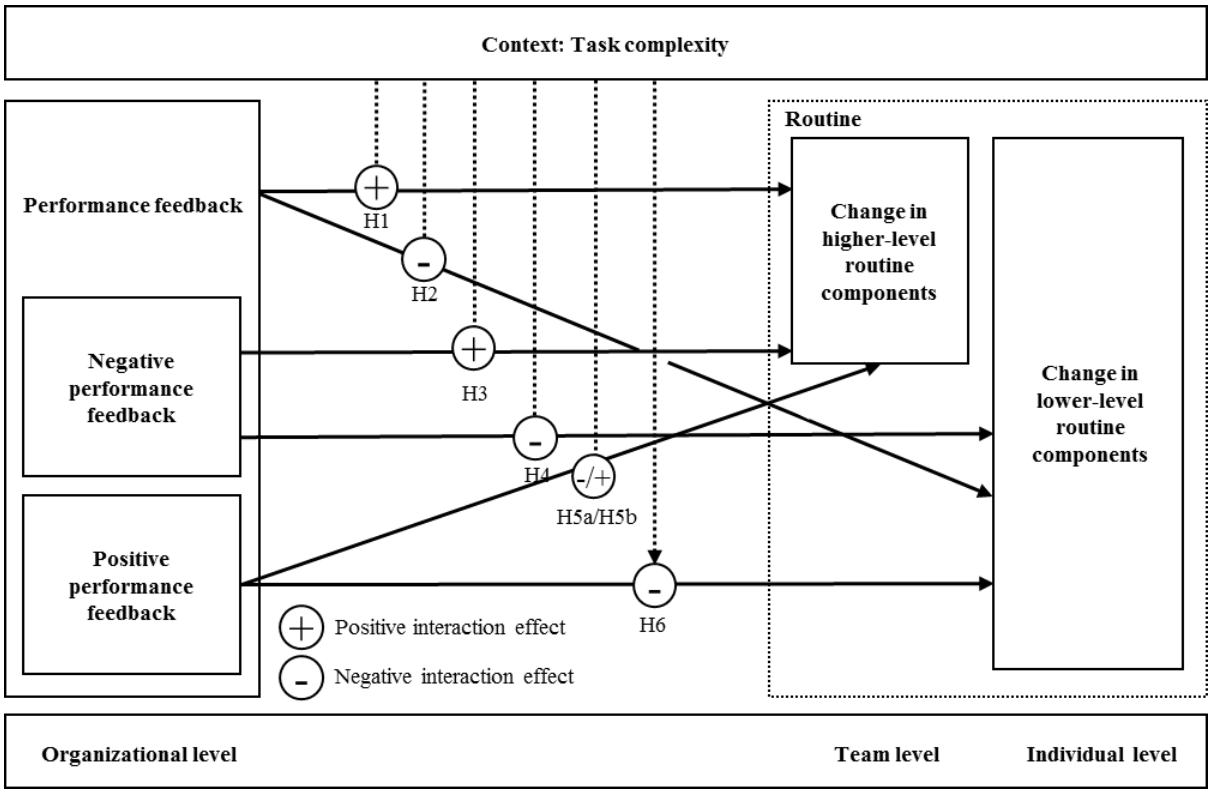
*H5a: Positive performance feedback in combination with higher task complexity results in less change in higher-level routine components than does positive performance feedback in combination with lower task complexity.*

*H5b: Positive performance feedback in combination with higher task complexity results in more change in higher-level routine components than does positive performance feedback in combination with lower task complexity.*

*H6: Positive performance feedback in combination with higher task complexity results in less change in lower-level routine components than does positive performance feedback in combination with lower task complexity.*

***Summary of expectations:*** Figure 1 provides an overview of our predictions regarding the interaction effects of performance feedback and task complexity on change in higher-level and lower-level routine components. In this study, we focus on testing interactions between performance feedback and task complexity. Such interactions reveal how relative changes (rather than absolute levels) of task complexity influence the effects of performance feedback on routine change, and as such may provide a better explanation of the top-down effects of performance feedback on routine change.

*Figure 1: Hypothesized interaction effects between performance feedback and task complexity and their effects on change in higher-level and lower-level routine components*




## 2.3. Method

### 2.3.1. Experimental design

To test the interaction effects of performance feedback and task complexity on routine change, we relied on a laboratory experiment based on a 2 (negative vs. positive performance feedback) × 3 (early vs. continued vs. late performance feedback) factorial design with a separate control condition. The experimental design featured Target the Two (TTT), a card game developed by Cohen and Bacdayan (1994). TTT allows researchers to analyze and manipulate organizational routines in a controlled setting and is widely accepted as an important means to research routines (Egidi & Narduzzo 1997; Garapin & Hollard 1999; Winter 2013; Wollersheim & Heimeriks 2016). TTT requires individuals to successfully coordinate their individual actions in teams of two through routinization (Cohen & Bacdayan 1994). Thus, the game combines individual-level and team-level actions, providing an effective research object for multilevel

analyses. In our specific setting, we manipulated the team-level and individual-level routines that formed in the game through top-down performance feedback; as a result, we exposed newly-formed routines at these levels of analysis to higher-level influences. With regard to the provided top-down performance feedback, we varied the timing of the feedback, since Kozlowski and Klein (2000) suggest to control for time as a potential factor in multilevel phenomena. However, given our research focus, we treated feedback timing as a basic control variable and did not explicitly interpret its effects.

### 2.3.2. Sample

In total, 184 students from a German university took part in the study.[3] The sample consisted of 118 men, 62 women, and four participants who did not specify their gender. Their ages ranged from 17 to 50 years, with a mean of 22.55 years (*SD* = 4.04). The participants received a fixed incentive of €9.50 for participating in the experiment. In addition, they could earn points during the study to proportionally increase their probability of winning an iPad Air. Including the value of the iPad, the expected remuneration per participant amounted to €12 for approximately one hour of participation. The winner of the iPad was drawn a few weeks after the last experimental session. The chances of winning the iPad increased linearly with performance, and all participants had a fair chance of winning. For the drawing of the winner, we looked at actual rather than reported performance.

### 2.3.3. Procedure

We invited individuals to participate in the study using the ORSEE software (Greiner 2004). Individuals formed part of a larger pool of registered laboratory 'members'. In the invitation email, the participants were not given any detailed information about the study beyond its

[3] Each condition included either 14 (positive performance feedback × early performance feedback timing) or 13 (remaining conditions) teams. Due to a technical problem, the sessions of 11 teams had to be stopped early. The data from these sessions were excluded from the dataset prior to analyses.

estimated duration. Upon their arrival at the laboratory, participants were randomly assigned to computers and into pairs, each of which played up to 40 identical hands of a computerized version of TTT (Cohen & Bacdayan 1994; Wollersheim & Heimeriks 2016). The participants knew they had a team partner but were unaware of their partner's identity. Before the beginning of the game, the participants received oral and written introductions to the study, as well as a digital briefing, which included a demonstration of how to solve an exemplary hand in the game. After this training, the participants were allowed to ask questions, which were answered publicly. We then started the TTT game on the computers. Our performance feedback manipulations occurred during the game. The pairs of players were randomly assigned to seven different experimental conditions. In the three negative performance feedback conditions, participants received messages stating that their team underperformed compared to a peer group of allegedly similar teams. Messages were received either early in, throughout, or late in the game, depending on the performance feedback timing condition. For the three positive performance feedback conditions, participants received messages stating that their team outperformed their peer group (either early in, throughout, or late in the game). In the control condition, participants received no performance feedback. As soon as the participants finished the game, we asked them to remain seated and complete a printed questionnaire that we had placed next to each computer prior to the session. The questionnaire included manipulation checks, additional tests, and questions to obtain demographic information. After the participants filled out the questionnaire, they were asked to pick up their incentives in a separate room. To conform to the specific regulation of the laboratory in which we conducted our study, and to ensure that previous participants could not prepare future participants, we did not inform them about our manipulations or the purpose of the study either before or after the experimental session.

### 2.3.4. Task

TTT simulates a typical organizational problem in a dynamic environment, with a repeatedly encountered task that varies slightly over time and must be solved through collaboration by two members of a team. TTT uses a card deck composed of only six cards—the twos, threes and fours in the suit of clubs (♣) and the suit of hearts (♥). In each iteration of the game, players hold one card in their 'hand' (hidden to the other player). The remaining four cards lie on a board, which, in this setting, is represented by a computer screen. One of the cards on the board lies face up in a marked target position, and another one lies face up in an unmarked position. The remaining two cards on the board lie face down in unmarked positions. The game requires the pair of players to alternate swapping the card in their 'hand' with one of four cards on a board until the 2♥ card is placed in the marked target position on the board. Instead of exchanging cards with one of the positions on the board, team members can also activate a pass button, which enables them to forgo a card exchange. Each card exchange and each activation of the pass button incur costs, reducing a team's score, whereas each successfully finished task (i.e., each 2♥ in the target position) adds points to the score. The six cards of the game are dealt according to predetermined configurations, so that teams face many different orientations of the task throughout the game. As in Cohen and Bacdayan's (1994) original experiment, our TTT sessions lasted up to 40 tasks per team, or alternatively up to 40 minutes, as we stopped all sessions after 40 minutes, irrespective of game progress. We used the same tasks as Cohen and Bacdayan (1994) and Egidi (1996). These card constellations feature different degrees of task complexity. Depending on the respective task and its complexity, players are more or less challenged by (1) asymmetrical information, as the cards in the players' hands are visible only to the card-holding player; (2) communication problems, which result from the strict ban on any open communication between players; and (3) skill confinement, as each player holds a certain skill throughout the whole game that defines his or her scope of action. Specifically, in each team, one team member is designated as a 'Colorkeeper' and may swap the card in his or

her hand with a card in the target position only if both cards share the same color, whereas the other player is designated as ‘Numberkeeper’ and may swap the card in his or her hand with a card in the target position only if the number of the card is preserved.

### 2.3.5. Dependent measures

Cohen and Bacdayan (1994) show that teams playing TTT develop routines, and Egidi (1996) and Egidi and Narduzzo (1997) differentiate different routine components in the TTT game.

Regarding *higher-level routine components*, Egidi (1996) shows that TTT allows for different coordination patterns that may lead to task accomplishment, as long as team members manage to synchronize their individual functions and skills (cf. ‘Colorkeeper’ vs. ‘Numberkeeper’). This synchronizing requires successful coordination, which in the TTT game is enabled by high-level “production rules” (Egidi 1996). These higher-level routine components store, regulate, and leverage the functions and responsibilities that actors fulfil in order to accomplish tasks. They are connected to the team level or even higher levels of analysis as they regulate how teams, through effective combinations of their members’ individual actions, achieve performance. Specifically, in the TTT game, these higher-level routine components define which team member is in charge of targeting the 2♥ card; as such, they give purpose to all exchanges (cf. lower-level routine components) that take place before the actual targeting move. Given that team members cannot communicate openly, these higher-level routine components provide an implicit form of team-level communication, which enables successful enactments of lower-level routine components. Accordingly, these higher-level routine components not only represent building blocks of capabilities but also can be seen as team-level capabilities themselves.

In TTT, higher-level routine components can be observed by analyzing the cards that are placed in the target position of the TTT game over the course of a given task. Task accomplishment in the TTT game requires teams to place the 2♥ card in the target position by

exchanging cards with the board positions. Specifically, the team members need to exchange cards with the board positions in a way that leads to a card constellation in which the target position holds a card that the team member with the matching skill (either the Colorkeeper or the Numberkeeper) can exchange with the 2♥ card when he or she has this card in his or her hand. The constellations of cards that are placed in the target position over the course of a task reveal how teams coordinate their members' functions and skills in order to successfully finish the task. There are two different coordination forms, which differ strongly from each other. Teams may either play the 2♥ card into the hand of the Colorkeeper, who then takes over the function of targeting the 2♥ card in the target position, or they may play the 2♥ card into the hand of the Numberkeeper, who then takes over the function of targeting the 2♥ card. Depending on whether the Colorkeeper or the Numberkeeper targets the 2♥ card, the last move of a task represents either an exchange of the 4♥ or 3♥ card with the 2♥ card (we denote this approach the '42/32 coordination form') or an exchange of the 2♣ card with the 2♥ card (we denote this approach the '22 coordination form'). Generally, 42/32 and 22 coordination forms are not equally effective for all tasks. Hence, teams may benefit from occasionally switching between 42/32 and 22 coordination forms, however, these changes only result in increased performance if both team members cooperate. The digital briefing for the game explained to participants how to solve a TTT hand by means of a 22 coordination form, making participants aware of this specific coordination form and its effects (Egidi & Narduzzo 1997). Subsequent changes between coordination forms could only be enacted successfully if team members developed a routine that enabled them to coordinate their functions effectively.

Regarding *lower-level routine components*, Cohen and Bacdayan (1994) show that teams playing TTT repeatedly execute individual actions (or moves), which "develop into 'chunks' that are run off as units" over time (Cohen & Bacdayan 1994: 561). Such lower-level action components of routines may represent the building blocks of higher-level routine components (i.e., they may be executed as part of 42/32 and 22 coordination routines).

However, they are only effective if they are successfully regulated by higher-level routine components. Accordingly, they comply with our notion of lower-level routine components (Parmigiani & Howard-Grenville 2011). In our experimental setting, lower-level routine components can be identified and differentiated according to the actions that team members execute as part of their 42/32 and 22 coordination routines. In TTT, each action can be associated with a card exchange with a field position on the virtual table or with an activation of the pass button. Thus, actions in the game may be aggregated into sequences that capture the chronological order according to which specific field positions or passes are activated over the course of one hand. In our measurements, these sequences take the shape of strings of letters, such as UDPTUUPT, where U denotes an exchange with a field position in which a card lies face up, D denotes an exchange with a field position in which a card lies face down, T denotes an exchange with the target position, and P denotes a pass. Following Cohen and Bacdayan (1994), we used this methodology and identified a wide array of action sequences, some of which are repeated throughout the game. To differentiate lower-level action components of routines from each other, we analyzed either the last four moves of a task (if a task was completed within four or more moves) or the last three moves of a task (if the task was solved within three moves, which is only possible in some uncomplex hands of the game). We chose this approach because the first few moves of each action string are usually very specific to the respective task, whereas the last few moves of each hand capture the actual placement of the 2♥ card in the target position.

***Change in higher-level routine components:*** In our experimental setting, change in higher-level routine components may take two different forms. First, teams might replace stable 42/32 or 22 coordination routines with the respective alternative coordination form (cf. change through replacements of higher-level routine components, Levinthal & March 1981). Second, teams that previously relied on stable 42/32 or 22 routines might replace their stable routines

with a more flexible routine mix that includes combinations of both coordination forms (cf. change through dynamic higher-level routine components/capabilities, Zollo & Winter 2002).[4] Our measure of change in higher-level routine components captures both forms of change. For each task *i* and each team *j*, we determine the degree of repetitiveness $HL_{ji}$ of the respective coordination form (i.e., either 42/32 or 22), which *j* applies to solve *i*. If, for *i*, *j* uses a certain coordination form for the $n^{th}$ time over the course of the game, $HL_{ji}$ takes the value of n. Our measure of change in lower-level routine components is calculated according to the following formula:

$$\textit{Change in higher-level routine components}_{ji} = \frac{1}{HL_{ji}} \quad (1)$$

This formula implies that if a team replaces a stable higher-level routine component with a new stable component, $\textit{Change in higher-level routine components}_{ji}$ takes the highest possible value (one) and decreases logarithmically with each additional iteration of the new stable routine. If a team replaces a stable higher-level routine component with a flexible mix of routine components, $\textit{Change in higher-level routine components}_{ji}$ increases temporarily with the first iteration of the new coordination form that is added to the existing coordination routine. The more evenly teams mix different coordination forms, the more logarithmically $\textit{Change in higher-level routine components}_{ji}$ decreases with each additional iteration.

***Change in lower-level routine components:*** To measure change in lower-level routine components, we used an approach that was very similar to our measure for change in higher-level routine components. For each task and team, we analyzed how often the specific action sequence that a team executed to complete a task was repeated during the course of the game up to the task. Thus, for each task *i* and each team *j*, we determined the degree of repetitiveness $LL_{ji}$ of the respective lower-level action pattern, which *j* applies to solve *i*. $LL_{ji}$ simply represents

[4] Furthermore, we account for the possibility that there might be transitions from flexible routine mixes to stable 42/32 or 22 routines. However, we did not view these transitions as routine change, as they actually correspond to increases in stability rather than to change.

a counter that captures how often team *j* repeated the respective action sequence, which it used to finish task *i*, prior to this hand (including the current repetition). Our measure for change in lower-level routine components is calculated according to the following formula:

$$\textit{Change in lower-level routine components}_{ji} = \frac{1}{LL_{ji}} \quad (2)$$

This formula implies that if a team changes its lower-level routine components by recombining moves in a new way, then our variable *Change in lower-level routine components*$_{ji}$ has a higher value. With each iteration of a previously enacted action sequence, *Change in lower-level routine components*$_{ji}$ decreases. Therefore, the measure enables us to differentiate between stable mixes of repeated action patterns and enhancements of lower-level routine components by modular performances (Rerup & Feldman 2011).

### 2.3.6. Independent measures

Teams in our performance feedback conditions received top-down performance reports informing them of how they performed in comparison to a peer group (a sample of students with similar backgrounds who participated in a pretest under equal conditions). We designed the performance feedback based on common performance feedback practices in sales organizations, where individual sales people or sales teams are often compared with others by some higher authority and receive rewards based on their relative performance. Participants knew they were competing in teams of two for a reward (iPad Air), which was awarded based on the performance of the team. Accordingly, all provided performance feedback referred to the performance of the team as a whole. To avoid selection biases resulting from low-performing teams exclusively receiving negative performance feedback and high-performing teams exclusively receiving positive performance feedback, we randomly sorted pairs of players into our different experimental conditions (Bandura & Cervone 1983; Tindale et al. 1991). Depending on their assignment, teams received either negative performance feedback (relative to the peer group), positive performance feedback (relative to the peer group), or no

performance feedback (control condition). We manipulated both negative and positive performance feedback at different points in time in order to control for timing effects (Gersick 1988). We provided the feedback either early in, throughout, or late in the game. Accordingly, we employed seven different experimental conditions, some of which we aggregated in our analyses (see details below). For our tests, we generally relied on the following independent variables.

***Performance feedback:*** This dummy aggregates all performance feedback conditions (= 1) and contrasts them with the control condition (= 0).

***Negative performance feedback:*** This dummy aggregates all performance feedback conditions in which negative performance feedback was provided (= 1) and contrasts them with the remaining conditions (= 0).

***Positive performance feedback:*** This dummy aggregates all performance feedback conditions in which positive performance feedback was provided (= 1) and contrasts them with the remaining conditions (= 0).

***Performance feedback timing:*** By means of several dummy variables, we controlled for different timings at which we provided performance feedback. We manipulated feedback timing to control for potential timing effects (Gersick 1988; Kozlowski & Klein 2000) that might affect the relationship between performance feedback and routine change. Yet, due to the fact that the theory on feedback timing is limited and provides no clear suggestions regarding the effects of feedback timing, we merely operationalized feedback timing as a control variable and did not explicitly interpret its effects. To ensure that differences between the timing conditions did not result from differences in the frequency of interventions, we subjected the teams in all conditions in which performance feedback was provided to the same number of interventions. Specifically, teams received performance feedback (1) at the beginning of the game after five, ten and 15 tasks (in these conditions, the dummy variable for early performance feedback becomes 1); (2) in an even distribution over the course of the game after ten, 20 and

30 tasks (continued performance feedback = 1); or (3) at a comparatively late point in the game after 20, 25 and 30 tasks (late performance feedback = 1).

***Task complexity:*** As Egidi (1996) and Egidi and Narduzzo (1997) showed, TTT comprises different levels of task complexity. A total of 13 tasks in the game feature comparatively lower levels of task complexity, whereas 27 tasks feature higher levels of task complexity.

The 13 less complex tasks represent card constellations that favor one specific solution. These tasks cue teams to use a certain approach and, accordingly, require comparatively less coordinative effort. Specifically, less complex tasks include card constellations that enable teams to directly exchange the 2♥ card with the card that is originally located in the target position. Given that a task is accomplished when the 2♥ card is placed in the target position, teams simply need to find the 2♥ (which may be in one of the remaining field positions on the table or in one of the players' hands) and pass it to the team member who has the required skill to exchange it with the card in the target position. For example, if the initial card in the target position is the 3♥ or 4♥, only the Colorkeeper has the required skill to effectively place the 2♥ in the target position. On the other hand, if the initial card in the target position is the 2♣, only the Numberkeeper is able to place the 2♥ in the target position. Accordingly, less complex tasks favor certain solutions, thus reducing the complexity.

The 27 more complex tasks represent card configurations that do not favor one specific solution. These tasks begin with a card in the target position that cannot be directly replaced by the 2♥ card by either team member (e.g., 4♣ or 3♣). Consequently, to solve a complex task, teams need to exchange the initial card in the target position with a 'bridge card', which, in turn, can be replaced by the 2♥. This bridge card influences how the team continues to play, as it determines whether the Colorkeeper or the Numberkeeper subsequently targets the 2♥. If the bridge card is the 4♥ or 3♥, the Colorkeeper takes over the function of finishing the task. If the bridge card is the 2♣, the Numberkeeper finishes the task. Thus, for complex tasks, teams need

to accomplish two jobs simultaneously. First, they have to coordinate which team member will take over the function of targeting the 2♥ by picking a suitable bridge card. Second, they need to move the 2♥ into the hand of the player who is supposed to finish the task. Given that team members cannot openly communicate, this requirement of two simultaneous and coordinated acts adds complexity to these 27 tasks.

Accordingly, the 27 more complex tasks of the TTT game feature a substantial increase in task complexity relative to the 13 less complex tasks. The complex tasks comprise of more ambiguity and difficulty (Akgün et al. 2005; Scott & Tiessen 1999), as they relate to an increase in the number of possible combinations (Becker 2005) of routine components that can be applied to accomplish these tasks (Egidi 1996). We operationalized task complexity by forming a variable “task complexity" that takes a value of zero for the 13 low-complexity tasks and a value of one for the 27 high-complexity tasks.

## 2.4. Experimental results

### 2.4.1. Manipulation check

Following the card game, we asked all participants to estimate their team’s performance in the TTT game relative to other teams. On average, participants in the negative performance feedback conditions estimated that their team was outperformed by 63.73 percent (*SD* = 19.78) of the other participating teams. On the other hand, participants in the positive performance feedback conditions estimated that their team was outperformed by only 26.58 percent (*SD* = 12.08) of the other teams, $t(152) = 14.15$, $p < 0.001$. Finally, participants in the control condition estimated that their team was outperformed by 37.69 percent (*SD* = 16.57) of the other teams in their peer group (and therefore systematically overestimated their performance). Thus, overall, our performance feedback manipulations were successful.

### 2.4.2. Descriptive statistics and correlations

Table 1 reports the means of the main variables and their correlations at the 'task level'. Table 1 suggests that changes in higher-level routine components are positively correlated with changes in lower-level routine components. Accordingly, in each task in which teams changed higher-level routine components, they were also comparatively more likely to change lower-level routine components.

**Table 1: Descriptive statistics and correlations (level of analysis: Task-level)**

| | | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(1)** | Change in higher-level routine components | 0.18 | 0.22 | 1 | | | | | | | | | |
| **(2)** | Change in lower-level routine components | 0.57 | 0.35 | 0.42*** | 1 | | | | | | | | |
| **(3)** | Performance | 20.25 | 13.15 | -0.23*** | -0.08*** | 1 | | | | | | | |
| **(4)** | Performance feedback | 0.85 | 0.35 | 0.00 | 0.01 | -0.05*** | 1 | | | | | | |
| **(5)** | Negative performance feedback | 0.41 | 0.49 | 0.01 | 0.00 | -0.11*** | 0.34*** | 1 | | | | | |
| **(6)** | Positive performance feedback | 0.44 | 0.50 | -0.01 | 0.01 | 0.07*** | 0.35*** | -0.76*** | 1 | | | | |
| **(7)** | Task complexity | 0.67 | 0.47 | 0.04 | -0.10*** | -0.01 | 0.00 | -0.01 | -0.01 | 1 | | | |
| **(8)** | Early performance feedback | 0.30 | 0.46 | 0.00 | 0.00 | 0.06*** | 0.26*** | 0.07*** | 0.10*** | 0.01$^{+}$ | 1 | | |
| **(9)** | Continued performance feedback | 0.29 | 0.45 | -0.00 | -0.01 | 0.03*** | 0.25*** | 0.05*** | 0.12*** | 0.00 | -0.40*** | 1 | |
| **(10)** | Late performance feedback | 0.27 | 0.44 | 0.01 | 0.02 | -0.13*** | 0.25*** | 0.13*** | 0.04*** | -0.01$^{+}$ | -0.41*** | -0.40*** | 1 |
| **(11)** | Task index | 19.41 | 11.44 | -0.66*** | -0.48*** | 0.28*** | -0.03*** | -0.04*** | 0.02** | 0.02*** | 0.02* | 0.00 | -0.04*** |

$^{+}$ *p ≈ 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001; n = 3512*

### 2.4.3. The relationship between performance feedback, task complexity, and routine change

We tested our hypotheses regarding the relationship between performance feedback and routine change by conducting several OLS regression analyses. Given that the intensity of a routine change was determined by the stability of a team's actions before it changed its routines, we analyzed routine change at the task level. That is, in our regression analyses, for each of the tasks performed by any participating team, we observed how much change in higher-level and

lower-level routine components the team enacted with respect to that specific task. Based on the assumption that a routine needs to exist before it can be changed, we accounted for a routine development period by excluding from our analyses the first four tasks that each participating team completed (Laureiro-Martinez 2014). Moreover, in our regression models, we controlled for the task index (represented by a variable from 1-40). Given the non-linear characteristics of our dependent variables (Figure 2 and Figure 3), we also controlled for the squared task index and the logarithmized task index. Figure 2 and Figure 3 visualize changes in higher-level and lower-level routine components in the TTT game and show that change in higher-level (relative to lower-level) routine components decreased more strongly over the course of the TTT game.

*Figure 2: Observed change in higher-level routine components*

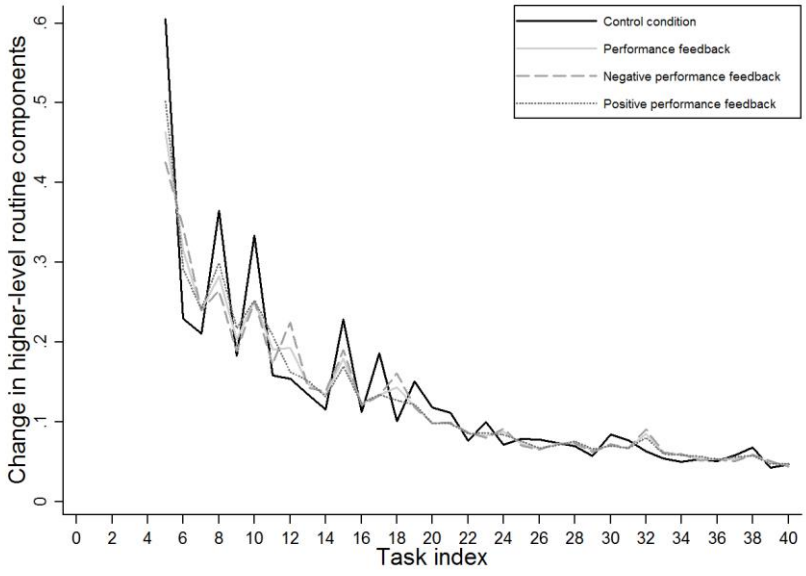
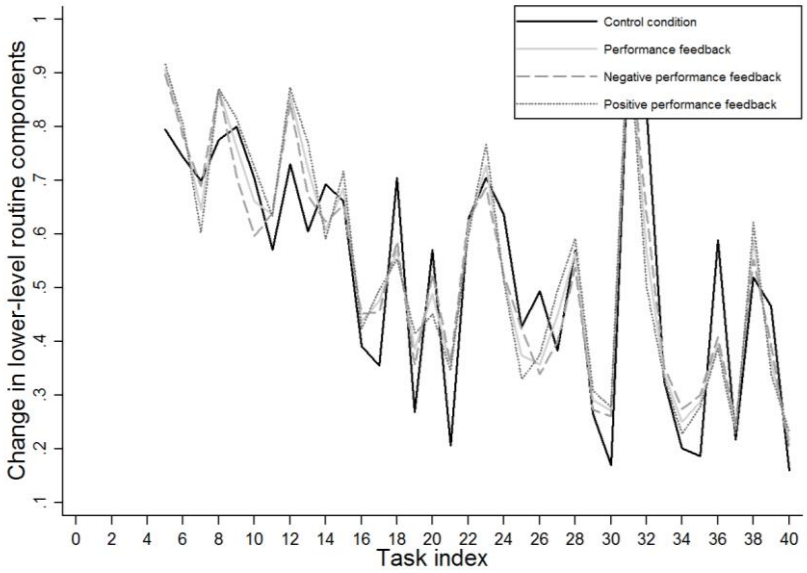


*Figure 3: Observed change in lower-level routine components*




***Performance feedback × task complexity:*** In H1, we hypothesized that performance feedback in combination with higher (vs. lower) task complexity results in greater change in higher-level routine components. In order to test H1, we conducted a regression analysis (Table 2), in which we tested whether teams in the feedback conditions changed their higher-level routine components differently than teams in the control condition (which received no performance feedback). Our regression analysis suggests that the interaction of performance feedback and higher task complexity results in increased change in higher-level routine components ($b$ = 0.039, $p$ < 0.001). Accordingly, we find strong support in favor of H1. As predicted, performance feedback in combination with higher (vs. lower) task complexity results in greater change in higher-level routine components. Interestingly, in this analysis (and further analyses below) we observe interaction effects of performance feedback and task complexity that are opposed to the respective main effects of these individual variables. Specifically, in our test of H1, the observed positive interaction effect of performance feedback and task complexity outweighs the negative main effect of performance feedback (please note that, in our interpretation, we do not consider the main effect of task complexity, as task complexity is considered an exogenous moderator). Thus, we may conclude that the positive interaction of

performance feedback and task complexity reverses the negative main effect of performance feedback on change in higher-level routine components.

**Table 2: The effects of performance feedback and task complexity on routine change (OLS regression model)**

| | | Change in higher-level routine components | | | Change in lower-level routine components | |
|---|---|---|---|---|---|---|
| | | Coeff. | *S.E.* | | Coeff. | *S.E.* |
| Performance feedback | | -0.029*** | *0.008* | | 0.035 | *0.026* |
| | | (0.000) | | | (0.175) | |
| Task complexity | | -0.069*** | *0.009* | | -0.047 | *0.030* |
| | | (0.000) | | | (0.113) | |
| Performance feedback × task complexity | **H1** | **0.039*** ** | *0.010* | **H2** | **-0.044** | *0.032* |
| | | (0.000) | | | (0.170) | |
| Task index | | 0.023*** | *0.003* | | 0.010 | *0.011* |
| | | (0.000) | | | (0.402) | |
| Task index squared | | -0.000*** | *0.000* | | -0.000 | *0.000* |
| | | (0.000) | | | (0.361) | |
| Task index logarithmized | | -0.371*** | *0.027* | | -0.276** | *0.088* |
| | | (0.000) | | | (0.002) | |
| Constant | | 0.884*** | *0.032* | | 1.237*** | *0.103* |
| | | (0.000) | | | (0.000) | |
| Observations | | 3,169 | | | 3,235 | |
| $R^2$ | | 0.487 | | | 0.178 | |

*Level of analyses: Task-level. First four hands of the game excluded to account for a routine development period; P-values in parentheses; ** p < 0.01, *** p < 0.001*

In H2, we hypothesized that performance feedback in combination with higher task complexity results in less change in lower-level routine components. In order to test H2, we conducted another regression analysis (also shown in Table 2), in which we tested whether teams in the feedback conditions changed their lower-level routine components differently than teams in the control condition. Our regression analysis suggests no clear effect of the interaction of performance feedback and task complexity on change in lower-level routine components ($b$ = -0.044, $p$ < 0.170). Accordingly, we reject H2. Performance feedback in combination with higher task complexity does not clearly result in less change in lower-level routine components.

***Negative performance feedback × task complexity:*** In H3, we hypothesized that negative performance feedback in combination with higher task complexity results in greater

change in higher-level routine components. In order to test H3, we conducted a regression analysis (Table 3), in which we tested whether teams in the negative feedback conditions changed their higher-level routine components differently than teams in the control condition. Our regression analysis suggests that the interaction of negative performance feedback and task complexity results in increased change in higher-level routine components ($b$ = 0.037, $p$ < 0.001). Accordingly, we find strong support in favor of H3. As predicted, the interaction of negative performance feedback and higher task complexity results in comparatively more change in higher-level routine components.

**Table 3: The effects of negative and positive performance feedback and task complexity on routine change (OLS regression model)**

| | | **Change in higher-level routine components** | | | **Change in lower-level routine components** | |
|---|---|---|---|---|---|---|
| | | Coeff. | *S.E.* | | Coeff. | *S.E.* |
| Negative performance feedback | | -0.028*** | *0.008* | | 0.023 | *0.028* |
| | | (0.001) | | | (0.405) | |
| Positive performance feedback | | -0.030*** | *0.008* | | 0.046$^{+}$ | *0.027* |
| | | (0.000) | | | (0.092) | |
| Task complexity | | -0.069*** | *0.009* | | -0.047 | *0.030* |
| | | (0.000) | | | (0.113) | |
| Negative performance feedback × task complexity | **H3** | 0.037*** | *0.010* | **H4** | -0.032 | *0.035* |
| | | (0.000) | | | (0.356) | |
| Positive performance feedback × task complexity | **H5a/ H5b** | 0.041*** | *0.010* | **H6** | -0.056$^{+}$ | *0.034* |
| | | (0.000) | | | (0.103) | |
| Task index | | 0.023*** | *0.003* | | 0.010 | *0.011* |
| | | (0.000) | | | (0.405) | |
| Task index squared | | -0.000*** | *0.000* | | -0.000*** | *0.000* |
| | | (0.000) | | | (0.363) | |
| Task index logarithmized | | -0.371*** | *0.027* | | -0.276** | *0.088* |
| | | (0.000) | | | (0.002) | |
| Constant | | 0.884*** | *0.032* | | 1.237*** | *0.103* |
| | | (0.000) | | | (0.000) | |
| Observations | | 3,169 | | | 3,235 | |
| $R^2$ | | 0.487 | | | 0.179 | |

*Level of analyses: Task-level. First four hands of the game excluded to account for a routine development period; P-values in parentheses; $^{+}$ $p \approx 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

In H4, we hypothesized that negative performance feedback in combination with higher task complexity results in less change in lower-level routine components. In order to test H4, we conducted another regression analysis (also shown in Table 3), in which we tested whether

teams that received negative performance feedback changed their lower-level routine components differently than teams that received no performance feedback. Our regression analysis suggests no clear effect of the interaction of negative performance feedback and task complexity on change in lower-level routine components ($b$ = -0.032, $p$ < 0.356). Accordingly, we reject H4. Negative performance feedback in combination with higher task complexity does not clearly result in less change in lower-level routine components.

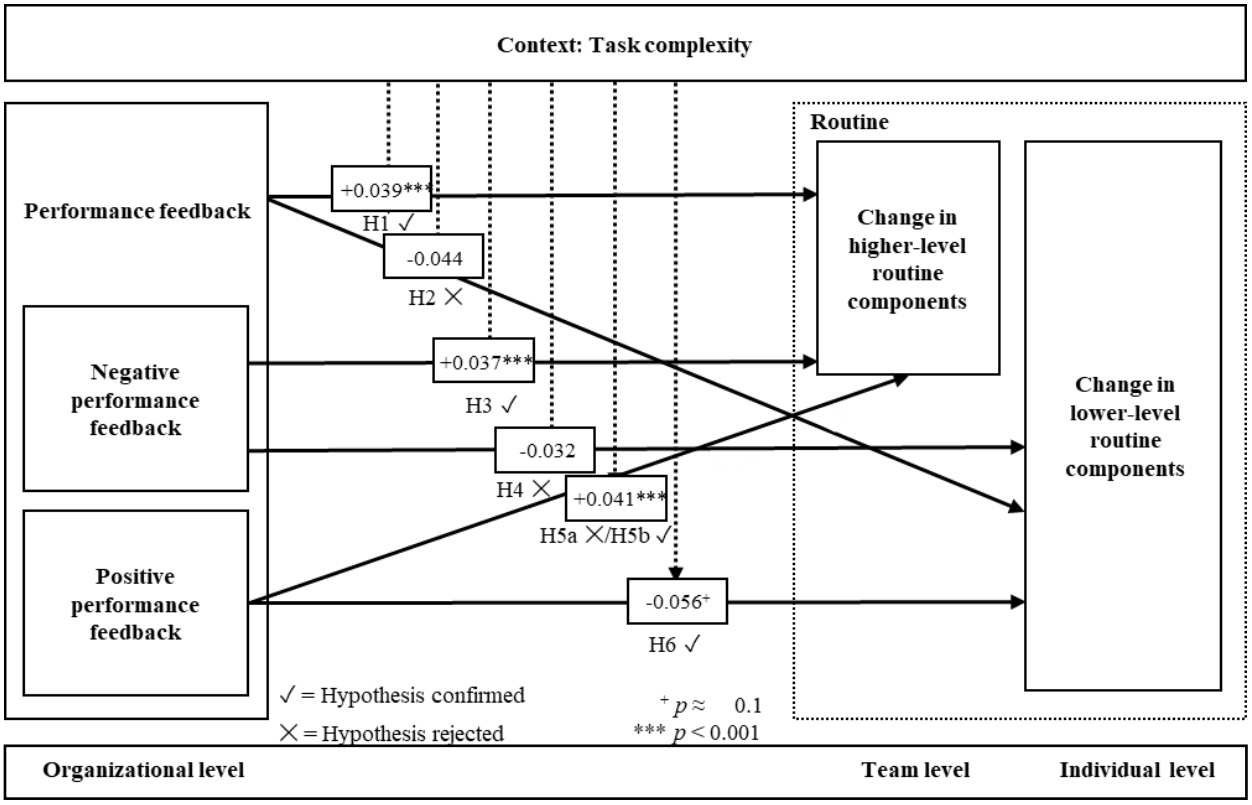
***Positive performance feedback × task complexity:*** In H5a, we hypothesized that positive performance feedback in combination with higher task complexity results in less change in higher-level routine components. In contrast, in H5b, we associated positive performance feedback with 'slack search', and we hypothesized that positive performance feedback in combination with higher task complexity results in greater change in higher-level routine components. Our regression analysis, which we present in Table 3, suggests a positive interaction effect for positive performance feedback and task complexity ($b$ = 0.041, $p$ < 0.001). Accordingly, we reject H5a and confirm H5b. Positive performance feedback in combination with higher task complexity results in greater change in higher-level routine components.

In H6, we hypothesized that positive performance feedback in combination with higher task complexity results in less change in lower-level routine components. Our regression model in Table 3 suggest a negative interaction effect of positive performance feedback and task complexity that corresponds to less change in lower-level routine components, although this effect is only slightly significant ($b$ = -0.056, $p$ < 0.103). Thus, our findings weakly support H6. Positive performance feedback in combination with higher task complexity tends to result in less change in lower-level routine components.

***Summary of findings:*** Figure 4 provides an overview of our findings. Regarding change in higher-level routine components, in line with our hypotheses, our analyses reveal positive interaction effects for performance feedback and task complexity (H1), for negative performance feedback and task complexity (H3), and for positive performance feedback and

task complexity (H5b), which are opposed to the main effects of (negative and positive) performance feedback on higher-level routine change. Thus, the interplay of performance feedback and task complexity reverses the relationship between (negative and positive) performance feedback and change in higher-level routine components. Regarding change in lower-level routine components, contrary to our hypotheses, our analyses reveal no clear interaction effects for performance feedback and task complexity (H2) or for negative performance feedback and task complexity (H4). However, we observe a slightly significant negative interaction effect for positive performance feedback and task complexity (H6). In summary, our tests suggest the following: first, performance feedback differentially affects change in higher-level and lower-level routine components; second, these effects are moderated by task complexity; and third, both negative and positive performance feedback lead to routine change.

*Figure 4: Summary of findings: Observed interaction effects between performance feedback and task complexity and their effects on change in higher-level and lower-level routine components*



## 2.5. Discussion

This study set out to explain how top-down performance feedback affects routine change within organizations. Previous research identified top-down performance feedback as a 'master switch' of routine change, but empirical analyses of this relationship have been mostly limited to 'macro routines' (Greve 1998; 2003b), which denote higher-level constructs (e.g., strategies or capabilities) that aggregate lower-level constructs (e.g., routines). Whereas previous research assumed that feedback-triggered change in these higher-level constructs would bring about change in organizational routines (Greve 2008), so far no reliable evidence has been produced to support these claims (Avery 1996). Most of the recent efforts to explore the microfoundations of routine change have focused on the bottom-up effects of performance feedback (Wee & Taylor 2018) and thus failed to account for the fact that pressures for change often originate at higher levels within the organization, from which they are passed on to lower levels (Greve 2008). Thus, we asked: How does top-down performance feedback affect routine change across different levels of analysis, specifically at the team level, to which the concept of the routine is predominantly tied (Salvato & Rerup 2011)? To answer this question, we conducted a laboratory experiment, in which we tested our expectation that the following three steps would result in a better understanding of the multilevel relationship between top-down performance feedback and routine change: first, differentiating between change in higher-level and lower-level routine components; second, accounting for interaction effects between performance feedback and task complexity; and third, differentiating between negative and positive performance feedback. The results of our experiment showed the following clear indications: first, that performance feedback differentially affects change in higher-level and lower-level routine components; second, that this relationship is moderated by task complexity; and third, that both negative and positive performance feedback may result in routine change.

### 2.5.1. Performance feedback differentially affects change in higher-level and lower-level routine components

Our finding that top-down performance feedback (moderated by task complexity) has a different effect on higher-level routine components than on lower-level routine components suggests that a multilevel perspective is required in order to understand how top-down performance feedback guides routine change within organizations. We find that different components of a single routine that relate to different levels of analysis react quite differently to top-down performance feedback. Specifically, we find that performance feedback generally has more predictable effects on change in higher-level components of a team's routine (i.e., those aspects of routines that store, regulate, and leverage actors' functions and responsibilities in solving tasks) than it has on change in their lower-level routine components (i.e., those aspects of routines that store the concrete actions and interactions of the individuals that take part in the routine).

Therefore, differentiating the individual components of routines is vital for achieving a better understanding of the top-down effects of performance feedback on routine change. Based on our findings, future research that aims to explain routine change might more precisely differentiate between different components of routines and their respective dynamics.

### 2.5.2. Task complexity moderates the effects of performance feedback on routine change

Our finding that task complexity moderates the relationship between top-down performance feedback and routine change adds more depth to previous models of the relationship between performance feedback and routine change (Greve 1998; 2008). Specifically, our findings suggest that task complexity affects two aspects of performance feedback: first, whether performance feedback affects higher-level or lower-level routine components; and second, whether performance feedback leads to more or less change in higher-level and lower-level routine components.

We found that, in more complex tasks, top-down performance feedback directs change efforts towards higher-level routine components, whereas in less complex tasks it directs change efforts away from higher-level routine components (in the case of positive feedback) towards lower-level routine components. It is likely that, due to the comparatively higher number of possible combinations of higher-level and lower-level routine components that can be applied to accomplish more complex tasks (Becker 2005), feedback recipients in such tasks cannot directly associate the performance feedback with specific routine components. Accordingly, in more complex tasks, performance feedback results in broader questions regarding the overall performance of the team, unit or organization. In contrast, in less complex tasks, performance feedback can be directly related to problems with specific routine components, which can be changed accordingly. Thus, our findings reveal that task complexity determines how top-down performance feedback is interpreted and whether it results in changes in higher or lower-level routine components.

Moreover, our findings suggest that task complexity reverses the main effects of some forms of top-down performance feedback on routine change. With regards to change in higher-level routine components, we observed that performance feedback (either negative or positive) in combination with more (vs. less) task complexity results in more change in these components, whereas performance feedback (either negative or positive) generally results in less change in these components. With regard to change in lower-level routine components, we generally observed comparatively less significant interactions between performance feedback and task complexity. Nevertheless, we found that positive performance feedback in combination with more (vs. less) task complexity results in slightly less change in lower-level routine components, whereas the main effect of positive performance feedback is (slightly significantly) positive.

Thus, the complexity of a task determines whether performance feedback leads to more or less routine change. Hence, we suggest that future research on routine change should shed

more light on the complexity of the tasks that the analyzed routines aim to accomplish. In this effort, future research can draw from an array of previous studies that broach the issue of task complexity in the context of routine research (Becker 2005; Pentland 1995; 2003).

### 2.5.3. Not only negative performance feedback but also positive performance feedback may trigger routine change

Our finding that, conditional on task complexity, not only negative but also positive top-down performance feedback may trigger routine change contrasts with most of the previous routine literature. Most previous studies of routine change either exclusively focused on negative performance feedback (Rerup & Feldman 2011; Shimizu 2007) or associated positive performance feedback with decreases in routine change (Greve 1998; with the notable exception of Greve 2003a). In contrast, we find that positive top-down performance feedback (in combination with higher task complexity) results in more change in higher-level routine components, and that positive performance feedback (in combination with lower task complexity) results in more change in lower-level routine components.

A potential explanation for this finding points to slack search, a form of change that has mostly been researched at the organizational level and that may occur when organizations perform above their aspirations (Cyert & March 1963; Greve 2003a; Simon 1947; 1957). In our setting, the positive performance feedback might have encouraged teams to experiment with and change their routines. In more complex tasks, possibly due to the generally higher potential for variation in routines in such tasks (Becker 2005), these change efforts were comparatively more likely to be directed towards higher-level routine components. In less complex task, the change efforts were more likely to be directed towards lower-level routine components. This is perhaps because performance feedback could be more closely associated with specific routine components in such tasks. Nevertheless, these explanations are preliminary, and the

relationship between positive performance feedback and routine change remains under-researched.

As such, future research could shed more light on the complex relationship between positive performance feedback and routine change. In this effort, future research might seek to more precisely differentiate the motivational, learning, and cueing effects of performance feedback (Nadler 1979).

### 2.5.4. Implications for organizational research

Whereas entity perspectives of routines assume that top-down performance feedback somehow guides routine change across several levels of analysis, previous research has so far not explored these effects empirically (Greve 2008). We derived a multilevel research model that explains this relationship in detail and provided evidence that top-down performance feedback, in fact, predictably affects routine change across different levels of analysis (specifically at the team and individual levels). Our findings indicate that, first, performance feedback differentially affects change in higher and lower-level routine components; second, that this relationship is moderated by task complexity; and third, that both negative and positive performance feedback may result in routine change. These findings hold some important theoretical contributions.

First, our findings suggest that, to some extent, team-level and individual-level routine change can be predicted by organizational-level theories. Our research model, which we largely based on organizational-level models of change and entity perspectives of routines (Greve 1998; 2008; Nelson & Winter 1982), successfully predicted how top-down performance feedback under consideration of task complexity affected change in teams' higher-level routine components, as well as, to a lesser extent, how this interaction affected change in lower-level routine components. Thus, we enhance the established organizational-level models for lower levels of analysis, specifically for the team and individual levels, and show that the organizational theory predicts not only organizational-level change (Greve 1998) but also, to

some extent, change at lower levels of analysis. We tested our multilevel research model at the interface of team-level and individual-level actions and interactions. We urge future research to find and explore further missing parts in the organizational theory in order to close the micro-macro divide in routine and management research (Salvato & Rerup 2011). Specifically, we suggest exploring potential interactions of organizational-level, unit-level, group-level, and team-level forms of change to provide a more complete multilevel perspective of routine change.

Second, our findings suggest that performance feedback shapes routines not only in a bottom-up fashion (Rerup & Feldman 2011) but also in a top-down fashion. Whereas generative systems perspectives of routines often conceptualize routine change as a heterogeneous, endogenous, and unpredictable bottom-up phenomenon (Pentland et al. 2011; Rerup & Feldman 2011), we show that routine change, not only at the organizational level but also at lower levels of analysis, is systematically guided by top-down performance feedback. Although we generally concur with previous microfoundational studies, which suggest that routine change takes place largely heterogeneously (Pentland et al. 2011; Rerup & Feldman 2011), we enhance these perspectives by showing that team-level routines can be managed actively to some extent—even by simple means, such as performance feedback. We leave it to future research to explore how the bottom-up and top-down dynamics of performance feedback interact and what consequences such potential interactions have for routine change at different levels of analysis.

### 2.5.5. Managerial implications

Previous research on performance feedback and routine change has been limited in its practical implications, as it either focused on organizational-level mechanisms, e.g. how organizations react to exogenous feedback from the market environment, (Greve 1998) or, alternatively, focused on heterogeneous lower-level mechanisms, which are difficult to control through

managerial interventions (Pentland et al. 2011). In contrast, our findings suggest that practitioners can systematically use top-down performance feedback in order to manage the routines of teams and individuals (e.g., to align them with organizational goals). Specifically, our findings have the following important practical contributions.

First, in work environments that predominantly feature comparatively more complex tasks (i.e., those that require high levels of coordination; e.g., R&D departments), managers can induce change in higher-level routine components by providing both negative and positive top-down performance feedback. In contrast, in work environments that predominantly feature less complex tasks (i.e., those that require low levels of coordination; e.g., highly standardized administrative processes), managers can increase stability in higher-level routine components by providing negative or positive top-down performance feedback (or alternatively can keep routines flexible by not providing performance feedback). Thus, when managers intend to enable their teams to organize more flexibly in order to cope with their dynamic environment, they are advised to provide performance feedback only when task complexity is high and to abstain from providing performance feedback otherwise.

Second, in work environments that feature complex tasks, managers can use positive top-down performance feedback in order to increase stability in lower-level routine components. In contrast, in work environments that feature less complex tasks, managers can use positive top-down performance feedback in order to induce more change in these components. Thus, when managers intend to affect the concrete actions of individuals in teams, positive performance feedback seems to be a more effective mechanism than negative performance feedback. Nevertheless, our findings regarding the relationship between performance feedback and change in lower-level routine components are comparatively weak. Top-down performance feedback is generally better suited to guide change in higher-level rather than lower-level routine components.

Third, we find that both negative and positive performance feedback have comparable effects on routine change. In fact, it is not the positive or negative valence of feedback but rather the complexity of the task to which it refers that determines whether performance feedback results in more or less change. Thus, managers who intend to manage change through performance feedback should put less emphasis on the positivity of performance feedback and more emphasis on task complexity. For instance, if managers use leaderboards to rank the performance of different teams, instead of ranking teams' overall performance they might consider ranking teams' performance in different types of tasks (cf. higher vs. lower task complexity). In this way, routines relating to more (vs. less) complex tasks can be managed separately and more effectively. Our findings generally support the following rule of thumb: The more likely performance feedback is to result in broad open questions (cf. high task complexity) the more likely it is to result in higher-level routine change; conversely, the more likely performance feedback is to reveal specific problems, the more likely it is to result in lower-level change.

### 2.5.6. Limitations

This study has limitations that are partially related to the methodology and design. First, although our measures of change are based on previous experimental studies (Egidi 1996; Egidi & Narduzzo 1997), they are associated with our specific experimental task, the TTT card game. Although TTT was developed to simulate a typical team task, routines in the field are likely to be more sophisticated than routines in TTT, and they can be expected to comprise many different layers of interrelated routine components. For instance, our setting only features teams of two. Despite the fact that it is common in experimental studies of routines to observe the behavior of pairs of participants (Cohen & Bacdayan 1994; Egidi & Narduzzo 1997), it can be argued that these settings do not sufficiently account for the dynamics that may occur in groups of three or more members. Moreover, whereas our experimental design technically allows for

causal interpretations with regard to the effects of performance feedback on routine change, such interpretations are limited to our specific setting and routine components we observe in our setting. Nevertheless, the routine components we observed in the TTT game featured many of the characteristics of routines that can be observed in the field (Cohen & Bacdayan 1994). Moreover, in contrast to observational field studies, our experimental approach features a high degree of internal validity. Also, in our experimental setting, we provided performance feedback that only referred to one system parameter—performance—to be enhanced in order to maximize rewards. Thus, we isolated participants from severe goal and aspiration conflicts, which are often observed in the field (D'Adderio 2014). Future research could aim to explain goal and aspirational conflicts more effectively in this context.

## 2.6. Conclusion

In conclusion, this study provides experimental evidence regarding how performance feedback affects routine change. Our key findings were as follows: first, performance feedback differentially affects change in higher and lower-level routine components; second, task complexity moderates the effects of performance feedback on routine change; and third, not only negative but also positive performance feedback may trigger routine change. Our findings provide explanations as to how performance feedback affects routine change at the team and individual levels in a top-down fashion, thus bridging organizational-level models of change (which so far have been limited to explaining change in higher-level constructs) and microfoundational models of change (which so far have been limited to explaining the bottom-up effects of performance feedback while overlooking top-down effects).

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# 3. War and peace: How conflict affects teams' decisions whether to enact routines or creative projects

**Abstract:**

This study explores the causal relationship between conflict and actions taken by teams to accomplish their tasks. We differentiated between two forms of action trajectories, routines and creative projects, and used a laboratory experiment with a 2 (task conflict: yes vs. no) × 2 (interpersonal conflict: yes vs. no) factorial design to test how task and interpersonal conflicts affect teams' decisions to enact routines or less routine creative projects. Teams subjected to task, interpersonal, or a combination of task and interpersonal conflict solved recurring challenges in the computer game Minecraft. We find that both task and interpersonal conflict independently increase teams' tendency to pursue change by enacting creative projects. We conclude that task and interpersonal conflict lead teams to avoid developing routines and to attempt creative projects.

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## 3.1. Introduction

Teams often face a decision between either maintaining and/or incrementally modifying their routines or initiating non-routine 'creative projects', which either initiate entirely new action or challenge existing routines (Obstfeld 2012). Both routines and creative projects can be understood as action trajectories, which vary on a continuum between highly repetitive routines and relatively non-repetitive creative projects (Obstfeld 2012; Winter 2006). Routine action trajectories are at the root of established organizational practices and organizational capabilities (Parmigiani & Howard-Grenville 2011). These trajectories are not entirely fixed, and they serve as the basis for teams to simultaneously exploit and adjust existing processes (Feldman & Pentland 2003). In turn, creative projects action trajectories allow organizations to get "markedly distinct new things […] started" (Obstfeld 2012: 1573), i.e., to initiate completely new action that cannot be adequately described by the routine construct, "no matter how [it] is stretched or redefined" (Obstfeld 2012: 1573). Teams might alternate between routine and creative project action trajectories as a means of responding to context and balancing innovation and stability (Obstfeld 2012). Insights about what drives these alternations provide a better understanding of why and how teams evolve, adapt, and succeed.

Teams' choices between routine and creative project action trajectories could be driven by conflicts that occur between team members. Researchers of conflict often agree that conflict generally comes in (at least) two different forms: task conflict and interpersonal conflict. Task conflict is "rooted in the substance of the task which the group is undertaking", whereas interpersonal conflict derives "from the emotional, affective aspects of the group's interpersonal relations" (Guetzkow & Gyr 1954: 369). There is indication that both task and interpersonal conflict might influence routines and creative projects. Regarding routines, Nelson and Winter (1982) argue that task and interpersonal conflict explain the existence of routines, which offer a truce that allows organizations to function despite conflict. Related perspectives suggest not

only that routine action trajectories may enable teams to cope with conflict but also that routines may in fact engender latent conflict (Pentland & Feldman 2005; Zbaracki & Bergen 2010). Regarding creative projects, there is evidence that task conflict may stimulate creative action in teams, whereas interpersonal conflict tends to be detrimental to creative action (De Dreu & West 2001; Jehn 1994). Thus, conflict may have an impact on the formation and conduct of both routines and creative projects (Obstfeld 2012; Zbaracki & Bergen 2010).

However, previous studies have separated routines and creative projects in order to understand the influences of conflict on team-level action trajectories (Jehn 1995; Zbaracki & Bergen 2010). In contrast, recent advances in behavioral theory suggest that routines and creative projects represent different sides of the same coin, i.e., different related action trajectory forms, between which teams alternate to get their tasks done and to get new endeavors started (Obstfeld 2012). Yet, while we know that conflict strongly affects both routines and creative projects separately from each other, we do not know, at this point, *how task and interpersonal conflict causally affect teams' decisions whether to enact routine or creative project action trajectories.*

This lack of knowledge is critical, given that choosing between routines and creative projects may be decisive for whether and how teams (as nuclei of organizational dynamics) change (Obstfeld 2012). Neither routines nor creative projects are ends in themselves. That is, whether routines and creative projects are beneficial to performance depends entirely on context. As a matter of fact, teams can often alternate quite freely between routines and creative projects (Obstfeld 2012). Many – if not most – working contexts do not prescribe a certain form of action trajectory. In such 'anarchic contexts' (Cohen et al. 1972), teams' decisions whether to enact routines or creative projects may be decisive for an organization's future success (Obstfeld 2012). Despite the high frequency and overall importance of conflict in dynamic environments, little is known about how conflict influences teams' decisions whether to enact routines or creative project action trajectories. A better understanding of these influences could

have important managerial implications with respect to how conflict can be managed, remedied and even induced as a means to shape action trajectories and better manage organizational change and innovation.

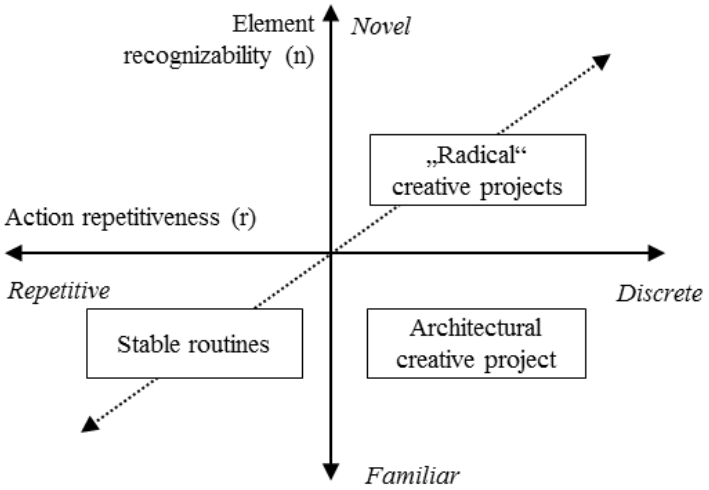
We aimed to fill this research gap by means of a laboratory experiment. Building on Obstfeld (2012), we conceptualized routines and creative projects as two different gradations of action trajectories, both of which are located within the same behavioral context. We draw from behavioral theory and creativity research to predict how conflict shapes action trajectories. Our innovative experimental approach, built around the computer game Minecraft, allowed us to explore how task and interpersonal conflict causally affected the action trajectories of collaborating teams that repeatedly faced similar challenges in a dynamic environment. We found that both task and interpersonal conflict increased teams' tendencies to enact creative projects instead of routines, whereas combinations of task and interpersonal conflict led to relatively more routine action trajectories. Our findings contribute to a better understanding of conflict as a driver of routines and creative action in dynamic environments.

### 3.2. Theory

To understand how conflict affects decisions between routine and creative project action trajectories, it is important to understand how routines and creative projects are connected. Both routines and creative projects consist of actions of and interactions between team members. These actions and interactions can be attributed to routines and creative projects through an action trajectory perspective (Obstfeld 2012). The action trajectory perspective is based on the assumption that routinization and creative action are not dichotomous and that "[t]here is, instead, a quite continuous gradation from highly routine behavior to highly innovative behavior" (Winter 2006: 139). While Obstfeld's (2012) action trajectory perspective is not the first perspective to account for the coexistence of nonroutine, less routine and routine forms of behavior (Brown & Eisenhardt 1997; Cohen et al. 1972; Miner et al. 2001), the previous

research tended to distinguish these phenomena at the firm level. In contrast, Obstfeld's (2012) action trajectory perspective introduced a microfoundational perspective on organizing that can be integrated into the foundational routines literature, therefore remedying "the absence of a conceptually integrated account of how organizations not only get things done, but how they start and achieve markedly distinct new things" (Obstfeld 2012: 1572). From this microfoundational perspective, actions and interactions form part of action trajectories, which can be allocated along a behavioral spectrum according to their degree of repetitiveness and novelty (Obstfeld 2012). From the action trajectory perspective, routines are associated with a high degree of repetitiveness in action, whereas creative projects are associated with a low degree of repetitiveness. An action trajectory's degree of novelty, in turn, determines whether non-repetitive action trajectories are seen either as radical creative projects (low degree of repetitiveness, high degree of novelty) or as architectural creative projects (low degree of repetitiveness, low degree of novelty; cf. Figure 5). Radical creative projects represent creative and less predictable explorations of entirely novel approaches, whereas architectural creative projects represent a more predictable recombination of familiar actions and interactions.

*Figure 5: Two dimensions of interdependent action (Obstfeld 2012)*




According to the action trajectory perspective, some creative projects may become more repetitive and familiar over time and evolve into routines. Others remain 'temporary endeavors'

(Duncan 1996) that allow "anticipating or responding to emergent means and ends" (Obstfeld 2012: 1574). The action trajectory perspective on organizational action, with its assumption of a (non-dichotomous) gradation of routines and creative projects (radical or architectural), thus helps us "understand how organizational routines and creative projects differ, interrelate, and, in some cases, evolve into another" (Obstfeld 2012: 1590). This perspective sheds light on the routine and on the 'non-routine' or 'anti-routine', (Weick & Sutcliffe 2006), i.e., on forms of organizing outside the boundaries of routines. Accordingly, this perspective connects routine forms of action and interaction (and the literature covering these phenomena) to non-routine forms of action and interaction (and the literature covering these phenomena).

### 3.2.1. Conflict as a 'motor' of change in action

Although we know that conflict, as a 'motor' of change (Van De Ven & Poole 1995), affects both routine action (Feldman 2003; Nelson & Winter 1982; Zbaracki & Bergen 2010) and creative action (De Dreu 2006; Jehn 1995), we do not know how conflict guides decisions between different forms of action trajectories. Nevertheless, in predicting the relationship between conflicts and alternations between routine and creative projects, we may build on previous literature that addresses routines and creative action. In fact, given the assumption of the action trajectory perspective, namely that both routines and creative projects represent different sides of the same coin, their influences can be expected to be connected. If, for instance, task conflict led to more creative projects, we would simultaneously expect task conflict to result in fewer routines. Yet, the existing evidence regarding the relationships between task and interpersonal conflict and routines and creative projects is ambiguous (as we will explain below). To provide a clearer picture, we combine research from the routine and innovation literatures to predict how conflict affects teams' decisions whether to enact routine or creative project action trajectories, and we test our predictions in a laboratory setting. Given

that previous literature has highlighted differences in the effects of task and interpersonal conflict (Jehn 1995), we derive separate predictions for both forms of conflict.

### 3.2.2. How task conflict shapes action trajectories

To understand the relationship between task conflict and teams' decisions whether to enact routine or creative project action trajectories, we combine the literature on task conflict in the context of routines with the literature on task conflict in the context of creative projects.

Regarding task conflict and routine action trajectories: A recent study of routines suggests that task conflict (i.e., different perspectives on how to do something) may result in the collapse of routines and consequently in less repetitive action trajectories (Zbaracki & Bergen 2010). The previous literature provides an explanation for this effect. Prevailing definitions of routines suggest, routines only function if they are recognizable in some way (Feldman & Pentland 2003), as they "combine multiple participants and their perspectives on what constitutes the routine" (Zbaracki & Bergen 2010: 963). Hence, by definition, routines require common understanding of what to do. If a team experiences task conflict, this conflict endangers the required common understanding of what to do, and consequently, routines collapse or they do not develop in the first place. There is some indication that sometimes a team's common understanding of a routine might survive minor task conflict (Zbaracki & Bergen 2010), and that routines may accommodate task conflict to some extent (Nelson & Winter 1982). Yet, as Zbaracki and Bergen (2010) find, when open task conflict breaks out and teams completely lack a common understanding of their routines, routines inevitably collapse. Thus, we may expect that task conflict results in collapses of routines; at this point, tasks that were previously considered routine suddenly become subject to discussion.

Regarding task conflict and creative project action trajectories, studies of creative action may help us understand what happens following task conflict-driven challenges of routines, or in situations in which teams have never developed a routine. There is some indication that, in

the absence of routines, non-repetitive action trajectories—creative projects—emerge, in which case task conflict may stimulate creative action. For instance, Jehn (1995) observes a negative relationship between task conflict and performance in tasks that are perceived as routine, and a positive relationship for tasks that are perceived as non-routine. This observation implies that in the absence of routines, task conflict may stimulate creative action. In fact, the previous research suggests that outside of routines, task conflict may enable organizational members to critically assess relevant information (Jehn 1995), and it may foster learning as well as creative and divergent thinking (De Dreu & West 2001; Jehn 1994). Hence, it may result in greater novelty in teams' actions and interactions. Yet, there is opposing evidence suggesting that task conflict does not necessarily result in novel, radical creative projects. First, Jehn (1995) finds a curvilinear relationship between task conflict and creative performance in non-routine contexts in which teams face novelty. In her study, only medium levels of task conflict improved creative performance in non-routine contexts, whereas high levels of task conflict were related to a decline in creative performance in these contexts. And second, a meta-analysis by De Dreu and Weingart (2003) associates task conflicts with comparatively reduced creative performance in non-routine contexts (Puck & Pregernig 2014).

Thus, whereas the routine and innovation literature suggests that task conflict results in breakdowns of repetitive routine action trajectories and in more non-repetitive creative project action trajectories ($H_{1.1}$), the extant literature is less clear with regard to the degree of novelty that these creative projects involve. Hence, there is no clear indication whether and when task conflict results in radical creative projects (higher degree of novelty) or in architectural projects (lower degree of novelty). Accordingly, we will derive opposing predictions with regard to the relationship between task conflict and novelty. First, based on De Dreu and West (2001) and Jehn (1994), we may predict that task conflict results in more novelty in action ($H_{1.2a}$). Second, based on De Dreu and Weingart (2003) and Puck and Pregernig (2014), we may predict that task conflict results in less novelty ($H_{1.2b}$). Third, based on Jehn (1995), we may predict a

curvilinear relationship between task conflict and novelty ($H_{1.2c}$). Hence, we postulate the following:

*$H_{1.1}$: Task conflict relates to a decrease in the repetitiveness of teams' action trajectories.*

*$H_{1.2a}$: Task conflict relates to an increase in the novelty of teams' action trajectories.*

*$H_{1.2b}$: Task conflict relates to a decrease in the novelty of teams' action trajectories.*

*$H_{1.2c}$: Task conflict has a curvilinear effect on the novelty of teams' action trajectories.*

### 3.2.3. How interpersonal conflict shapes action trajectories

Conflicts may reach states at which they become predominantly emotional. Such conflicts are clearly not exclusively rooted in divergent ideas of how to get something done but rather emerge from (and reveal) emotional aspects of interpersonal relations (Guetzkow & Gyr 1954). To understand the relationship between interpersonal conflict and teams' decisions whether to enact routine or creative project action trajectories, we combine the literature on interpersonal conflict in the context of routines with the literature on interpersonal conflict in the context of creative projects.

Regarding interpersonal conflict and routine action trajectories, early perspectives on routines suggest that routines provide truces, which allow teams to function despite conflict (Nelson & Winter 1982). These early perspectives suggest that conflict may lead teams to retreat to repetitive routines, which can be enacted successfully despite the conflict. As we argued above, routines are likely to collapse when teams experience serious task conflict:

Routines require a common understanding among team members and the emergence of task conflict suggests that such a common understanding is missing. Yet, when conflict is not directly connected to team members' understanding of their routines, but instead to their interpersonal and emotional relations, routines may provide a 'safe harbor' to which teams can retreat and operate more or less successfully despite their interpersonal conflict (Nelson & Winter 1982). In contrast to these early perspectives on routines, a more recent study by Zbaracki and Bergen (2010), who observe a specific interaction in which conflict becomes strongly emotional, suggests that interpersonal conflict is likely to lead to collapses of routines and thus to decreased repetitiveness in action. We can thus derive two opposing narratives regarding interpersonal conflict and its effects on routine action trajectories. According to the first narrative, interpersonal conflict induces teams to retreat to repetitive routines as truces (Nelson & Winter 1982). According to the second narrative, interpersonal conflict leads to collapses of routines (Zbaracki & Bergen 2010).

Regarding interpersonal conflict and creative project action trajectories: Previous literature quite consistently associates interpersonal conflict with decreased creative performance (De Dreu & Weingart 2003). For instance, Carnevale and Probst (1998: 1307) find that participants who anticipate conflict-laden negotiations develop a cognitive rigidity and an "intellectual deficit", even if they never actually experience the anticipated conflict situation. Furthermore, participants in that study not only showed a lower degree of creativity but also responded in an extreme fashion to categorization tasks (Carnevale & Probst 1998). Potential explanations for this observation point to attentional and cognitive overload. Individuals facing interpersonal conflict "may use precious cognitive resources in the effort to beat the other negotiator rather than develop creative optimal solutions" (Carnevale & Probst 1998: 1308). De Dreu and Nijstad (2008) consistently find that interpersonal conflict may shift cognitive attention towards conflict resolution. Rather than engaging in creative task-solving activities, team members subject to interpersonal conflict focus their cognitive efforts on developing

creative conflict strategies, which enable them to outsmart their team members and to defend themselves against their team members' malicious activities. These conflict strategies, however, require teams to access cognitive resources that otherwise would have been available for creative task-solving approaches. Teams can compensate for this lack of available cognitive resources by relying on repetitive action trajectories, which enable them economize on cognitive resources (Becker 2004). Yet, this reduction in creative activity decreases the likelihood that teams will come up with novel task-related ideas and solutions (Cowen 1952). The extant creativity research thus suggests that interpersonal conflict is likely to lead to more repetitiveness and less novelty in action.

Thus, combining the literature on routine with the literature on creative projects results in opposing predictions regarding the effect of interpersonal conflict on teams' decisions whether to enact routine or creative project action trajectories. First, based on early perspectives on routines that associate interpersonal conflict with a withdrawal to highly repetitive routine action trajectories, which offer a truce (Nelson & Winter 1982), and based on cognitive load theory (Carnevale & Probst 1998), we may predict that interpersonal conflict leads to an increase in repetitiveness in action ($H_{2.1a}$). Second, based on more recent perspectives on routines that associate interpersonal conflict with collapses of routines (Zbaracki & Bergen 2010), we may predict that interpersonal conflict leads to less-repetitive action trajectories ($H_{2.1b}$). Given that the literature unambiguously associates interpersonal conflict with decreased cognitive abilities (Carnevale & Probst 1998), we may predict that interpersonal conflict results in decreased novelty in action trajectories ($H_{2.2}$). Accordingly, we can derive two different narratives. In the first narrative, interpersonal conflict results in an increased tendency to enact repetitive ($H_{2.1a}$), less-novel ($H_{2.2}$) action trajectories that show comparatively more resemblance to routines than to creative projects. In the second, narrative, interpersonal conflict results in an increased tendency to enact less-repetitive ($H_{2.1a}$) action trajectories, which

simultaneously feature a low degree of novelty ($H_{2.2}$), and which thus in Obstfeld's (2012) taxonomy classify as 'architectural' creative projects. Hence, we postulate the following:

*$H_{2.1a}$: Interpersonal conflict relates to an increase in the repetitiveness of teams' action trajectories.*

*$H_{2.1b}$: Interpersonal conflict relates to a decrease in the repetitiveness of teams' action trajectories.*

*$H_{2.2}$: Interpersonal conflict relates to a decrease in the novelty of teams' action trajectories.*

### 3.2.4. How interactions between task and interpersonal conflict shape action trajectories

Task and interpersonal conflict often coexist (De Dreu & Weingart 2003; Zbaracki & Bergen 2010). So far, we know very little about the interaction effects of task and interpersonal conflict. Yet, there is some indication that interactions between task and interpersonal conflict might affect teams' action trajectories. For instance, we know that in creative tasks interpersonal conflict moderates the relationship between task conflict and team performance (De Dreu & Weingart 2003). Specifically, in these tasks highly positive correlations between task and interpersonal conflict correspond to negative correlations between task conflict and creative performance (De Dreu & Weingart 2003). Accordingly, combinations of task and interpersonal conflict can be expected to be detrimental to a team's ability to come up with novel actions and to incorporate them into their action trajectories. At the same time, given that conflict generally stresses cognitive capacities (Carnevale & Probst 1998), it is likely that combinations of interpersonal and task conflict increase team members' cognitive load and increase their

tendency to retreat to routines, which allow economizing on cognitive resources (Becker 2004). Accordingly, we expect that interactions between task and interpersonal conflict lead to a relative retreat from creative projects to routines, which reduce teams' cognitive load and enable them to function despite their task and interpersonal conflict (Becker 2004; Simon 1947). Hence, we postulate the following:

*$H_{3.1}$: When task and interpersonal conflict interact, the repetitiveness of teams' action trajectories increases.*

*$H_{3.2}$: When task and interpersonal conflict interact, the novelty of teams' action trajectories decreases.*

### 3.3. Method

To test our predictions regarding how task and interpersonal conflict causally affect teams' decision whether to enact routine or creative project action trajectories, we decided to pursue an experimental approach, which enabled us to address causality (Bono & McNamara 2011). Given that inducing conflict randomly in the field appears to be (almost) impossible, we conducted a laboratory experiment, which we based on a modification of the popular computer game Minecraft.

#### 3.3.1. Sample and incentives

In all, 148 students from a German university took part in our study. The sample consisted of 105 men (70.95%) and 43 women (29.05%), with ages ranging from 18 to 52 years and a mean age of 23.20 years ($SD$ = 4.08). Each participant's remuneration was based on three factors: First, a performance-based financial incentive of up to €10.50 per person that referred to the experimental task ($M$ = €6.98, $SD$ = 1.50); second, compensation based on participants' success

in a separate negotiation game ($M$ = €9.60, $SD$ = 1.41); and third, a fixed participation bonus of €2. Altogether, our three distinct financial incentives added up to an average remuneration of €18.57 ($SD$ = 1.97) per participant for approximately 1 hour and 45 minutes of participation.

### 3.3.2. Experimental design

We used a 2 (task conflict: yes vs. no) × 2 (interpersonal conflict: yes vs. no) factorial design. We randomly assigned all participants to teams of two, and we randomly assigned the teams to our experimental conditions.

### 3.3.3. Experimental task

Our research question required us to identify an experimental task that teams could solve by means of both routine and creative project action trajectories. To enable the formation of routines, the task needed to comprise repeated challenges, which could be solvable by means of repeated, familiar actions (Cohen & Bacdayan 1994). At the same time, to enable the enactment of creative projects, the task had to provide space for non-repetitive, novel actions. In prior research, we did not find experimental tasks that matched both requirements. Thus, we carefully developed a new, innovative experimental setting, which we based on the computer game Minecraft. Minecraft is an open world game, which provides its players with a large amount of freedom regarding their actions in the game. The game revolves around equally sized building blocks (similar to Lego), which are arranged in a fixed grid and which can freely be broken, collected and replaced. Apart from their size, these building blocks differ in their properties in that they represent different elements and materials. Blocks made of stone, for instance, take longer to be broken than blocks made of soil or sand. We decided to implement our experimental challenges in a Minecraft World, as this environment provides space for almost unlimited creativity within a rigid virtual environment. On the one hand, actors in the game can freely mine blocks and items and recombine them to craft new blocks and items. For instance, actors may cut down a tree and use the collected wood to craft a boat, which they may

board to cross a river. On the other hand, the rigid physical engine of the game enables exact replication and measurement of behavioral patterns.

We designed several challenges, which had to be solved through cooperation between dyads of participants who collaborated in the virtual Minecraft setting. In each challenge, the two members of a team were spawned on different sides of a virtual world, which was divided by a stream of lava. Both team members were instructed to follow one main goal: Find a way to cross the lava to meet each other. They could directly advance to the next challenge as soon as they managed to complete their current challenge, i.e., as soon as both members of a team managed to run into each other. If teams failed to complete a challenge within three minutes, the next challenge started automatically. We designed two stages of the Minecraft Game: first, a learning stage, in which participants learned how to control their avatar in the game and developed a basic routine by solving simplified challenges; and second, a main stage, in which teams had up to 30 minutes to play up to 20 slightly varying challenges, and in which they received performance-based financial incentives.

In the learning stage, the teams completed a comprehensive tutorial and subsequently could solve several identical rounds of a simplified version of the challenges that they would face later on in the main stage. The simplified challenges of the learning stage were designed to train the participants in enacting a specific, comparatively easy "default routine" (clearing a blocked-up bridge which led over the lava stream), which could be applied throughout the entire game. At this point, the participants faced no incentives to search for alternative task-solving approaches.

In the main stage, the teams faced more complex challenges, which they could solve by means of many different approaches—including the familiar "default routine" they had learned in the learning stage. In the main stage, teams received financial rewards for successful performance. Each team started the main stage with a balance of €1, received €0.50 for each commenced challenge, and an additional €0.50 for each successfully finished challenge. Yet,

mining a block to solve a challenge cost €0.05, and we did not limit teams' overall spending (Cohen & Bacdayan 1994). That is, in any challenge during the main stage, teams could lose all of their hitherto-earned rewards (we did not allow for negative balances). A display in the upper left corner of the computer screen continuously informed the participants about their teams' financial gains. Considering that the teams could complete up to 20 challenges within 30 minutes, they were incentivized to play effectively and quickly at the same time (Cohen & Bacdayan 1994). Yet, simply relying on static routines (such as the "default routine") could be costly. We slightly varied the challenges so that the optimal solution varied among individual challenges. For instance, in some challenges the "default routine" required teams to mine many blocks at a cost of €0.05 per block. Thus, in these challenges sticking to this familiar routine became very costly. The teams could hence improve their performance by staying alert and by flexibly adjusting their task-solving approaches to the requirements of the respective challenge. Generally, each challenge of the main stage could be solved by means of many different more or less creative approaches, and even we ourselves cannot claim to know all of them. For instance, teams could divert a nearby stream of water to flood the lava stream, which – on contact with water – turned into stone and could be walked upon, or they could ignite dynamite to blow up a path to the other side of the lava stream. Figure 6 presents screenshots of the learning and main stages of the Minecraft Game.

*Figure 6: Screenshots Minecraft Game*


*Figure 6a: Minecraft Game learning stage (1)*


*Figure 6b: Minecraft Game learning stage (2)*

*Figure 6c: Minecraft Game main stage*


*Figure 6d: Minecraft Game main stage instructions*

### 3.3.4. Procedure

***Introduction and learning stage:*** Figure 7 summarizes our procedure. Upon their arrival at the laboratory, we randomly placed the participants at computers and randomly matched each participant with a team partner. Each newly formed team was then randomly assigned to one of the four distinct experimental conditions (without the team's knowledge). The participants were neither informed about the identity of their team partner nor about the purpose of the study. All participants were informed that in the experiment they were supposed to exclusively interact and communicate in the virtual setting. We informed them that any communication outside of the virtual setting was prohibited. After having logged into the system, the participants received detailed, written instructions about the study, which were given through the laboratory software z-Tree (Fischbacher 2007). The written instructions included information about the overall procedure, the experimental task, and the financial incentives. The participants had several minutes to read the instructions, and they could subsequently ask questions, which were answered publicly. Next, we started the learning stage of the Minecraft Game on the PCs of the participants, who then had 15 minutes to finish an in-game tutorial in which they learned the basic controls of the game and could develop their "default routine" for crossing the lava stream.

*Figure 7: Procedure*

| *Stage 1* | *Stage 2* | *Stage 3* | *Stage 4* | *Stage 5* |
|---|---|---|---|---|
| Introduction and learning stage | Discussion: Task conflict manipulation | Discussion: Interpersonal conflict manipulation | Main stage | Negotiation game and concluding questionnaire |
| —Objective: Learning and developing a first "default routine" | —Objective: Induce task conflict in the respective conditions | —Objective: Induce interpersonal conflict in the respective conditions | —Objective: Actual measurement of whether teams enact routines or creative projects | —Objective: Further manipulation checks and data collection |
| —Means: Simplified version of the Minecraft Game | —Means: Devil's advocacy and consensus-style discussions | —Means: Preparation for an intense negotiation; Variation of instructions | —Means: Comprehensive version of the Minecraft Game | —Means: Decomposed Games and questionnaire |

***Discussion stage (task conflict manipulation):*** After the learning stage, the Minecraft Game automatically closed down, and further instructions informed the participants that they were now supposed to discuss with their respective team member (via a computer chat) their further course of action for the upcoming main stage of the Minecraft Game. The instructions suggested that the teams should make use of this opportunity to coordinate their actions for the upcoming main stage of the game, during which they could earn money but not communicate anymore. The instructions provided all teams with the information that to solve the Minecraft Game, they could, in principle, rely on two different strategies: (1) either repeating and gradually optimizing the solution they had established in the learning stage of the game, or (2) exploring novel, more effective solutions. We asked all teams to discuss which of these two strategies they wanted to pursue in the upcoming main stage of the Minecraft Game.

To induce task conflict, we varied the instructions and the process of this chat discussion. For the task conflict manipulations, we drew from two experimental studies conducted by Schweiger et al. (1986) and Schweiger et al. (1989). We adapted their procedures to our virtual setting and carefully developed and tested our manipulations by means of several pre-tests, which included 84 remunerated participants.[5]

[5] The respective data is not reported here completely but can be obtained from the authors on request.

In the task conflict conditions, we induced task conflict by asking teams to discuss their strategy following a devil's advocacy (DA) discussion. Schweiger et al. (1989) identify the DA discussion as a "programmed conflict approach" (Schweiger et al. 1989: 747), which "employ[s] conflict as [its] primary structural mechanism" (Schweiger et al. 1986: 53). The DA approach is based on one set of recommendations, developed by one party of a team ("non-DA"), which is subjected to a formal critique by the other party, the DA (Cosier 1981). The approach stimulates constructive task conflicts, which are acted out in structured discussions. We provided instructions based on Schweiger et al. (1986) and structured the discussion based on Cosier (1981). The discussion followed a five-step approach: In *Step 1,* one team member was randomly assigned as the non-DA and was given up to one minute to choose one of the two recommended strategies (1) or (2) (cf. above), which he or she would recommend to the DA. *Step 2:* The non-DA now had five minutes to develop up to five arguments in favor of his or her recommendation. At the same time, the DA received information about the strategy recommendation of his or her partner and received instructions to assume the role of the DA, which required him or her to find five arguments against the position of the non-DA. While developing their arguments, both team members received six pieces of information, each supporting their respective positions. These pieces of information contained generic arguments, which helped participants to find convincing arguments for their respective strategy recommendations. Both team members received instructions to write their own arguments in text boxes. *Step 3:* In a two-minute period, both team members could read the arguments of the respective other team member. Both team members received instructions to call into question the arguments and recommendations presented by the respective other side and to prepare for an upcoming chat discussion. In this process, the participants could take notes, which were not revealed to their team partners. *Step 4:* The participants were instructed to formally discuss the strategy recommendation of the non-DA in a chat window and to agree on common actions for the Minecraft Game. In this discussion, both team members could see all arguments from step

2 and their individual notes from step 3. Based on Schweiger et al. (1986), the DA received instructions to focus on formally criticizing the arguments of the non-DA and not to give in unless the non-DA provided valid arguments for his or her recommendation. *Step 5:* The team members were separately asked to state whether their teams had agreed on common actions and which actions they were going to take. Furthermore, they were asked about the extent to which they personally supported the outcome of the discussion.

In the no-task-conflict conditions, we asked teams to discuss their further course of action following a consensus approach (Nemiroff et al. 1976; Schweiger et al. 1986). Consensus-oriented discussions are directed towards avoiding disagreements between team members and rely on cooperation and consensus rather than task conflict (Schweiger et al. 1986; Schweiger et al. 1989). We adopted and modified Schweiger et al.'s (1986; 1989) instructions for our experimental setting. To ensure comparability, the structure of the consensus-oriented discussion only differed slightly from the structure of the DA-style discussion. *Step 1:* In contrast to the DA-approach, both team members could decide on a strategy, which they would recommend to their team member. *Step 2:* When formulating arguments for their respective positions, each team member received three pieces of information supporting and three pieces of information opposing their strategy choice. Altogether, teams in all experimental conditions received exactly the same twelve pieces of information. Hence, the experimental conditions differed only with regard to the distribution of the pieces of information within the teams. Regardless of the experimental condition, the two members of a team never received the same pieces of information. *Step 3:* As opposed to the task conflict condition, we did not specifically instruct participants to fight their team members' arguments but rather to question and consider them for the purpose of their own argumentation. *Step 4:* In the chat discussion, we followed Schweiger et al. (1986) and Nemiroff et al. (1976) in instructing our participants not to argue blindly for their perspectives but rather to account for the reactions of their team members and

to make sure that both players accepted the final recommendation of the team. *Step 5:* This step was identical to step 5 in the task conflict treatment.

***Discussion stage (interpersonal conflict manipulation):*** After the teams had finished discussing their strategies, we provided them with further instructions. In a text box, we informed all participants that—in addition to the financial reward they could earn within the Minecraft Game—each team would receive a bonus of €20 to be distributed among the two team members in a negotiation game at the end of the study. We varied the announcement of the negotiation game based on an experimental study by Carnevale and Probst (1998), who mentally prepare participants for an intense negotiation to stimulate conflict. Our pre-tests revealed that conflict anticipations lead to actually perceived interpersonal conflict. Due to this fact we could use Carnevale and Probst's (1998) approach as a means to induce interpersonal conflict.

Regarding the announcement, participants assigned to the interpersonal conflict conditions were instructed to consider that, in the negotiation game at the end of the study, their team member might act in their own interest and that they should "disregard the needs and interests of the other negotiator" (Carnevale & Probst 1998: 1302) and exclusively act in their own interest when negotiating the team bonus. Subsequently, the participants were asked to state in check-boxes whether they were willing to act as tough negotiators. If participants agreed with this statement, a pre-generated message was sent to the respective team members, informing them about their team member's willingness to engage in a tough negotiation. If participants were not willing to act 'tough', no message was sent.

Participants assigned to the no interpersonal conflict conditions were instructed to "work for the good of both negotiators" (Carnevale & Probst 1998: 1302) and to consider equally sharing the bonus. We asked participants by means of check-boxes whether they were willing to share the bonus in a fair manner with their team member. If the participants agreed

to follow the instructions, we informed the respective team members about their decision. If participants were not willing to share the bonus fairly, no message was sent.

***Main stage:*** After we stimulated task and interpersonal conflict in the discussion stage, all participants received a quick introduction to the main stage of the Minecraft Game, reminding them that they now could gain money by solving up to 20 challenges within 30 minutes. The main stage enabled us to observe how the conflict manipulations affected teams' action trajectories in the Minecraft Game. Teams that managed to finish all 20 challenges within the overall time limit could continue playing the game without any financial incentive until we closed down the game on all computers after 30 minutes.

***Negotiation game and concluding questionnaire:*** Finally, teams played the negotiation game, as announced in the discussion stage (in contrast to Carnevale and Probst, 1998, we avoided deceiving participants, and actually conducted the negotiation game). We based the negotiation of the team bonus on so-called 'Decomposed Games', which in principle represent a modified version of a 'Prisoner's Dilemma'. The Decomposed Games served as an additional manipulation check, which we employed to test whether our interpersonal conflict manipulations actually translated into conflictual actions (which they did—in the interpersonal conflict conditions, significantly more individuals were willing to forgo a part of their own bonus in order to ensure their team member would receive no bonus at all[6]) (Carnevale & Probst 1998). At the end of the negotiation game, the participants were asked to fill out a digital questionnaire, which included further manipulation checks and additional tests, and subsequently, they separately received their financial rewards in a nearby room.

[6] In the Decomposed Game, participants in the pure interpersonal conflict condition cooperated in 3.26 of 7 rounds (SD = 2.96), and thus slightly significantly less often than participants in the control condition (M = 4.53, SD =2.88) , Z = 1.82, p = 0.069, and in the pure task conflict condition (M = 4.61, SD = 2.58), Z = 1.88, p = 0.060. Participants in the task × interpersonal conflict condition (M = 2.50, SD = 2.86) were significantly less likely to cooperate compared with participants in the control condition, Z = 3.09, p = 0.002.

### 3.3.5. Dependent variables

We programmed a Java-based solution, which tracked the participants' movements, actions, and interactions within the Minecraft Game. Our pre-test data suggested that teams generally relied on eleven different approaches to solve the Minecraft challenges (in this context "approaches" denote recognizable categories of task solutions, such as "clearing and crossing a bridge" or "flooding the lava with water"). Based on these observations, we developed further algorithms, which (through localization data) automatically recognized when teams used any of the previously observed approaches in the main study. The algorithms successfully recognized and categorized more than 99% of all applied task-solving approaches in the main study. For the remaining 1% of unidentified approaches, we created a new category, which we treated as a distinct type of approach in our analyses. All data were stored in a central SQL database. We clustered all task-solving approaches, which we observed in the main stage of the game, in action trajectories $A_i(r,n)$, with $i$ denoting the respective team that enacted the approach, $r$ denoting the degree of repetitiveness, and $n$ denoting the degree of novelty of the respective action trajectory. Whenever a team applied – for the first time – one of the pre-categorized task-solving approaches to solve a challenge, this first enactment of the approach ejected a new action trajectory $A_i(r,n)$. Based on Obstfeld's (2012) action trajectory perspective, we associated comparatively higher values of $r$ with more routine action and lower values of $r$ with creative projects, whereas higher values of $n$ related to 'radical' creative projects and lower values of $n$ to 'architectural' creative projects (cf. Figure 5).

***Repetitiveness:*** For each action trajectory $A_i(r,n)$, $r$ represented the number of a team's successful repetitions of the respective task-solving approach clustered in $A_i(r,n)$. Whenever a team reiterated a previously successfully enacted task-solving approach, $r$ increased by one.

***Novelty:*** For each action trajectory $A_i(r,n)$, $n$ represented the extent to which the task-solving approach clustered in $A_i(r,n)$ represented a globally novel solution. We

operationalized novelty as the extent to which a team's action trajectory contained elements that were unfamiliar and unrecognizable, i.e., novel, to other teams in our setting (Obstfeld 2012). Specifically, for each action trajectory $A_i(r, n)$ enacted by any team, we measured the extent to which the other participating teams had recognized and successfully applied the same task solving approach. $n$ represents the percentage of teams (relative to all participating teams) that, in the main stage of the game, did not enact the task solving approach clustered in $A_i(r, n)$.

***Additional variables:*** To analyze the properties of action trajectories emerging in the Minecraft Game in more detail, we additionally measured (1) Performance: We measured how much money teams earned in the Minecraft Game as an indicator of their successful action trajectory choices. (2) Time required for challenge: We assessed how quickly teams solved the challenges in the Minecraft Game as an additional indicator of routinization (Cohen & Bacdayan 1994; Laureiro-Martinez 2014). (3) Distance moved per challenge: We measured teams' movements in the game as an indicator of search behavior. (4) Items used and created: We analyzed teams' use and creation of items in the game in order to measure their exploration in the Minecraft Game. (5) Blocks mined: We observed teams' mining behavior in the game as an indicator of their effective adjustments to environmental changes (as mining blocks occurred costs). (6) Accidents: We analyzed teams' accidents as indicators of risky actions in the game. (7) Questionnaire data: The study concluded with a comprehensive questionnaire, through which we collected demographic data, conducted several (concluding) manipulation checks, and asked participants about their experiences in the Minecraft Game. The questionnaire included translated versions of Edmondson's (1999) items for psychological safety; Jehn's (1995) intraconflict items; several items based on Perrow's (1970) index of routinization; Van de Ven, Delbecq, and Koenig's (1976) measures for task variety; and Hackman and Oldham's (1975) Job Diagnostic Survey.

## 3.4. Results

### 3.4.1. Manipulation check

We relied on a quite comprehensive set of manipulation checks. A detailed description of our manipulation checks can be obtained upon request from the authors. In summary, we successfully induced task conflict in the pure task conflict and in the task × interpersonal conflict condition, although over the course of the game, our manipulations slightly weakened. Directly after our manipulations, participants in the pure task conflict condition ($M$ = 1.08, $SD$ = 1.11) reported significantly higher levels of task conflict than participants in the control condition ($M$ = 0.48, $SD$ = 0.65), $t(74) = 2.95$, $p = 0.004$. Consistently, participants in the task × interpersonal conflict condition ($M$ = 1.92, $SD$ = 1.03) reported significantly higher levels of task conflict than participants in the control condition, $t(76) = 7.45$, $p < 0.001$. Regarding interpersonal conflict, in the respective conditions, we successfully induced anticipations of interpersonal conflict, which generally translated into actually perceived interpersonal conflict. Directly after our manipulations, participants in the pure interpersonal conflict condition ($M$ = 0.29, $SD$ = 0.72) reported significantly higher levels of experienced interpersonal conflict than participants in the control condition ($M$ = 0.05, $SD$ = 0.22), $t(72) = 2.04$, $p = 0.045$. Consistently, participants in the task × interpersonal conflict condition ($M$ = 0.50, $SD$ = 0.98) also reported significantly higher levels of interpersonal conflict than participants in the control condition, $t(76) = 2.83$, $p = 0.006$. In general, interpersonal conflict was always stronger when we induced it in combination with task conflict.

### 3.4.2. Descriptive statistics and correlations

Descriptive statistics and correlations are shown in Table 4, which describes the most important variables aggregated for the team level. The correlations give us a better understanding of differences between repetitive routines and non-repetitive creative projects. The more teams enacted repetitive (i.e., routine) action trajectories the less money they gained in the Minecraft

Game, $\rho$ = -0.51, $p < 0.001$, the less time it took them to finish their challenges, $\rho$ = -0.65, $p < 0.001$, the less they moved in order to solve their challenges, $\rho$ = -0.76, $p < 0.001$, the fewer items they used in order to solve the challenges, $\rho$ = -0.37, $p = 0.001$, and the more blocks they mined, $\rho$ = 0.53, $p < 0.001$. Repetitive routine action thus occurred higher financial costs than non-repetitive creative action. Yet, non-repetitive creative projects required more effortful exploration (cf. distance moved and use of items) and time. Moreover, our finding of a negative correlation between repetitiveness and accidents, $\rho$ = -0.54, $p < 0.001$, suggests that non-repetitive creative projects entailed more risk than repetitive routines, which generally represent a way to avoid risk (Becker, 2004).

**Table 4: Selected descriptive statistics and correlations (team level)**

| | | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Team performance (profit) | 13.958 | 3.013 | **1** | | | | | | | | | | | |
| (2) | Repetitiveness (r) | 10.052 | 6.774 | **-0.512** (0.000) | **1** | | | | | | | | | | |
| (3) | Novelty (n) | 0.371 | 0.258 | **0.611** (0.000) | **-0.906** (0.000) | **1** | | | | | | | | | |
| (4) | Mean time req. for challenge | 58.668 | 21.936 | **0.241** (0.039) | **-0.649** (0.000) | **0.497** (0.000) | **1** | | | | | | | | |
| (5) | Mean distance moved per challenge | 8,048.792 | 3,358.550 | **0.370** (0.001) | **-0.755** (0.000) | **0.654** (0.000) | **0.777** (0.000) | **1** | | | | | | | |
| (6) | Mean use of items per challenge | 0.973 | 1.125 | **0.088** (0.456) | **-0.367** (0.001) | **0.337** (0.003) | **0.312** (0.007) | **0.549** (0.000) | **1** | | | | | | |
| (7) | Mean creation of items per challenge | 0.006 | 0.052 | **-0.074** (0.531) | **0.157** (0.181) | **-0.142** (0.228) | **0.036** (0.763) | **0.096** (0.416) | **0.186** (0.112) | **1** | | | | | |
| (8) | Mean blocks mined per challenge | 2.877 | 1.682 | **-0.729** (0.000) | **0.526** (0.000) | **-0.494** (0.000) | **-0.380** (0.001) | **-0.310** (0.007) | **0.192** (0.102) | **0.184** (0.117) | **1** | | | | |
| (9) | Accidents | 12.338 | 9.538 | **0.398** (0.000) | **-0.542** (0.000) | **0.525** (0.000) | **0.464** (0.000) | **0.583** (0.000) | **0.400** (0.000) | **0.102** (0.390) | **-0.366** (0.001) | **1** | | | |
| (10) | Task conflict | 0.503 | 0.500 | **-0.090** (0.447) | **-0.057** (0.627) | **0.024** (0.836) | **0.111** (0.348) | **0.098** (0.406) | **0.051** (0.668) | **-0.117** (0.321) | **0.050** (0.672) | **0.045** (0.704) | **1** | | |
| (11) | Interpersonal conflict | 0.480 | 0.500 | **0.002** (0.987) | **-0.135** (0.251) | **0.116** (0.324) | **0.053** (0.653) | **0.1123** (0.339) | **-0.087** (0.459) | **-0.114** (0.334) | **-0.110** (0.353) | **0.039** (0.744) | **0.054** (0.647) | **1** | |
| (12) | Task × interpersonal conflict | 0.255 | 0.436 | **-0.080** (0.496) | **0.015** (0.897) | **-0.032** (0.784) | **0.027** (0.821) | **0.089** (0.451) | **-0.041** (0.727) | **-0.069** (0.560) | **0.005** (0.966) | **0.076** (0.519) | **0.588** (0.000) | **0.604** (0.000) | **1** |

### 3.4.3. Routine formation prior to conflict manipulations

In the learning stage, we trained teams to enact a specific, comparatively easy, task-solving approach ("default routine"), which required them to clear a bridge in order to cross the lava.

In total, all teams together solved 569 out of 590 played challenges (96.44 percent) by means of this approach. Except for one team, all other teams successfully applied the "default routine" at least once. On average, all teams successfully executed this approach 7.69 times (*SD* = 3.16) throughout the learning stage. An OLS regression suggests that with each challenge completed, teams reduced their search activity (*B* = -471.77, *SE* = 80.15), *F*(1,606) = 34.64, *t* = -5.89, *p* < 0.001, $R^2$ = 0.05, for which we observed the mean distance moved per challenge. These findings suggest that in the learning stage, the average team developed a routine in solving the experimental task.

### 3.4.4. How task conflict shapes action trajectories

To assess how the conflict manipulations shaped action trajectories within the Minecraft Game, we observed team-level action trajectories in the main stage of the game, i.e., the stage that occurred after the conflict manipulations. Table 5 provides an overview of all observed action trajectories in the main stage of the Minecraft game. It shows that many teams continued to enact the "default routine", which they had learned in the learning stage, in order to solve the challenges of the main stage. Altogether, 73 out of the overall 210 observed action trajectories were based on such "default routine" task solving approaches. Thus, we observe the formation of 137 new action trajectories in the main stage of the Minecraft game. Table 5 provides some initial indication that teams in the different experimental conditions might have differed with regard to their enactment of action trajectories. In the following, we analyze these differences in detail by testing our hypotheses.

**Table 5: Overview of action trajectories**

| Condition | Task solving approach: | "Default routine: clearing bridge" | "Unregistered solution" | "Cross next to bridge 1" | "Cross next to bridge 2" | "Build new bridge" | "Clear spider web tunnel" | "Flood lava and climb across" | "Dive through dark tunnel" | "Build a dam" | "Climb along wall" | "Use hidden tunnel" | "Use trap doors to cross" | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control condition | **Obs.** | **20** | **1** | **4** | **2** | **6** | **2** | **0** | **5** | **3** | **0** | **1** | **1** | **45** |
| | Repetitions | 13.200 | 1 | 1.500 | 2.500 | 5.833 | 4 | - | 8.400 | 6 | - | 2 | 2 | |
| | *SD* | *6.748* | - | *1* | *0.707* | *3.656* | *2.828* | - | *5.320* | *7* | - | - | - | |
| Task conflict | **Obs.** | **18** | **1** | **4** | **1** | **7** | **10** | **3** | **7** | **1** | **4** | **1** | **0** | **57** |
| | Repetitions | 10.944 | 2 | 1.500 | 1 | 4.571 | 3.600 | 7.333 | 2.857 | 2 | 6 | 3 | - | |
| | *SD* | *6.394* | - | *1* | - | *3.780* | *3.502* | *5.686* | *2.268* | - | *5.292* | - | - | |
| Interpersonal conflict | **Obs.** | **16** | **0** | **3** | **3** | **7** | **4** | **5** | **4** | **4** | **4** | **1** | **2** | **53** |
| | Repetitions | 10.938 | - | 2.666 | 2 | 3.571 | 4.250 | 5.200 | 5.750 | 1.500 | 3.500 | 1 | 1.500 | |
| | *SD* | *7.019* | - | *1.528* | *1* | *2.149* | *5.188* | *4.711* | *5.188* | *0.577* | *1.732* | - | *0.707* | |
| Task × interpers. conflict | **Obs.** | **19** | **1** | **4** | **1** | **8** | **6** | **6** | **4** | **2** | **4** | **0** | **0** | **55** |
| | Repetitions | 13.368 | 7 | 1 | 1 | 2.875 | 2.333 | 6.167 | 2.750 | 3.500 | 1.750 | - | - | |
| | *SD* | *6.148* | - | *0* | - | *1.808* | *1.506* | *4.708* | *2.062* | *0.707* | *0.957* | - | - | |
| Total | | **73** | **3** | **15** | **7** | **28** | **22** | **14** | **20** | **10** | **12** | **3** | **3** | **210** |

Our first set of hypotheses looked at the effects of task conflict on teams' action trajectories. $H_{1.1}$ predicted that task conflict relates to a decrease in the repetitiveness of teams' action trajectories. To test $H_{1.1}$, we conducted a Wilcoxon rank-sum (Mann-Whitney) test, which compares our experimental conditions. This test supports $H_{1.1}$. Action trajectories enacted by teams in the pure task conflict condition (i.e., the condition where we did not combine task and interpersonal conflict) were, on average, repeated 6.05 ($SD$ = 5.68) times, and thus less often than action trajectories in the control group ($M$ = 8.51, $SD$ = 6.92), $Z$ = 1.86, $p$ = 0.063, $d$ = 0.389. An additional regression analysis (Model 1 in Table 6) provided further support for $H_{1.1}$. We observed a negative main effect of task conflict on repetitiveness, $B$ = -2.46, $p$ = 0.048. Accordingly, teams that experienced task conflicts repeated their task-solving approaches comparatively less often and thus showed a higher tendency to engage in rather discrete projects, although the observed effect size is rather small. Thus, our findings provided support for $H_{1.1}$.

$H_{1.2a}$ predicted that task conflict relates to an increase in the novelty of teams' action trajectories, whereas $H_{1.2b}$ predicted an opposite effect. In contrast, $H_{1.2c}$ predicted that task conflict has a curvilinear effect on the novelty of teams' action trajectories. Our pair-wise linear tests supported neither $H_{1.2a}$ nor $H_{1.2b}$. With regard to novelty, action trajectories enacted by

teams in the pure task conflict condition ($M$ = 0.52, $SD$ = 0.35) did not significantly differ from action trajectories enacted by teams in the control condition ($M$ = 0.43, $SD$ = 0.39), $Z$ = -0.75, $p$ = 0.456, $d$ = 0.243. Consistently, our regression analysis (Model 2 in Table 6) suggested no clear relationship between task conflict and novelty, $B$ = 0.08, $p$ = 0.265. We therefore rejected $H_{1.2a}$ and $H_{1.2b}$. To test for the curvilinear relationship between task conflict and novelty that we predicted in $H_{1.2c,}$ we used polynomial regressions, which allowed us to test various non-linear curve shapes. Specifically, we tested 3,002 different fractional polynomial regression models against a linear regression model, in which we tested the relationship between task conflict and novelty. Given the binary nature of our experimental manipulations, for all polynomial regressions we based our independent variables on self-reported conflict data (obtained through a manipulation check, which we conducted directly after the experimental manipulation). For six degrees of fractional polynomials, our tests identified the best fitting model among the fractional powers (-2, -1, -0.5, 0, 0.5, 1, 2, 3) and compared the lowest deviance model with all other fitted models (including the linear regression model). Our test rejected the notion that the best fitting sixth-degree fractional polynomial model with the powers (-2, -2, -2, -2, -0.2, -0.5), chosen among 3,002 fitted models, better explains the relationship between task conflict and novelty than the underlying linear regression model, $p$ = 0.994. Accordingly, we can reject not only $H_{1.2a}$ and $H_{1.2b}$ but also $H_{1.2c}$. Our findings suggest no clear relationship between task conflict and novelty—not positive, negative, or curvilinear.

In conclusion, the action trajectories of teams that experienced task conflict show more resemblance to non-repetitive creative projects than to repetitive routines. Yet, we observe no clear increase in novelty with task conflict. Accordingly, against our predictions, task conflict does not lead to particularly novel ‘radical’ creative projects but instead has no effect on novelty. This finding suggests that task conflict is just as likely to lead to ‘radical’ radical creative projects than it is to lead to ‘architectural’ radical projects.

**Table 6: OLS regression analysis of conflict and action trajectories**

| | (1) Repetitiveness (r) | | (2) Novelty (n) | |
|---|---|---|---|---|
| | *B* | *SE* | *B* | *SE* |
| Task conflict | -2.458* (0.048) | 1.235 | 0.0817 (0.265) | 0.073 |
| Interpersonal conflict | -2.775* (0.028) | 1.256 | 0.116 (0.120) | 0.074 |
| Task × interpersonal conflict | 3.359$^{+}$ (0.052) | 1.717 | -0.134 (0.189) | 0.102 |
| Constant | 8.511*** (0.000) | 0.924 | 0.434*** (0.000) | 0.055 |
| Observations | 210 | | 210 | |
| $R^2$ | 0.027 | | 0.012 | |

*P-values in parentheses; + p < 0.1, * p < 0.05, *** p < 0.001*

### 3.4.5. How interpersonal conflict shapes action trajectories

Our second set of hypotheses looked at the effects of interpersonal conflict on action trajectories. $H_{2.1a}$ predicted that interpersonal conflict leads to an increase in the repetitiveness of teams' action trajectories, whereas $H_{2.1b}$ predicted the opposite effect. In opposition to $H_{2.1a}$ and in support of $H_{2.1b}$, our pair-wise tests suggest that action trajectories enacted by teams in the pure interpersonal conflict condition ($M$ = 5.74, $SD$ = 5.77) had, on average, 2.78 fewer iterations than action trajectories enacted by teams in the control group, $Z$ = 2.01, $p$ = 0.045, $d$ = 0.436. Consistently, our regression analysis (Model 1 in Table 6) suggests a small negative main effect of interpersonal conflict on repetitiveness, $B$ = -2.78, $p$ = 0.028. Thus, in opposition to $H_{2.1a}$ and in support of $H_{2.1b}$, action trajectories of teams that experienced interpersonal conflict were enacted significantly less repetitively than action trajectories of teams that did not. Hence, interpersonal conflict led to action trajectories that, with regard to repetitiveness, show comparatively more resemblance to creative projects and less resemblance to routines.

$H_{2.2}$ predicted that interpersonal conflicts relate to a decrease in the novelty of teams' action trajectories. Our pair-wise tests provided no support for $H_{2.2}$. With regard to novelty, action trajectories of teams in the pure interpersonal conflict condition ($M$ = 0.55, $SD$ = 0.37) did not clearly differ from action trajectories of teams in the control condition ($M$ = 0.43, $SD$ =

0.39), $Z$ = -1.50, $p$ = 0.135, $d$ = 0.316. Consistently, our regression analysis (Model 2 in Table 6) also suggested no conventionally significant relationship between interpersonal conflict and novelty, $B$ = 0.12, $p$ = 0.120. Although our findings were not significant, they generally suggested a tendency towards more novelty with interpersonal conflict, and thus they directly opposed $H_{2.2}$. Hence, we could clearly reject $H_{2.2}$.

In conclusion, the action trajectories of teams that experienced interpersonal conflict show more resemblance to non-repetitive creative projects than to repetitive routines. Against our predictions, we observed no decrease in novelty and instead even a slight (yet not at conventional levels significant) tendency towards more novelty with interpersonal conflict. We thus observe comparatively more 'radical' instead of 'architectural' creative projects with interpersonal conflict.

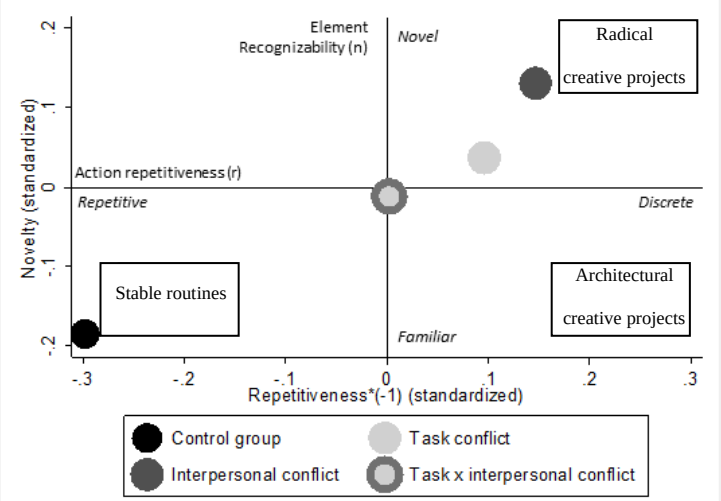
### 3.4.6. How interactions between task and interpersonal conflict shape action trajectories

Our third set of hypotheses looked at interactions between task and interpersonal conflict and their effects on teams' action trajectories. $H_{3.1}$ predicted that interactions between task and interpersonal conflict result in increases in the repetitiveness of teams' action trajectories. Our regression analysis (Model 1 in Table 6) generally supports this prediction. We found a positive interaction effect for task × interpersonal conflicts corresponding to a relative increase in repetitiveness with task and interpersonal conflict co-occurring, $B$ = 3.36, $p$ = 0.052. Thus, our analysis supported $H_{3.1}$.

$H_{3.2}$ predicted that interactions between task and interpersonal conflict cause a decrease in the novelty of teams' action trajectories. Our regression analysis (Model 2 in Table 6) suggests no significant relationship between the interaction term for task and interpersonal conflict and for the novelty variable, $B$ = -0.134, $p$ = 0.189. Thus, we could reject $H_{3.2}$. Overall, the regression models that we used to test $H_{3.1}$ and $H_{3.2}$ explain a rather small share of the variance of the dependent variables.

In conclusion, the interaction of task and interpersonal conflict leads to a relative increase in repetitiveness and thus to a retreat from non-repetitive creative projects to repetitive routines. This interaction effect opposes the respective main effects of task and interpersonal conflict, which we found above. Figure 8 integrates our findings for repetitiveness and novelty regarding our four different experimental conditions in Obstfeld's (2012) action trajectory model. For illustrative purposes, we have standardized our measures for repetitiveness and novelty in Figure 8.

*Figure 8: Observed action trajectories in Obstfeld's (2012) model*




## 3.5. Discussion

This study provides an understanding of how conflict guides teams' choices between routines and creative projects and thereby sheds light on the microfoundational processes underlying stability and change within organizations. In attempting to understand the relationship between conflict and action trajectories, previous behavioral studies have not explored outcomes in terms of these two microsocial outcomes. Moreover, in focusing on only one of these behavioral phenomena, these studies have often neglected an important aspect: Neither routines nor creative projects are ends in themselves. That is, whether routines and creative projects are beneficial to performance depends entirely on context. Whereas some contexts benefit from the engagement of routines, the pursuit of creative projects is more advantageous in others. In

dynamic environments, organizations and teams often need to act strategically, deciding whether they want to stick to their routines or engage in creative projects instead, and their ability to make the right decision can be crucial to surviving and advancing (Farjoun 2010). Thus, whereas previous research provided us with insights with regard to how conflict affects routines in routine contexts (Zbaracki & Bergen 2010) and creative action in creative contexts (Carnevale & Probst 1998), not much is known with regard to how conflict guides choices between routines and creative projects in contexts that do not prescribe a certain form of action trajectory. However, these 'anarchic' contexts (Cohen et al. 1972)—the zero hour of innovation—may be decisive for an organization's future success (Obstfeld 2012). This study sheds more light on the zero hour of team-level action trajectories by revealing the role of task and interpersonal conflict in contexts in which teams may freely choose between routines and creative projects.

First, regarding task conflict: In support of our predictions, we found that this form of conflict relates to less repetitiveness in action trajectories, which is associated with creative projects. Opposed to our predictions, we found no clear relationship between task conflict and the extent to which teams' action trajectories entailed novelty. Thus, according to Obstfeld' (2012) taxonomy, task conflict is just as likely to lead to 'architectural' creative projects – creative projects that involve familiar elements (Henderson & Clark 1990) – as it is to lead to 'radical' creative projects (Obstfeld 2012). Hence, although task conflict in our setting did not necessarily lead teams to incorporate much more novelty into their actions, it nevertheless seems to have helped teams actively assess task-solving options (Jehn 1995) and abstain from mindlessly repeating pre-established routines (De Dreu & West 2001; Jehn 1994). We may conclude that when teams can freely decide between routine and creative project action trajectories, task conflict increases their tendency to break from routines.

Second, we found interpersonal conflict, in contrast to our predictions, which we based on the early routine literature (Nelson & Winter 1982) and on cognitive load theory (Carnevale

& Probst 1998), yet consistent with more recent studies of routines (Zbaracki & Bergen 2010), increases teams' tendency to enact non-repetitive creative projects instead of repetitive routines. Interpersonal conflict seems to have impeded the development of routines and to have promoted routine collapses (Zbaracki & Bergen 2010). Accordingly, our data suggests rejecting the idea that open interpersonal conflict leads to the development of routines as truces, i.e., as countermeasures that ensure successful cooperation in times of interpersonal conflict (Nelson & Winter 1982). Against our predictions, we observed no decreases in novelty in situations of interpersonal conflict. We thus found no support for our expectation that we would find cognitive rigidity or an "intellectual deficit" as a consequence of interpersonal conflict (Carnevale & Probst 1998: 1307). Instead, we observed that interpersonal conflict leads to action trajectories, which incorporate some – albeit not much – novelty, and which nevertheless show slightly more features of 'radical' creative projects than do the action trajectories of teams not subjected to interpersonal conflict. Thus, when teams can freely decide between routines and creative project action trajectories, interpersonal conflict increases their tendency to enact 'radical' creative projects.

Third, regarding interactions between task and interpersonal conflict: In support of our predictions, we found that the combination of task and interpersonal conflict resulted in an increased tendency to enact routine rather than creative project action trajectories. In separate analyses (available upon request from the authors), we found that this interaction effect, which is reversed to the individual main effects of task and interpersonal conflict, cannot be explained by a potentially curvilinear relationship between conflict strength and creative action. That is, the measured interaction effect actually results from the interaction of task and interpersonal conflict and not from the generally more intense level of conflict that we induced in the experimental condition, in which task and interpersonal conflict were combined. Nevertheless, given their individual main effects, task and interpersonal conflict – in combination – still lead to a higher tendency to enact creative projects compared with a situation of no conflict at all. In

conclusion, when teams can freely decide between routines and creative project action trajectories, the combination of task and interpersonal conflict increases their tendency to enact routines, yet this interaction effect is outweighed by the main effects of task and interpersonal conflict, which lead to more creative projects.

### 3.5.1. Theoretical contribution

This study and its findings have some important theoretical implications. First, our findings contribute to a better understanding of how conflict affects routine and non-routine organizational action. While microfoundational studies of routines explored the internal dynamics of routines and thus opened the "black boxes" of routines (Felin et al. 2012), in doing so, they often created new "black boxes" for behaviors that take place beyond the boundaries of routines—so called 'non-routines' or 'anti-routines' (Weick & Sutcliffe 2006). The limited previous research that accounted for the coexistence of nonroutine, less routine, and routine forms of action mostly focused on the firm level, and thus is not suited to analyze microsocial phenomena, such as team-level conflicts (Brown & Eisenhardt 1997; Cohen et al. 1972; Miner et al. 2001). By following Obstfeld's (2012) microfoundational action trajectory perspective we were able to open "black boxes" – of routines and anti-routines – at the same time to shed light on the effects of conflict at the intersection between routine and non-routine action. We found that at this intersection, conflict influences choices between routine and creative project action trajectories and that it may shift teams' decisions whether to enact routines or creative projects either towards creative projects (pure task or interpersonal conflict) or towards routines (interactions of task and interpersonal conflict). We thus identified team-level conflict as an important cause for alternations between routines and creative projects, and hence as an explanation as to how organizations get new things done (Obstfeld 2012). Our findings suggest that conflict induces teams to break out of their routines and to engage in creative projects, which challenge existing structures. It forms a microsocial 'motor' of organizational change

(Van De Ven & Poole 1995). We thus provide an in-depth understanding of the microsocial relationship between conflict and organizational action. Our findings will contribute to more precise theory that uncovers the microfoundations of organizational change (Felin et al. 2012; Salvato & Rerup 2011).

And second, we shed more light to the causal effects of conflict on routines and the processes in which they form. In contrast to previous studies in this field of literature, we differentiate between the effects of task and interpersonal conflict, and we provide causal evidence regarding the effects of each. We find that both task and interpersonal conflict increase teams' tendency to abstain from developing and enacting routines. Our findings are hence compatible with a recent study of routines, which associates conflict with collapses of routines (Zbaracki & Bergen 2010). We build on that study by showing that different forms of conflict – task and interpersonal conflict – result in a retreat from more routine action trajectories. In contrast to Zbaracki and Bergen (2010), we can clearly show that conflict is not only a side effect of routine collapses but in fact causes less-routine forms of organizing. Hence, our findings regarding the individual effects of task and interpersonal conflict seemingly oppose the idea that conflicts result in the development of routines as truces that are established as countermeasures, which allow teams to function despite their experienced or anticipated conflicts (Nelson & Winter 1982). Instead, our findings suggest that the truces provided by routines are 'endangered' by conflict and that conflict prevents routine formation and leads to non-repetitive projects instead. Thus, our findings suggest that in order to understand routines and routine formation it is important to understand the microsocial context in which they occur. While previous research has already suggested that microsocial context affects the outcomes of routines (Feldman & Pentland 2003), our findings enhance this research by suggesting that microsocial context affects whether or not routines form at all. Our findings hence support the view that routine formation, which is often seen as a direct result of repetition and retention (Feldman & Pentland 2003; Pentland et al. 2012), is not as inevitable as it is sometimes

presented (Gersick & Hackman 1990). Instead, microsocial phenomena, such as team-level conflict, may heavily disturb the formation of routines by preventing repetition. Clearly, our study analyzed the emergence and evolution of action trajectories only over a short time span and we cannot rule out that some of the creative projects that we observed in our setting might have turned into new stable routines had we observed them for a longer time span. Yet, based on our findings we can state that such routines would result from comparatively more variation and experimentation if they were formed by teams which experienced conflict. It is left to future research to test the long term effects of conflict on routines.

### 3.5.2. Practical contribution

Our findings call for conflict management as a means of shifting teams between routines and creative projects. Organizations' relative interest in pursuing more routines or creative projects, may determine the extent to which they incorporate conflicts into their work environments. For instance, structured devil's advocacy style discussions, which result in task conflict, may be applied in order to stimulate less routine and more creative project action trajectories. Moreover, our findings are counterintuitive in that they suggest that not only task conflict but also interpersonal conflict may have certain benefits. Organizations seeking creative projects might benefit from allowing teams to act out their interpersonal conflicts. In contrast, organizations seeking rigid routines should avoid task and interpersonal conflicts (e.g., by recruiting a homogenous workforce or by standardizing procedures).

### 3.5.3. Limitations and future research

Our experimental approach is subject to several limitations, which could be addressed in future research. Our conflict manipulations took place in comparatively complicated processes, and given the complexity of these processes, there is a considerable risk of confounding. For instance, our observations may in part be explained by the negative emotions associated with conflict. We know that negative emotions, which we might have induced through our

experimental procedure, may affect the exploration and exploitation of work teams (Døjbak Håkonsson et al. 2016), and given the close connection between conflict and emotions, we could not isolate conflict from emotions. Future research could benefit from a better understanding of the interplay conflict and emotions in the context of routines and creative projects.

We induced rather weak levels of conflict (in particular with regard to interpersonal conflict) in a virtual experimental setting, in which participants interacted anonymously through computer chats. The weak manipulations may explain the small effect sizes that we observe. Clearly, our study could not fully capture the full complexity, intensity, and all potential dynamics of organizational conflict. Nevertheless, the fact that even in such a stylized setting we could observe visible differences between different experimental manipulations suggests that the predicted effects might be even more powerful in the field. It is left to future research to explore the relationship between conflicts and action trajectories in more practical settings.

Finally, we analyzed conflict as an antecedent of action trajectories. Clearly, conflictual interactions not only precede but also form part of action trajectories. Conflict may become a part of routines and creative projects and shape their internal dynamics (Zbaracki & Bergen 2010). Given that the extant behavioral research has mostly focused on the cognitive roots of organizational action (Cohen 2007), future research could shed more light on the conflictual and emotional dynamics of organizational action trajectories—ideally by observing organizational action over a comparatively longer period.

### 3.6. Conclusion

This study provides important insights into conflict as an important influence on organizational action that drives teams' decisions whether to enact routine or creative project action trajectories. Our experimental design enabled us to provide causal evidence regarding the effects of task and interpersonal conflict on action trajectories. We find that conflict affects

teams' choices between routine and creative project action trajectories and thus determines whether and how teams (as organizational nuclei) change. We find that task as well as interpersonal conflict tends to result in more creative projects, whereas combinations of both forms of conflict lead to a relative shift towards routines. Conflict may therefore be used to induce teams to attempt creative projects.

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# 4. When is it good to feel bad? How sadness and fear differ in their effects on routine development

**Abstract:**

This study follows recent calls to explore the emotional foundations of routine development. Routine development forms a nexus between stability and change and is thus crucial to successful organizational adaptation and change. Individuals and teams going through organizational change often experience sadness and fear. Using experimental data from 84 teams in a laboratory experiment, we find that teams that experience sadness develop comparatively more repetitive, quicker, and reliable routines, whereas teams experiencing fear react better to 'performance traps' in which pre-established routines are ineffective. Our findings show how routine development is guided by negative emotions, contributing to new theory that will enable researchers and practitioners to better understand and harness the emotional capacities of groups in change contexts.

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## 4.1. Introduction

To succeed, organizations "must reconcile stability […] with change" (Farjoun 2010: 202). To do so, they develop routines—"repetitive, recognizable patterns of interdependent actions, carried out by multiple actors" (Feldman & Pentland 2003: 95). Routine development provides stability through repetitiveness and allows for quick and reliable performances (Cohen & Bacdayan 1994). At the same time, it frees cognitive resources that can be redirected towards strategic change efforts (Levinthal & Rerup 2006). Thus, routines may simultaneously represent inhibitors as well as sources of change (Feldman & Pentland 2003). Understanding routine development is crucial to understanding whether and how organizations and teams in organizations change.

Previous research on routines and routine development has been generally more committed to "explanations that rely primarily on 'cool' cognition" (Adler & Obstfeld 2007: 20) rather than on 'hot' affect (Bernheim & Rangel 2004), although even early research on human behavior emphasizes the importance of emotions in explaining behavior in organizations (Dewey 1922). Even though routine research has for quite some time theoretically hypothesized that emotions are somehow connected to routines (Adler & Obstfeld 2007), only recently have Døjbak Håkonsson et al. (2016) empirically shown this connection. They find that negative emotions generally relate to a lower likelihood of adaption to new routines than positive emotions and may thus inhibit organizations from changing their routines.

Døjbak Håkonsson et al. (2016) set the stage for performing emotion-related routine research, but they generalize positive and negative emotions and do not differentiate between distinct negative emotions such as sadness and fear. Generalizing emotions may lead to imprecise findings and predictions, which in turn may result in ineffective management practices. We know from managerial and psychological research that distinct emotions, particularly distinct negative emotions, have different effects on a wide range of organizational actions that are connected to routines, from proactivity (Lebel 2017) to risk taking (Lerner &

Keltner 2000; 2001) and entrepreneurial action (Welpe et al. 2012). These (often) strong differences in the effects of distinct negative emotions on organizational action suggest that research should differentiate between distinct negative emotions and their effects on routine development.

Moreover, Døjbak Håkonsson et al. (2016) focus their analyses on general strategic decisions to explore new routines versus exploiting existing ones. However, microfoundational perspectives suggest that the development of routines is to a lesser extent driven by conscious strategic decisions about whether to exploit or explore routines as static 'black-boxes' (Døjbak Håkonsson et al. 2016). Rather, routines and the processes in which they are developed are "fine-grained, and multilayered [in] nature" (Salvato & Rerup 2011: 469), and are subject to complex internal dynamics (Feldman & Pentland 2003; Felin et al. 2012). Accordingly, in order to better understand routine development, it is important to explore the microfoundations of routines (Salvato & Rerup 2011).

Thus, while Døjbak Håkonsson et al.'s (2016) study is highly valuable, as it suggests that the evolution of routines is in part shaped by highly contagious negative emotions (Barsade 2002; Bartel & Saavedra 2000), our understanding of the differential and microfoundational effects of distinct negative emotions on routine development remains limited. Understanding these effects is important for developing "new theory and research […] to shed light on the generative mechanisms through which firms might […] harness the […] emotional capacities of individuals and groups" (Hodgkinson & Healey 2014: 1306).

The two distinct negative emotions sadness and fear are particularly relevant in the context of routine development. First, sadness and fear are likely to result in different effects on routine development. For instance, lab studies show that whereas sadness relates to uncertainty acceptance, fear relates to uncertainty avoidance (Lerner & Keltner 2001; Raghunathan & Pham 1999). Given that routine development represents a means to reduce uncertainty (Becker 2004; Nelson & Winter 1982), it is likely that routine development

processes involving sadness differ from routine development processes involving fear. Second, sadness and fear are particularly likely to be experienced in the context of routine development. Routine development is closely connected to organizational change, which is often accompanied by sadness and fear (Fugate et al. 2002; Kabanoff et al. 1995). While developing routines during times of change, organizational members are likely to feel sad about leaving a past state, for instance, due to layoffs of beloved colleagues or due to the breakup of their team (Appelbaum et al. 2000; Basch & Fisher 2000), and they often experience fear about the future, for instance, fear of losing their jobs or situational control (Appelbaum et al. 2000). Third and finally, sadness and fear are among the most often observed forms of emotional distress (Raghunathan & Pham 1999; Selye 1956) and may, for instance, be caused by dysfunctional supervision in change contexts (Oh & Farh 2017). While routine development takes time, both fear and sadness can be experienced over long periods of time throughout change processes (Verduyn et al. 2009) and may thus shape routine development continuously.

Despite the relevance of sadness and fear in contexts in which routine development occurs, so far we do not know how they affect routine development. This research gap is regrettable given the potential consequences of sadness and fear for routine development. For instance, with regard to fear, Vuori and Huy (2016) find that in the case of Nokia, shared fear among employees led to inertia and contributed to the downfall of this formerly world-leading company. This case exemplifies that the economic actors involved in change processes are not devoid of emotions, and it is likely that their routines are shaped by emotions (Hodgkinson & Healey 2014). New theory is required to solve the problem that "theory and research rooted in the cold cognition era of human psychology has laid microfoundations for practices […] that are fundamentally unfit for purpose" (Hodgkinson & Healey 2014: 1306). Accordingly, we follow the repeated calls in the extant literature to "also account for emotions […] to complete the microfoundations of our theories" (Hodgkinson & Healey 2011). At the same time, we follow Barsade and Gibson's (2007: 52) call, who note that "[r]esearch and practice should be

directed to the important questions of, "Under what conditions can negative affective responses lead to positive organizational outcomes?" To do so, it would be helpful for emotion scholars to focus on examining the various discrete negative emotions, as the outcomes […] are likely going to be very different."

We ask, how do sadness and fear differentially affect routine development? We use a laboratory experiment to causally address this research question. Relying on an established paradigm (Cohen and Bacdayan 1994), we employ a microfoundational perspective on routines given that "routines and capabilities […] ultimately […] are best understood at the micro-level" (Abell et al. 2008: 489). Specifically, we employ four different dimensions to operationalize routine development, i.e., (1) repetitiveness in action, (2) speed in action, (3) reliability in action, and (4) attentiveness in action. Accordingly, our findings lead to a better understanding of the mechanisms through which negative emotions affect routine development. Our experimental study provides causal evidence that these individual dimensions of routine development processes are differently affected by sadness and fear and thus suggest that distinct emotions as well as different dimensions of routine development should be differentiated in order to understand the effects of negative emotions on routine development. Our findings may lead to the development of more emotion-sensitive change practices and might sensitize organizations to better understand and predict the effects of negative emotions in change processes.

## 4.2. Theoretical background

### 4.2.1. Routine development and its operationalization

In our notion, routine development comprises two aspects: first, routines may develop (i.e., routines emerge), and second, routines may be developed (i.e., routines are modified). The behavioral theory describes two processes that address both aspects of routine development. The first process refers to the emergence of operating routines and of ecologies of operating

routines as repetitive practices that evolve through internal dynamics (Parmigiani & Howard-Grenville 2011). The second process describes the external modification of operating routines through dynamic capabilities, i.e., "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" (Zollo & Winter 2002: 340). Both the emergence and the modification of operating routines, are closely intertwined, and to understand routine development, both processes need to be analyzed jointly (Levinthal & Rerup 2006).

To determine an operationalization of routine development, one might draw from microfoundational perspectives on routines (Felin et al. 2012: 1352). Microfoundational studies of routines have found helpful means to operationalize operating routines, their emergence, and the mechanisms through which they are regulated. For instance, in their pioneering experimental work on organizational routines, Cohen and Bacdayan (1994) introduced four dimensions to operationalize routines and their development. These four dimensions show overlaps with alternative operationalizations of routines (Becker 2005; Laureiro-Martinez 2014; Pentland 2003a; 2003b) and have been used to operationalize both operating routines (Cohen & Bacdayan 1994) and dynamic capabilities (Wollersheim & Heimeriks 2016). Accordingly, they represent a valuable framework to analyze routine development. Three out of the four dimensions introduced by Cohen and Bacdayan (1994) capture the emergence of operating routines by means of three important characteristics of routines: (1) repetitiveness in action, (2) speed in action, and (3) reliability in action. The fourth of Cohen and Bacdayan's (1994) dimensions captures to what extent teams are able to recognize 'performance traps' and, accordingly, to attentively modify their routines in situations in which adjustments may lead to increased performance. This fourth dimension, (4) attentiveness in action, provides a meaningful operationalization of routine modification (please note that Cohen and Bacdayan,

1994, refer to this dimension as 'occasional suboptimality')[7]. All four dimensions capture different facets of routine development, and (as we discuss below) they may be differently affected by sadness and fear.

### 4.2.2. The effects of sadness and fear on routine development

***Repetitiveness in action:*** Routine development involves the emergence of action sequences, which through repetition develop into operating routines and which, due to their repetitiveness, are recognizable as such (Becker 2004; Feldman & Pentland 2003). It has been argued that "[t]hrough repetition and recognition, organizational routines are created" (Feldman & Pentland 2003: 108). Repetitiveness in action is hence crucial to the recognizability and emergence of operating routines. It indicates whether or not routines develop, exist, and dissolve (Laureiro-Martinez 2014; Reich & Zautra 1991). Moreover, through repetitiveness in action, routines provide control. That is, the more repetitive routines are, the more foreseeable and comparable they are and the easier they are to control (Becker 2004). In the context of our research model, repetitiveness in action corresponds to the question: Which operating routines or ecologies of operating routines develop, and how much control do they provide?

There is some indication that sadness and fear may affect repetitiveness in action. Emotions generally "provide[…] the motivating force driving strong commitment to novel choices" and actions (Hodgkinson & Healey 2014: 1310), while negative emotions generally decrease the likelihood of teams abandoning their existing behavioral patterns and adopting novel actions (Døjbak Håkonsson et al. 2016). Consequently, both sadness and fear are likely

[7] Wollersheim and Heimeriks (2016) rely on Cohen and Bacdayan (1994) to capture the regulation of routines through dynamic capabilities. In contrast to this study, they use an experimental design that challenged participants' capacity to identify appropriate procedures following a change in the environment and that required modification of operating routines. In their experiment, they primarily base their identification of the characteristic qualities of dynamic capabilities on Cohen and Bacdayan's (1994) dimensions by analyzing differences between groups in low vs. high dynamic capability conditions in this change situation. In this study, we use a comparatively stable environment in which participants jointly form and modify routines. In this comparatively stable environment, we employ three of Cohen and Bacdayan's (1994) dimensions, (1) repetitiveness in action, (2) speed in action, and (3) reliability in action, to describe the emergence of operating routines, given that these dimensions describe aspects of operating routines that may be observed irrespective of change. (4) Attentiveness in action, in turn, describes to what extent teams are able to *deliberately* adjust routines in the more stable, yet due to the different card configurations changing environment. Thus, in this study, we relate this dimension to the modification of routines.

to result in the development of more-repetitive operating routines. This expectation is supported by appraisal perspectives on emotions, which associate both sadness and fear with high levels of situational control (Smith & Ellsworth 1985). That is, in change processes, sad and fearful teams and their members are likely to attribute the control of their situation to uncontrollable circumstances (Smith & Ellsworth 1985), for instance, to the market environment or to the management. We may expect that teams of sad and fearful individuals restore a feeling of control by increasing the repetitiveness of their actions (Becker 2004; Nelson & Winter 1982). Consistent with this prediction, Staw et al.'s (1981) threat-rigidity thesis suggests that external threats, which tend to be accompanied by fear, generally lead to more repetitiveness in behavior. In conclusion, we expect the development of more repetitive, recognizable, and thus controllable operating routines for teams whose members share a feeling of sadness or fear relative to teams whose members do not feel these emotions. However, we expect no differences between sadness and fear regarding repetitiveness in action.

***Speed in action:*** Routine development allows "for the rapid processing of large amounts of information with little effort" (Laureiro-Martinez 2014: 1113) and for economizing on cognitive resources (Becker 2004). While developing routines, the actors store the components of the operating routines in their procedural memory (Cohen & Bacdayan 1994). This 'off-loading' enables them to act at increasingly higher speeds and to increase their output per unit of time (Cohen & Bacdayan 1994; Healey et al. 2015). Hence, routine development can be associated with increases in the speed in action (Cohen & Bacdayan 1994). Accordingly, the routine and management literature has frequently used speed in action as an indicator for routine development (Cohen & Bacdayan 1994; De Dreu 2003; Laureiro-Martinez 2014). Overall, speed in action corresponds to the question: How automatically are operating routines executed, i.e., how developed is the execution of operating routines?

There is some indication that sadness and fear may affect speed in action. For instance, sadness has been associated with local impatience, i.e., sad individuals tend to seek instant

gratification when facing choices between immediate and future payoffs, an observation that Lerner et al. (2013) denote as 'myopic misery'. In a change context, sadness may thus translate into an increased tendency to develop operating routines—quick and reliable behavioral patterns that may provide instant gratification (Cohen & Bacdayan 1994). Likewise, with regard to fear, Vuori and Huy (2016) find that structurally based fear within organizations (e.g., about the future of the company) may lead to temporal myopia, i.e., a focus on short-term activities and failure at implementing long-term activities. In their case study, fear, i.e., the "dread of impending disaster and an intense urge to defend oneself, primarily by getting out of the situation" (Öhman 2008: 710), pressured organizational members to act urgently (Lazarus 1991; Vuori & Huy 2016). Thus, with both sadness and fear, we may expect increases in the speed at which operating routines are enacted. In the extant literature, we have found no indication of differences between sadness and fear regarding their effects on speed in action.

***Reliability in action:*** Routine development is targeted towards reliability in action, i.e., towards reducing any risk and uncertainty attached to organizational actions (Becker 2004). Operating routines tend to be highly reliable, and their outcomes are almost certain (Cohen & Bacdayan 1994; Cyert & March 1963). Accordingly, routine development reduces the emotional costs that result from risk and uncertainty (Cohen & Bacdayan 1994; Laureiro-Martínez et al. 2015). In fact, it has been argued that routine development may be "viewed as an uncertainty decreasing strategy" (Becker 2004: 658). Reliability in action reveals how well-developed a routine is at fulfilling this function, and thus, it corresponds overall to the question: How functionally developed are operating routines?

There is an indication that sadness and fear may affect demands for reliability in action (Delgado-García et al. 2010). For instance, sadness generally relates to more uncertainty acceptance and to more risk taking and, accordingly, to a comparatively decreased demand for reliable actions that reduce uncertainty and risk (Raghunathan & Pham 1999). In contrast, fear relates to uncertainty avoidance and to less risk taking and, accordingly, to a comparatively

increased demand for reliability (Lerner & Keltner 2001; Liu & Perrewe 2005; Raghunathan & Pham 1999). In a change context, we may thus expect a lower demand for reliability and hence a lower tendency towards the development of reliable operating routines when sadness is experienced and a higher demand for reliability and hence a higher tendency towards the development of reliable operating routines when fear is experienced.

***Attentiveness in action:*** Routine development draws from collective activities—dynamic capabilities (Levinthal & Rerup 2006)—that are dedicated to the creation and modification of operating routines (Zollo & Winter 2002). Whereas dynamic capabilities themselves may represent mindless activities that are unknown to their actors, they shape operating routines through mindfulness and deliberation in action by disciplining collective attention towards operating routines and their enactments (Weick & Sutcliffe 2006). They allow one to find the optimal balance between stability and change, i.e., to understand when operating routines do not require attention and when they should be attentively enacted and modified. Dynamic capabilities become visible through the attentiveness that is put at work in the enactment and modification of operating routines in situations where routines require attention. Overall, attentiveness in action corresponds to the question: How effectively are operating routines enacted and modified to match the dynamics of their environment?

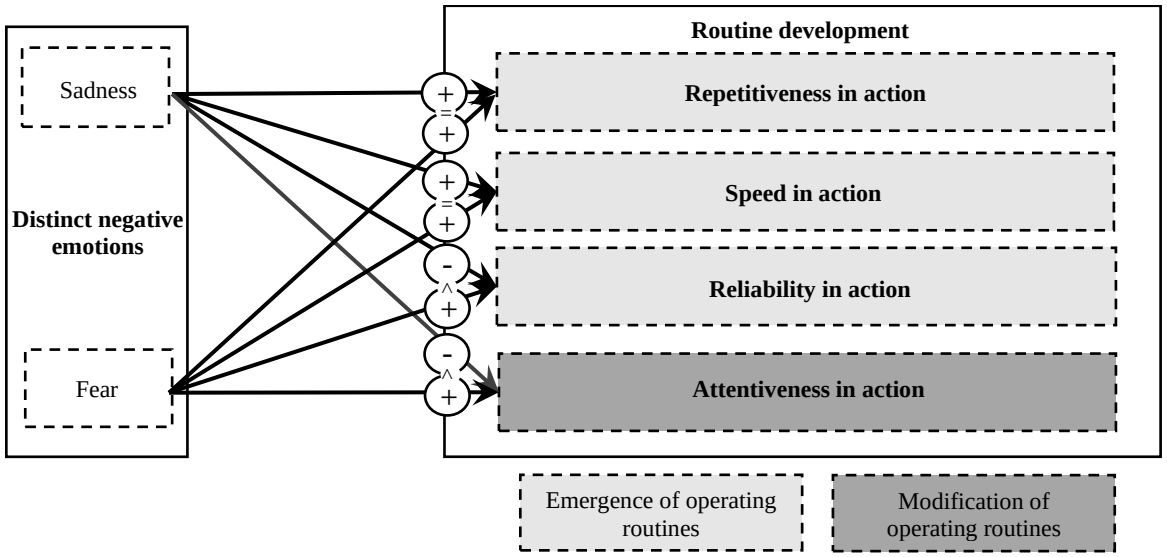
There is some indication that sadness and fear may affect attentiveness in action. For instance, Smith and Ellsworth (1985) generally associate sadness with comparatively lower levels of attention and fear with comparatively higher levels of attention. Gable and Harmon-Jones (2010) find that emotions associated with low motivational intensity (sadness) lead to widened attention, whereas emotions associated with high motivational intensity (fear) lead to narrowed attention. This finding implies that sadness might shift the focus of attention away from local stimuli towards global stimuli—for instance, away from the regulation of operating routines to the environment (e.g., towards issues not related to the task at hand). In contrast,

fear is likely to lead to an attention shift from the environment towards the regulation of operating routines.

### 4.2.3. Our research model

Building on previous studies of routines, our research model features three different dimensions that capture the emergence of operating routines: (1) repetitiveness in action, (2) speed in action, and (3) reliability in action (Cohen & Bacdayan 1994). Moreover, we operationalize the regulation of operating routines as a team's capability to (4) attentively modify operating routines in order to optimize performance. All four dimensions of routine development may be subject to emotional influences, and we expect several differences in the effects of sadness and fear. Figure 9 presents our research model.

*Figure 9: Expected effects of sadness and fear on different dimensions of routine development*




*The figure illustrates the expected effects of the distinct emotions sadness and fear on different dimensions of routine development. = denotes no effect; + denotes positive effect; - denotes negative effect; > denotes significant differences in the effect between sadness and fear*

## 4.3. Data and method

### 4.3.1. Task

As an experimental task, we used the Target the Two (TTT) card game developed by Cohen and Bacdayan (1994), which has already been used in several other studies to exemplify

organizational routines (Egidi & Narduzzo 1997; Wollersheim & Heimeriks 2016). TTT shares essential aspects with typical routine development situations in organizational settings (e.g., asymmetry of authorities, information asymmetry) and thus serves as a well-recognized laboratory-suited analog of organizational routine development. The game features two team members who are randomly assigned to each other and who need to quickly develop a new routine at solving repeated tasks, which vary slightly over time. Specifically, the card game involves six cards in total (2♥, 3♥, 4♥ and 2♣, 3♣, 4♣). Four of these cards lie on the playing board, and the other two cards are assigned as personal cards to each of the two team members. That is, each team member holds one personal card, which cannot be seen by the other team member. The remaining cards are on the playing board, with two lying face-up and two lying face-down. One of the face-up cards occupies a special position, the target position. The team members' common goal is to put 2♥ in the target position as quickly as possible and with the least possible number of moves. They alternately exchange their personal card with one of the cards on the playing board until the relative hand is completed—i.e., until 2♥ is placed in the target position. This process requires coordination, given that a special rule applies to the target position. The special rule differs depending on the authority the respective team member represents in the card game: one of the team members is given the authority of a Numberkeeper, which means that he or she can only exchange his or her personal card with the card in the target position if the cards are of the same number; the other team member is given the authority of a Colorkeeper, which means that he or she can only exchange his or her personal card with the card in the target position if his personal card has the same suit as the one in the target position. In each hand, the Colorkeeper moves first. In total, TTT involves 40 hands with various card constellations, and takes up to 40 minutes. Following Cohen and Bacdayan (1994), we instructed the teams to play up to 40 hands of TTT while not exceeding the maximum time frame of 40 minutes. Twenty-seven of the 40 original card constellations conceived by Cohen and Bacdayan (1994) are designed in a way that allows both Numberkeepers and Colorkeepers

to effectively target the 2♥ card in the target field. In these hands, teams need to coordinate on one authority (Numberkeeper or Colorkeeper), who places the 2♥ card in the target field, whereas the other team member assumes a supportive role (Egidi 1996; Egidi & Narduzzo 1997). Teams can only succeed in these tasks if they find a way to coordinate their respective authorities. Because they are urged not to communicate openly, team members may implicitly communicate through 'signal cards' to inform the team member about intended actions (Egidi 1996; Egidi & Narduzzo 1997).

Given that we try to elucidate routine development in the context of different emotional states, we induced sadness and fear in the respective experimental conditions prior to the TTT game. We thus created a situation in which emotionalized individuals with distinct authorities were combined into new teams (comparable to 'painful' organizational restructurings or post-merger integration processes, in which new tasks are distributed among newly formed teams) and had to find a way to work effectively while experiencing negative emotions. Additionally, we employed a control condition without inducing any emotions.

### 4.3.2. Procedure

***Introduction:*** On their arrival in the experimental laboratory, participants were assigned a computer (3I; 3 GHz; 2 GB RAM; 64-bit Windows 7). We then introduced our participants to the general background, procedure, and incentive structure of the experiment. Subsequently, we instructed our participants to log on and to run through a computerized training session. The computerized training included a written explanation of the rules of the game (including information on which authority the relative player represented, i.e., Colorkeeper or Numberkeeper) and a sample hand, which illustrated the rules of the game. Because reading and learning speeds vary, we gave the participants the necessary flexibility to complete the training by themselves. The computerized training was followed by a short question-and-answer session. In addition to answering the questions raised publicly, the experimenter

repeated answers to some general questions that—according to pretests and observations from other studies with this card game (Wollersheim & Heimeriks 2016)—appeared regularly. Thereby, we ensured that participants received identical information in all sessions. After the question-and-answer session, we distributed printed rule cards indicating the respective roles (i.e., Colorkeeper or Numberkeeper) and summarizing the rule that applied to the respective role of the participants. The participants were randomly allocated to teams, which—without their knowledge—were assigned to our three different emotion induction conditions. The participants knew that they would play with another person in the room; however, they were informed that the identity of their team member would not be revealed, neither during nor after the game.

***Emotional manipulation:*** We implemented the emotion intervention by inducing fear, sadness, or no specific emotions. We only induced one emotion per team (i.e., emotions were not mixed within teams). After introducing the experimental procedure, we instructed the participants to write a short essay for five minutes. Specifically, we instructed them to write a detailed description of an event that made them feel either deeply sad (sadness condition) or afraid (fear condition) or one that regularly occurs and does not have any obvious emotional influence (control condition). This emotion induction procedure is widely used in economic studies (e.g., Nelissen et al. 2011) in which decisions have to be made directly after finishing the writing task. Because this study needed to sustain these emotions for up to 40 minutes, we additionally used a combination of music and pictures for the emotion induction during the game (Lench et al. 2011). Previous research has shown that combining music and pictures is more effective for inducing emotions than using pictures alone (Baumgartner et al. 2006b), and several studies have successfully combined auditory and visual stimuli for inducing emotions (Drace et al. 2009; Haase & Silbereisen 2011).

During the experimental task, we played music that was used in previous research (Etzel et al. 2006; Krumhansl 1997) to the participants via headphones (headphones were also used in

previous studies, e.g., Stephens et al. 2010). Specifically, the musical stimulus material consisted of soundtrack (Etzel et al. 2006) and classical music (Baumgartner et al. 2006a; Mayer et al. 1995) to induce sadness and fear. The music excerpts were played in a random order. Participants in the control condition wore headphones without listening to music (Niedenthal et al. 2001), because "neutral music does not exist" (Baumgartner et al. 2006a: 41).

The visual stimulus material consisted of 10 pictures per experimental condition (i.e., 10 pictures for inducing sadness, 10 pictures for inducing fear, and 10 pictures for the control condition). Most of the pictures were taken from the International Affective Picture System (IAPS). Those pictures that were not taken from the IAPS were collected from the internet (IAPS pictures were also supplemented with pictures that had been collected by the authors in Baumgartner et al. 2006a). During the experimental task, the pictures regularly popped up on participants' computer screens. All pictures that were used for the main study had been pretested. In the pretest, we presented 30 pictures per experimental condition in a questionnaire to the students; they were instructed to indicate to what degree the picture made them feel sad, afraid, etc. The pictures exemplified (1) objects to induce the respective emotion (e.g., guns for fear), (2) individuals experiencing the respective emotion (e.g., a crying person for sadness), or (3) a combination of both (e.g., a sad person sitting next to the body of a person who recently died). Participants in the control condition were exposed to neutral objects. For the visual induction, each picture was presented at the center of the screen for 30 ms (e.g., Soussignan et al. 2010), and there was a time lag of 10 s between the picture presentations. The pictures were presented in random order.

Because this study induced emotions for such a long time frame, the whole emotion induction procedure was pretested. Participants ($N$ = 72) who did not take part in the main study were asked after five minutes, after 20 minutes, and after completion of the game to what degree

they currently felt sad and to what degree they currently felt afraid.[8] As shown in Table 7, the manipulation was successful across all time spans: Participants in the sadness condition were significantly more sad than participants in the control condition after 5 minutes, $t(40) = 4.83$, $p < 0.001$, after 20 minutes, $t(37) = 3.56$, $p < 0.01$, and after the completion of the game, $t(38) = 3.16$, $p < 0.01$. Participants in the fear condition were significantly more afraid than participants in the control condition after 5 minutes, $t(41) = 2.29$, $p < 0.05$, after 20 minutes, $t(32) = 2.08$, $p < 0.05$, and after the completion of the game $t(29) = 2.22$, $p < 0.05$. In the main study, we conducted further manipulation checks. Yet, in contrast to the pre-tests, we tested emotions only at the end of the study. Accordingly, the manipulation checks could not have influenced routine development in our main sessions.

**Table 7: Manipulation check pre-test**

| | Control condition | | Sadness condition | | | Control condition | | Fear condition | |
|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *SD* | *Mean* | *SD* | | *Mean* | *SD* | *Mean* | *SD* |
| **Reported sadness** | | | | | **Reported fear** | | | | |
| **After 5 min.** | ***1.21*** | ***1.62*** | ***4.08*** | ***2.43*** | **After 5 min.** | ***1.63*** | ***2.26*** | ***3.50*** | ***3.31*** |
| **After 20 min.** | ***1.46*** | ***1.56*** | ***3.71*** | ***2.68*** | **After 20 min.** | ***1.04*** | ***1.46*** | ***2.36*** | ***2.63*** |
| **After the game** | ***1.25*** | ***1.57*** | ***3.21*** | ***2.60*** | **After the game** | ***0.54*** | ***0.78*** | ***1.54*** | ***2.06*** |

***Measurement of routine development:*** After they had been given five minutes for their short essays, we instructed the participants to put on headphones and then started our experimental TTT task for all players in the experimental laboratory. Following Wollersheim and Heimeriks (2016) we used a computerized version of TTT (Cohen & Bacdayan 1994). Our version of TTT was programmed as a client-server-solution that displayed cards in the same order on each screen as the original game. We measured routine development in the game by means of four different dependent variables, of which the first three captured the emergence of operating

[8] Note that as part of our pretest for the emotion induction procedure, we also employed an experimental condition in which we induced happiness as an alternative control condition. However, because happiness could not be induced successfully, we did not collect data with regard to happiness in our main study, so we do not report these findings here.

routines by means of (1) repetitiveness in action, (2) speed in action, and (3) reliability in action, and of which the fourth captured the modification of operating routines by means of (4) attentiveness in action.

(1) To measure repetitiveness in action, we identified distinct action patterns and their repetitions in the TTT game (Cohen & Bacdayan 1994). In the game, action patterns can be identified and differentiated according to the field positions with which team members exchange the cards in their hands in their efforts to solve TTT. Every move in TTT either represents a card exchange with a field position on the virtual table or an activation of the pass button. Individual moves may, hence, be aggregated into action sequences that capture the chronological order of moves over the course of one hand. These action sequences take the shape of strings of letters, such as UPTDUUPT, where U denotes an exchange with a field position on which a card lies face *U*p, D denotes an exchange with a field position on which a card lies face *D*own, T denotes an exchange with the *T*arget position, and P denotes a *P*ass. We can use these strings to differentiate distinct action sequences and their repeated enactment throughout the game. Specifically, we analyzed either the last four moves of a hand if a hand was solved within four or more moves or the last three moves of a hand if the hand was solved within three moves (Cohen & Bacdayan 1994). We chose this approach because the first few moves of each action string tend to be very specific to the different constellations of cards on the playing field, whereas the last few moves of each hand can be replicated throughout various constellations of cards. Thus, for each team and each hand, we determined the combination of the last three to four moves that led to the solution of the hand. The respective solutions are stored in our variable 'distinct action sequences'. To determine repetitiveness in these distinct action sequences, we counted the recurrences of each 'distinct action sequence' for each team by means of our variable 'repetitiveness of distinct action sequences'.

(2) To measure speed in action, we followed Cohen and Bacdayan (1994) in measuring the 'average move time per hand' and changes in this variable throughout the TTT game

(Laureiro-Martinez 2014). That is, for each hand played by each team, we individually assessed the average time it took the team members to execute the moves of this hand. Measuring speed in action for each hand separately enabled us to assess how speed in action changed over the course of the TTT game.

(3) To measure reliability in action, we analyzed the 'deviation in number of moves relative to the best team'. That is, for each team and each hand, we determined the difference in the number of moves required by the analyzed team and the number of moves required by the team that required the lowest number of moves for the respective hand. Thereby, we refine Cohen and Bacdayan's (1994) measure for reliability, which is limited in its explanatory power, in that it basically only compares two out of all participating teams to each other. Our approach allows us to measure reliability in action for each team separately and, thus, to compare all participating teams to each other.

(4) To measure attentiveness in action, we looked at occasional suboptimality. Cohen and Bacdayan (1994) find that the development of operating routines, such as the so-called UU*T sequence (named after the sequence of activated fields *U*p, *U*p, *Anything, *T*arget), may contribute to occasional suboptimality. In their experimental setting, players—"like individuals who have been practicing left turns so long that they will pass by a right turn to make three lefts instead" (Cohen & Bacdayan 1994: 563)—tend to stick to pre-established action patterns even in situations in which different solutions would have been more efficient. Yet, Wollersheim and Heimeriks (2016) find that teams playing TTT may benefit from dynamic capabilities that are reflected in an increased attentiveness in teams' enactments of routines and that result in a lower likelihood of falling prey to the negative side-effects of operating routines. In TTT, there are several individual hands in the game, for which it can be shown that the use of stable operating routines leads to suboptimal performance. Following Cohen and Bacdayan (1994), we set up

three ‘traps’ in our experimental setting (hands eight, 15, and 38).[9] These hands can be comparatively easily solved by teams that do not rely on previously established action sequences, such as UU*T action sequences, to place the 2♥ card in the target field and instead choose an alternative approach. To measure attentiveness in action we determined for each team, which percentage of the three ‘traps’ we had set up were successfully avoided. We thus call our measure for attentiveness in action ‘percentage of traps avoided’.

***Measurement of money gained:*** We additionally measured how much money teams gained in the card game as an indicator of their capacity to “play quickly in order to increase the number of hands completed” and “to play carefully in order to avoid unnecessary moves in completing each hand” (Cohen & Bacdayan 1994: 560). Each player was awarded 50 cents per completed hand less five cents per move needed to put the 2♥ in the target position. Thus, the overall reward for each pair of players depended on the number of hands they solved within 40 minutes, and on the sophistication of the moves they executed in order to do so.

***Final questionnaire and remuneration:*** We ensured that the participants who were faster than others remained seated until all participants completed the experimental task. This allowed us to avoid having the participants rush through the experiment in order to leave early. Upon completion of the TTT game, the participants were asked to fill out a questionnaire, which included manipulation checks and demographical questions. Participants were paid their winnings in cash shortly after the end of the study. Basic data analyses contributed to determining the amount to be paid. Specifically, we made a fixed payment of €6.15 and paid participants an additional amount according to performance (*M* = €4.02, *SD* = €1.46, *Min* = €-3.60, *Max* = €5.18). To meet the requirements of the laboratory where we collected our data, we guaranteed that each participant would receive at least €6.00.

[9] Please note that Cohen and Bacdayan (1994) and Wollersheim and Heimeriks (2016) only reported their findings regarding hand 38. We identified another two hands (eight and 15) with similar features, which we included in our tests to increase the validity of our findings.

### 4.3.3. Sample

In total, 168 participants arranged into teams of two players participated in the study. Participants were randomly assigned to teams, and the teams were randomly assigned to the experimental conditions. 54 participants (i.e., 27 teams) were assigned to the control condition, 56 participants (i.e., 28 teams) were assigned to the sadness condition, and 56 participants (i.e., 28 teams) were assigned to the fear condition. The participants were recruited using the software ORSEE (Greiner 2004). For one pair of players, technical problems occurred; they could not finish the experiment and were thus excluded from the dataset prior to the analyses. The final sample—$N$ = 166—consisted of 118 men (71.1%) and 48 women (28.9%), with ages ranging from 18 to 50 and a mean age of 21.91 years ($SD$ = 3.08).

## 4.4. Experimental results

### 4.4.1. Manipulation check

In the main study, we observed a medium effect of the emotional manipulation on the participants' levels of self-reported sadness, $F(2, 163) = 7.17$, $p = 0.001$, $R^2 = 0.081$, and a small effect on self-reported fear, $F(2, 163) = 3.49$, $p = 0.033$, $R^2 = 0.041$. Participants in the sadness condition ($M = 3.23$, $SD = 2.54$) reported significantly higher levels of sadness than participants in the control condition ($M = 1.70$, $SD = 2.19$), $t(108) = 3.37$, $p = 0.001$, $d = 0.644$, and the fear condition ($M = 1.91$, $SD = 2.17$), $t(110) = 2.96$, $p = 0.004$, $d = 0.560$. Participants in the fear condition ($M = 1.79$, $SD = 2.42$) reported significantly higher levels of fear than participants in the control condition ($M = 0.94$, $SD = 1.57$), $t(108) = 2.16$, $p < 0.033$, $d = 0.413$, and in the sadness condition ($M = 0.95$, $SD = 1.70$), $t(110) = 2.13$, $p = 0.036$, $d = 0.402$. Our manipulation checks suggest that sadness and fear were successfully induced.

### 4.4.2. Summary statistics

Table 8 provides descriptions and correlations for the most important variables. We found correlations among all three dimensions that capture the emergence of operating routines. In contrast, we found no significant correlations between attentiveness in action—the dimension of routine development that captures the modification of operating routines—and the three dimensions that capture the emergence of operating routines. These findings support our assumption that operationalizing the emergence and modification of operating routines separately is reasonable.

**Table 8: Descriptive statistics and correlations (level of analysis: Team)**

| | | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **(1)** | **Repetitiveness in action**<br>Average no. of repetitions of each action sequence | 2.802 | 0.381 | 1 | | | | | | | |
| **(2)** | **Speed in action**<br>Average move time per hand | 5.460 | 0.739 | -.168<br>(.128) | 1 | | | | | | |
| **(3)** | **Reliability in action**<br>Average deviation in number of moves relative to best team | 1.647 | 0.650 | -.548<br>(.000) | .213<br>(.054) | 1 | | | | | |
| **(4)** | **Attentiveness in action**<br>Percentage of traps avoided | 0.388 | 0.322 | -.168<br>(.140) | .003<br>(.981) | -.074<br>(.518) | 1 | | | | |
| **(5)** | **Share of UU*T moves**<br>UU*T moves in relation to all moves | 0.220 | 0.052 | .430<br>(.000) | -.094<br>(.397) | -.563<br>(.000) | .026<br>(.819) | 1 | | | |
| **(6)** | **Money gained**<br>Money gained per team | 856.646 | 156.999 | .527<br>(.000) | -.194<br>(.079) | -.986<br>(.000) | .050<br>(.663) | .572<br>(.000) | 1 | | |
| **(7)** | **Sadness**<br>Mean sadness among team members | 2.278 | 1.728 | -.054<br>(.627) | .062<br>(.577) | -.043<br>(.701) | .057<br>(.620) | -.047<br>(.670) | .041<br>(.715) | 1 | |
| **(8)** | **Fear**<br>Mean fear among team members | 1.222 | 1.556 | -.028<br>(.805) | .252<br>(.022) | -.011<br>(.922) | .010<br>(.933) | .218<br>(.048) | .031<br>(.781) | .274<br>(.012) | 1 |

*P-values in parentheses*

### 4.4.3. The effects of sadness and fear on routine development

***Repetitiveness in action:*** To understand to what extent routine development differed between experimental conditions, we analyzed the 'repetitiveness of distinct action sequences'. On average, teams across all conditions repeated each action sequence 2.76 times (*SD* = 0.35). Teams in the sadness condition (*M* = 2.87, *SD* = 0.33) repeated their action sequences significantly more often than teams in the control condition (*M* = 2.62, *SD* = 0.49), *t*(53) = 2.23,

$p = 0.030$, $d = 0.599$. We thus observe a medium-sized effect of sadness on repetitiveness in action. We did not find additional significant differences for repetitiveness in action sequences between the other condition comparisons (fear condition: $M = 2.78$, $SD = 0.43$).

Thus, consistent with our expectations, we observed that teams experiencing sadness generally acted more repetitively than teams in the control condition. Accordingly, teams in the sadness condition developed comparatively more stable operating routines, presumably in order to increase control over their actions. Regarding fear, our findings do not robustly support our expectation that fear would generally lead to more repetitiveness in action. As expected, we did not find significant differences in repetitiveness in action between teams experiencing sadness and teams experiencing fear.

***Speed in action:*** To test whether sadness and fear affect how automatically operating routines are executed, we followed Cohen and Bacdayan (1994) in analyzing speed in action. Specifically, we observed the 'average move time per hand' in the TTT game. For each team and each hand, we measured the average number of seconds the team required to finish each move of that hand. This way, we were able to test absolute speed in action and changes in speed in action throughout the game.

**Table 9: Speed in action - OLS regression analysis of average move time per hand**

| | **Coeff.** | ***SE*** |
|---|---|---|
| Constant | 7.581*** (.000) | *.108* |
| Hand index | -0.103*** (.000) | *.005* |
| Sadness condition (1= yes vs. 0 = no) | -0.691*** (.000) | *.151* |
| Fear condition (1 = yes vs. 0 = no) | -0.225 (.137) | *.151* |
| Sadness condition × hand index | 0.025*** (.000) | *.007* |
| Fear condition × hand index | 0.012$^{+}$ (.086) | *.007* |
| Observations | 3,296 | |
| $R^2$ | 0.258 | |

*Negative coefficients correspond to more speed in action*
*P-values in parentheses;* $^{+}$ *p < 0.1,* *** *p < 0.001*

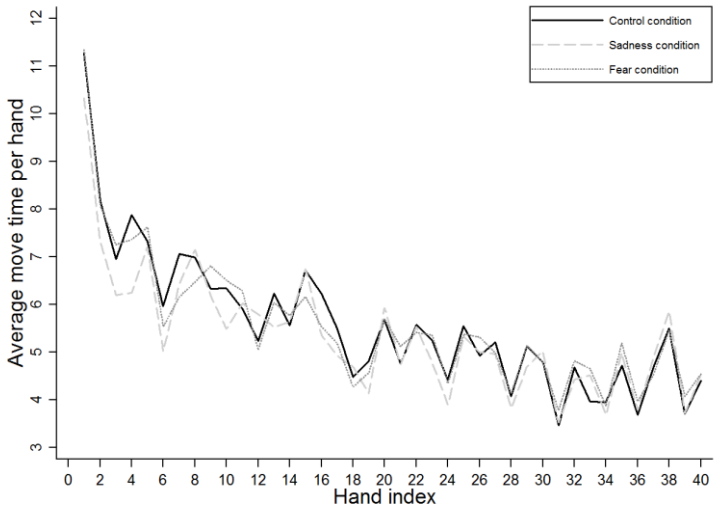
We started our analysis by comparing how teams in our experimental conditions differed regarding their absolute speed in action. Simple group-comparisons revealed that the 'average move time per hand' was significantly lower in the sadness condition ($M$ = 5.35, $SD$ = 1.87) than in the control condition ($M$ = 5.60, $SD$ = 2.25), $t(2174) = 2.84$, $p = 0.005$, $d = 0.122$. We found no significant differences in the 'average move time per hand' between the fear condition ($M$ = 5.56, $SD$ = 2.13) and the control condition, $t(2174) = 0.39$, $p = 0.695$, $d = 0.017$, but we found significantly quicker moves in the sadness condition relative to the fear condition, $t(2238) = 2.53$, $p = 0.012$, $d = 0.107$. Thus, sadness generally led to comparatively quicker moves, yet the observed effects are small.

To analyze the evolution of the 'average move time per hand' throughout the TTT game, we conducted an OLS regression analysis of speed in action, which we present in Table 9. Our regression analysis predicts that across all conditions, with each hand of the game, the 'average move time per hand' decreased by 0.10 seconds ($SE$ = 0.00, $p < 0.001$, $R^2 = 0.258$). Hence, every ten hands of the game, the 'average move time per hand' decreased by roughly one second.[10] With the regression model, we tested for interaction effects between the emotional manipulations and game progress, which in the regression analysis is represented by the variable hand index. We found a significant positive interaction effect between sadness and the hand index ($b$ = 0.02, $SE$ = 0.01, $p < 0.001$) and a slightly significant positive interaction effect between fear and the hand index ($b$ = 0.01, $SE$ = 0.01, $p < 0.086$). The positive coefficients suggest that teams experiencing sadness or fear could not decrease their 'average move time per hand' (and thus increase their speed in action) over the course of the game to the same extent as teams in the control condition.

[10] To rule out that these increases in speed in action resulted from differences in difficulty between early and late hands of the game, we followed Cohen and Bacdayan (1994) in replicating the first five hands of the game in exactly the same constellation 25 hands later in the game. The 'average move time per hand' in hands one to five turned out to be 3.24 seconds slower ($M$ = 8.04, $SD$ = 2.91) than in hands 26 to 30 ($M$ = 4.80, $SD$ = 1.30), $t(826) = 20.65$, $p < 0.001$. This observation supports our finding that the participating teams were generally able to increase their speed in action with game progress.

Figure 10 illustrates this finding. In the first few hands, teams in the sadness condition (and to a lower extent, teams in the fear condition) achieved greater decreases in the 'average move time per hand' than teams in the control condition, yet over the course of the game, teams in the control condition achieved comparable speeds.

*Figure 10: Speed in action: Development of the average move time per hand with game progress*




Thus, consistent with our expectations, we generally observed more speed in action in the sadness condition relative to the control condition. Contrary to our expectations, teams in the sadness condition not only acted generally quicker than teams in the control condition but also than teams in the fear condition. Yet, at the same time, teams in the sadness condition showed comparatively weaker increases in speed in action with game progress relative to teams in the control condition. Hence, whereas sad teams acted generally quicker than teams in the remaining conditions, this discrepancy in speed emerged at an early stage of the TTT game and tended to decrease over time. In other words, teams in the sadness condition were better at automatizing their actions, yet their automatization advantage decreased with game progress. Regarding fear, against our expectations, teams in the fear condition acted at speeds comparable to teams in the control condition. At the same time, teams in the fear condition increased their speed in action slightly less strongly over the course of the game than teams in the control

condition. Thus, fear did not robustly affect speed in action in absolute terms, but with game progress, it led to a relative decrease in speed in action relative to the control condition.

***Reliability in action:*** To test whether sadness and fear affected how functionally developed operating routines are, we followed Cohen and Bacdayan (1994) in analyzing reliability in action. To measure teams' reliability in action, we looked at the 'deviation in number of moves relative to the best team'.

**Table 10: Reliability in action - OLS regression analysis of deviation in number of moves relative to best team**

| | **Coeff.** | ***SE*** |
|---|---|---|
| Constant | 3.234*** | *.148* |
| | (.000) | |
| Hand index | -0.058*** | *.007* |
| | (.000) | |
| Sadness condition (1= yes vs. 0 = no) | -1.303*** | *.207* |
| | (.000) | |
| Fear condition (1 = yes vs. 0 = no) | -0.700** | *.207* |
| | (.001) | |
| Sadness condition × hand index | 0.034*** | *.009* |
| | (.000) | |
| Fear condition × hand index | 0.023* | *.009* |
| | (.011) | |
| Observations | 3,296 | |
| $R^2$ | 0.046 | |

*Negative coefficients correspond to more reliability in action*
*P-values in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

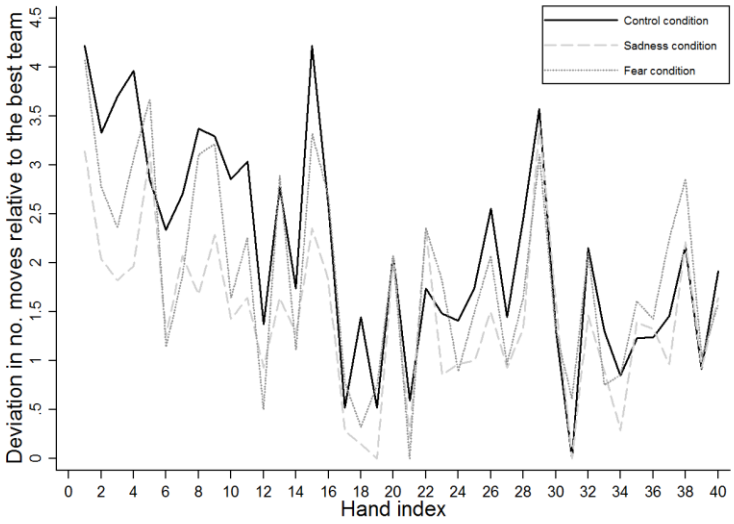
We conducted an OLS regression analysis in which we regressed 'deviation in number of moves relative to the best team' on the hand index, on two dummy variables corresponding to our experimental manipulations of sadness and fear, and on terms that test for interactions between our experimental manipulations and the hand index. We present our findings in Table 10. Our regression analysis (Table 10) suggests negative main effects for the sadness ($b$ = -1.30, $SE$ = 0.21, $p < 0.001$, $R^2$ = 0.046) and fear manipulations ($b$ = -0.70, $SE$ = 0.21, $p$ = 0.001) on the 'deviation in number of moves relative to the best team', relating to a relative increase in reliability with sadness and fear. To better understand differences in reliability in action

between our experimental conditions, we additionally conducted pairwise tests in which we aggregated teams' mean 'deviation in number of moves relative to the best team' over all hands. These tests revealed that teams in the sadness condition required, on average, only 1.46 more moves ($SD$ = 0.37) to finish a hand than the respectively best performing team, which is significantly fewer moves than teams in the control condition ($M$ = 2.21, $SD$ = 1.64), $t(53) = 2.37$, $p = 0.021$, $d = 0.634$. Regarding the fear condition, the pairwise tests reveal no significant differences in reliability in action between the fear condition ($M$ = 1.86, $SD$ = 0.83) and the control condition, $t(53) = 1.01$, $p = 0.317$, $d = 0.271$. Teams in the sadness condition performed significantly more reliably than teams in the control and fear conditions, $t(54) = 2.33$, $p = 0.024$, $d = 0.623$. We thus observed medium positive effects of sadness on reliability in action and no robust effects for fear. Accordingly, teams in the sadness condition generally solved the TTT game in a more reliable fashion than teams in the remaining conditions.

Whereas our regression analysis presented in Table 10 suggests that in all experimental conditions, the 'deviation in number of moves relative to the best team' decreased by an average of 0.06 moves ($SE$ = 0.01, $p < 0.001$) with each hand of the game, the regression yielded positive interaction coefficients for our emotional manipulation sadness and the hand index ($b$ = 0.03, $SE$ = 0.01, $p < 0.001$) and for fear and the hand index ($b$ = 0.02, $SE$ = 0.01, $p$ = 0.011). These positive coefficients suggest that with game progress (i.e., with increases in the hand index), the 'deviation in number of moves relative to the best team' decreased less strongly in our sadness and fear conditions than in our control condition. Over the course of the game, teams in the sadness and fear conditions thus could not increase their reliability in action to the same extent as teams in the control condition. Figure 11 presents this finding in a more comprehensible way. The graph illustrates how reliability in action in our experimental conditions increased with game progress. Whereas in the sadness and fear conditions the 'deviation in number of moves relative to the best team' decreased quickly in the early hands of the game, it took teams in the control condition longer (i.e., more hands) to perform reliably.

However, over the course of the game, teams in the control condition showed a steady increase in reliability, and towards the end of the game, they achieved similar levels of reliability.

*Figure 11: Reliability in action: Development of the deviation in number of moves relative to the best team with game progress*




Thus, against our expectations, teams in the sadness condition developed generally more reliable operating routines than teams in the control and fear conditions. These differences in reliability emerged at a very early stage of the TTT game, but they decreased over time. Unexpectedly, teams in the fear condition did not robustly differ from teams in the control condition in terms of their absolute reliability. Yet, with game progress, reliability in action in the fear condition increased comparatively less strongly than in the control condition.

***Attentiveness in action:*** To understand the effects of sadness and fear on the modification of operating routines, we analyzed attentiveness in action. This dimension allows us to address the question of whether sadness and fear affect how effectively operating routines are modified to match the dynamics of their environment. We implemented three 'trap hands', i.e., 8, 15, and 38, which can be solved quite easily by teams that act attentively but result in suboptimal performance if teams rely on pre-established operating routines (Cohen & Bacdayan 1994).

The 79 teams that managed to play all three hands were able to avoid, on average, 38.82 percent (*SD* = 0.32) of the three traps. We observed no significant differences in the 'percentage of traps avoided' between the sadness condition (*M* = 0.30, *SD* = 0.26) and the control condition (*M* = 0.39, *SD* = 0.34), *t*(49) = 1.11, *p* = 0.274, *d* = 0.307, nor between the fear condition (*M* = 0.48, *SD* = 0.34) and the control condition, *t*(49) = 0.88, *p* = 0.385, *d* = 0.247. However, we found significant differences in the 'percentage of traps avoided' between the sadness and fear conditions, *t*(54) = 2.18, *p* = 0.033, *d* = 0.583. The observed medium-sized effect is quite distinct. The average team in the sadness condition avoided only 29.76 percent (*SD* = 0.26) of the three 'traps', whereas teams in the fear condition avoided 47.62 percent of them (*SD* = 0.34).

Thus, the majority of teams in all experimental conditions were prone to act inattentively and to fall prey to the negative side-effects of operating routines. Against our expectations, teams in the sadness condition were acting as inattentively as teams in the control condition. We also found no differences in attentiveness between the fear condition and the control condition. Yet, as expected, teams in the sadness condition were acting less attentively than teams in the fear condition. Fearful teams were comparatively better at recognizing when their operating routines required no attention and when they could benefit from modifying their operating routines.

### 4.4.4. Additional analysis: The effects of sadness and fear on money gained

To better understand the consequences of our emotional manipulations, we additionally analyzed how much money the participating teams gained in the TTT game. Across all experimental conditions teams gained, on average, €8.04 (*SD* = €2.92). Teams in the sadness condition (*M* = €9.02, *SD* = €0.79) had significantly higher earnings than teams in the control condition (*M* = €7.05, *SD* = €4.42), *t*(54) = 2.32, *p* = 0.024, *d* = 0.619. Teams in the fear condition (*M* = €8.02, *SD* = €2.15) earned similar amounts of money as teams in the control condition, *t*(53) = 1.04, *p* = 0.305, *d* = 0.278, while teams in the sadness condition significantly

outperformed teams in the fear condition, $t(54) = 2.31$, $p = 0.025$, $d = 0.616$. Thus, we observe a medium effect of sadness on money gained—overall, participants in the sadness condition outperformed participants in both the fear and the control conditions.

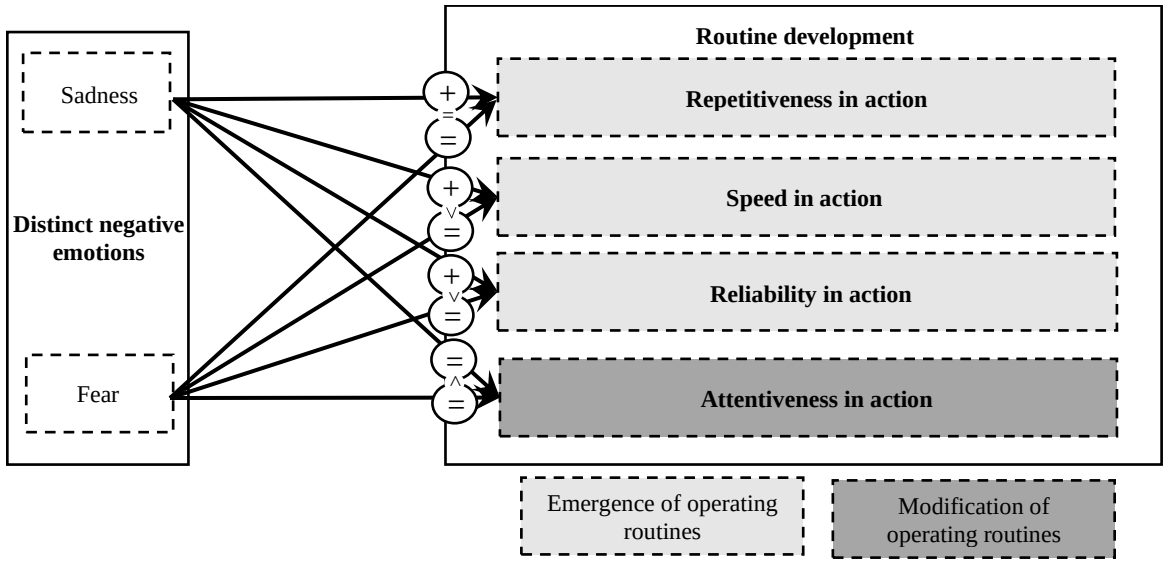
### 4.5. Discussion

This study set out to explore the effects of distinct negative emotions on routine development. We focused on sadness and fear due to their different natures—e.g., whereas sadness relates to uncertainty acceptance and risk taking, fear relates to uncertainty and risk avoidance (Lerner & Keltner 2001; Raghunathan & Pham 1999)—and due to their high relevance in change processes, in which sadness is related to certain states that are left behind, whereas fear is related to uncertain future states (Verduyn et al. 2009). Addressing recent calls for research stressing that in researching routines, "extending the Cohen-Bacdayan line is a promising path forward" (Winter 2013: 127), we replicated Cohen and Bacdayan's (1994) experimental setting and invited 168 players to solve the card game Target the Two in teams (Cohen & Bacdayan 1994) that were subjected to established emotion induction procedures. Target the Two, as an established and widely accepted paradigm in routine research (Cohen & Bacdayan 1994; Egidi & Narduzzo 1997; Winter 2013), allowed us to compare routine development among teams subjected to sadness and fear in an established and standardized setting.

Our laboratory experiment confirms our expectations that sadness and fear, two emotions of negative valence, in teams have distinct effects on teams' routine development. Figure 12 summarizes the observed differences between our emotional manipulations. Our findings support our underlying assumption that distinct negative emotions differ in their effects on routine development. In our operationalization of routine development, we distinguished three dimensions that describe routine development as the emergence of operating routines (i.e., repetitiveness in action, speed in action, and reliability in action) and one dimension that

captures routine development as the modification of operating routines (i.e., attentiveness in action).

*Figure 12: Measured effects of sadness and fear on different dimensions of routine development*




*The figure illustrates the actually measured effects of the distinct emotions sadness and fear on different dimensions of routine development. = denotes no effect; + denotes positive effect; - denotes negative effect; > denotes significant differences in the effect between sadness and fear*

Repetitiveness in action indicates to what extent sadness and fear led to the development of differing operating routines and how these operating routines differed with regard to their repetitiveness. We find that sad teams repeated their operating routines more often than teams in the control condition. A potential explanation for this observation points to situational control (Smith & Ellsworth 1985). Sadness may generally lead to a perceived shift from human control towards situational control (Smith & Ellsworth 1985), which in turn may be countered by an increased reliance on repetitive and thus easily controllable actions (Becker 2004; Nelson & Winter 1982). Against our expectations, we observe no clear tendency towards more repetitiveness in action in the fear condition. Fear kept teams from developing stable, repetitive routines, potentially due to the fact that fear in our setting led to more conscious, deliberate actions that differed from task to task (cf. our findings for attentiveness in action). Our findings suggest that sadness leads to a stronger urge to restore control through repetitiveness in action. In contrast, teams in the fear conditions seem to have tried to restore control by acting more

deliberately but less repetitively. Accordingly, only sadness increases stability and rigidity in operating routines.

By analyzing speed in action, we explored to what extent sadness and fear affected the 'off-loading' of cognitive efforts onto automatized—and hence quickly executed—operating routines (Laureiro-Martinez 2014). As expected, teams in the sadness condition acted at generally higher speeds than teams in the control condition while increasing their speed in action comparatively less strongly over the course of the game. Unexpectedly, sadness also led to quicker actions than fear, whereas we observe no absolute differences in speed in action between the fear and control conditions. However, teams in the fear condition, increased their speed less strongly over the course of the task than teams in the control condition. Thus, teams subjected to sadness were comparatively quicker at cognitively 'off-loading' their actions into automatized, quickly executed action sequences. This 'head start' in routine development enabled them to act at comparatively higher speeds. However, relative to the control condition, this advantage in speed gradually decreased over time. Given that we observe very similar levels of speed among our experimental conditions towards the end of the experimental task, sadness-induced speed in action seems to have been a temporary phenomenon limited to early stages of routine development. Our finding is consistent with the notion of sadness-induced 'myopic misery' (Lerner et al. 2013), which relates to impatience and an increased demand for instant gratification (Lerner et al. 2013). In our setting, this demand was satisfied by quick routine development. In fact, the sad teams' higher speed in action financially paid off: sad teams gained significantly more money than teams in the remaining conditions. With regard to fear, our findings do not suggest any association of fear with temporal myopia (Vuori & Huy 2016). Teams in the fear condition acted as patiently as teams in the control condition. The slower actions by teams in the fear conditions might be related to the increased degree of attention that we observed in the fear condition (cf. findings for attentiveness in action). Thus, fear does not seem to foster routine development by increasing impatience.

Reliability in action allowed us to test whether sadness and fear affected the functionality of the developed operating routines. Unexpectedly, sadness led to comparatively more-reliable operating routines. However, with game progress, this lead in reliability in the sadness condition became relatively smaller in comparison to the control condition. Against our expectations, fear was not robustly associated with an absolute increase in reliability in action. However, with game progress, we observed a decrease in reliability in action in the fear condition relative to the control condition. Thus, of the induced emotions, only sadness clearly increased the reliability of operating routines. This finding is somewhat surprising given that sadness is often associated with uncertainty acceptance and risk taking, in contrast to fear, which is associated with uncertainty avoidance and less risk taking (Raghunathan & Pham 1999). Accordingly, we would have expected a decreased demand for certain, riskless, and reliable actions with sadness and an increased demand for such actions with fear. If sadness in our setting actually caused a demand for less certainty, as previous literature would suggest, this demand was outweighed by sad teams' tendency to seek for speed by quickly repeating their predeveloped solutions without much consideration. However, in our setting, this behavior led to reliable outcomes (except for our trap hands, in which sad teams comparatively underperformed). In contrast, it seems that fearful teams' demand for more certainty was offset by their tendency to act more attentively, slower, and less repetitively. However, in our specific setting, this increased degree of deliberation did not lead to more reliability in action (except for our trap hands, in which fearful teams outperformed sad teams).

Attentiveness in action allowed us to test whether sadness and fear affected how effectively teams directed their attention to operating routines when the dynamics of their environment required attentive modifications in these routines. Against our expectations, sadness did not decrease and fear did not increase attentiveness in action relative to the control condition. However, in support of our expectations, sadness led to less attentiveness in action than fear. Hence, relative to the sadness condition, fear enabled teams to modify their operating

routines attentively in order to avoid 'performance traps'. This finding suggests that the increases in repetitiveness in action, speed in action, and reliability in action that we observe with sadness came at the cost of less attentiveness in action. Apparently, the high degree of routinization associated with sadness led to 'myopic misery' (Lerner et al. 2013). Sad teams' attention was 'suboptimally' regulated by dynamic capabilities (Cohen & Bacdayan 1994), whereas afraid teams, which relied on less-automatized operating routines, were comparatively better able to adjust their operating routines when necessary. Thus, our findings suggest that sadness leads to comparatively less-effective and fear to comparatively more-effective modification of operating routines.

In summary, sadness in teams promotes the development of comparatively more repetitive, quicker, and reliable operating routines, which receive less attention and less regulation through dynamic capabilities, whereas fear in teams enables teams to more attentively regulate operating routines through dynamic capabilities in order to avoid 'performance traps'.

### 4.5.1. Theoretical implications

This study holds several important theoretical implications. First, we show that distinct negative emotions may have distinct effects on different dimensions of routine development, hence providing a better understanding of how emotions affect change processes in organizations. With our finding of differential effects of distinct negative emotions, we enhance the growing body of work that demonstrates that operating routines and the dynamic capabilities through which they are regulated entail not only reason but also emotion (Døjbak Håkonsson et al. 2016; Hodgkinson & Healey 2011; 2014; Parke & Myeong-Gu 2017). We contribute to this research by showing that distinct negative emotions, such as sadness and fear, vary in their effects on routine development and by showing that these distinct emotions have differential effects on different dimensions of routine development. Whereas sadness promotes the emergence of

more repetitive, quicker, and reliable operating routines, fear enables teams to comparatively more attentively modify operating routines. Thus, whereas previous research finds that negative and positive emotions may generally affect the likelihood that teams adopt new routines (Døjbak Håkonsson et al. 2016), our findings suggest that in order to understand how negative emotions affect routines and their development, it is important, first, to differentiate between the distinct negative emotions that accompany routine development, and second, to follow Salvato and Rerup's (2011) suggestion of separating routines into their individual components and dynamics, which, as we find, may be subject to distinct emotional influences. Hence, our findings advise researchers who are responding to the repeated calls to explore the emotional foundations of organizations (Ashkanasy et al. 2017; Laureiro-Martinez 2014; Salvato & Rerup 2011) to not open only one black-box—organizational routines—while keeping emotions, as important antecedents of routines, in another black-box. Instead, our findings encourage researchers to explore the microfoundations of emotions and routines in connection in order to reveal their interrelations.

Second, we complement previous research emphasizing the importance of emotions in shaping the strategic decisions behind exploration and radical innovation in organizations, i.e., the decisions behind the abandonments of operating routines (Adler & Obstfeld 2007). We reveal that (distinct negative) emotions may also guide less-radical forms of change in organizations—organizational evolution through routine development. Whereas routine development may generally engender as well as inhibit innovation (Feldman 2000; Hannan & Freeman 1984), our findings suggest that distinct negative emotions shift work teams' actions between stability and flexibility and thus influence whether and how organizations evolve. Whereas sadness leads organizations to 'off-load' cognitively demanding strategic decisions onto quickly applied and relatively static 'production rules' (Egidi 1996) that only rigidly adapt to the dynamics of the environment, fear leads to comparatively more attentiveness in the enactment and development of operating routines. Thus, relative to sadness, fear is more likely

to result in effective modifications of pre-established operating routines. Both sadness and fear may hence affect strategic decisions between stability and flexibility in organizations. Sadness fosters rather heuristic decision making, whereas fear fosters comparatively more-attentive team-level decision making. With our findings, we hence respond to Hodgkinson and Healey's (2011: 1511) call to provide a "better understanding of both the positive and negative effects of emotion on strategic choice [… and …] on the speed and quality of strategic decision processes".

Third, we respond to more-general calls for more research on the (positive) effects of distinct negative emotions (Ashkanasy et al. 2017; Barsade & Gibson 2007). This experimental study follows several previous studies that stress that negative emotions do not per se lead to negative outcomes (Lebel 2017). We enhance these studies by providing evidence for further, previously unknown, and potentially positive effects of negative emotions. We find that two of the negative emotions that accompany change processes (Fugate et al. 2002), sadness and fear, are not necessarily harmful to routine development—an important component of change processes. Whereas sadness among team members leads to an 'off-loading' of cognitively demanding actions onto inattentive operating routines and therefore clears cognitive resources for alternative endeavors, fear enables teams to enact their routines comparatively more attentively (Gable & Harmon-Jones 2010). Accordingly, we provide a differentiated understanding of how distinct negative emotions may be beneficial and how they may be harmful to organizations.

### 4.5.2. Practical implications

The practical implications of our finding of partially positive effects of sadness and fear on routine development require an in-depth discussion. Most importantly, this finding is not to be understood as a recommendation to abusively induce sadness and fear in teams in order to promote routine development (Oh & Farh 2017). Instead, with this study, we follow calls to

identify emotional conditions,"[u]nder [… which …] negative affective responses lead to positive organizational outcomes" (Barsade & Gibson 2007: 52) in order to enable organizations to improve their management and change practices, which currently "are predicated on a (bounded) rationality façade, rooted in the cold cognition era" (Hodgkinson & Healey 2014: 1311). Our findings may contribute to better management and change practices in several ways.

Our findings suggest that managers should not isolate sad or anxious employees in order to avoid emotional contagion of work teams (Barsade 2002). Our findings reveal that negative emotions are not negative per se and that, in fact, in the right constellation, they may enable teams to better cope with the dynamics of their environment. Hence, negative emotions should be tolerated and not discouraged. Openly shared emotions may enable managers to identify the specific aspects of change processes that generate negative emotions and to intervene in order to harness the potentially beneficial effects of negative emotions. Such interventions require an in-depth understanding of the effects of distinct negative emotions. Our findings enable managers to better understand how negative emotions, specifically sadness and fear, affect routine development and thus provide them with a better understanding of when they should intervene (e.g., by inducing positive emotions) and when they should tolerate or even encourage negative emotions (e.g., by inviting organizational members to share their emotions).

For instance, in change processes, in which managers seek the quick development of reliable operating routines, managers might encourage employees to openly share their feelings of sadness; otherwise, they might avoid sadness (e.g., by generating positive experiences). Clearly, negative emotions such as sadness cannot easily be avoided in change contexts, yet managers might nevertheless have an influence on which distinct negative emotions dominate teams' feelings. For instance, sadness, which is related to the certain past, often follows fear, which is associated with uncertain future states (Verduyn et al. 2009). Accordingly, the timing of negative announcements might determine whether employees are afraid (e.g., of potentially

losing a beloved colleague) or sad (e.g., about the certain departure of the colleague). Managers who focus on quickly restoring organizational efficiency might in some situations benefit from substituting fear with sadness, e.g., by creating certainty with regard to a negative event. In contrast, managers who aim at flexibility in routine development might benefit from postponing negative announcements that would substitute fear with sadness.

### 4.5.3. Limitations and suggested paths for further research

Like all research, this study has some limitations. First, some of the differences we observe between sad and fearful teams could as well be the result of more-successful emotional manipulations in the sadness condition. The different effect sizes for sadness vs. fear that we observed in our manipulation check suggest that teams in the sadness condition might have experienced sadness to a greater extent than teams in the fear condition experienced fear. Yet, it is difficult to compare different levels of distinct negative emotions with each other (this general assumption represents a primary motivator of our decision to focus this study on distinct negative emotions). Accordingly, we do not know whether our comparatively weaker manipulations for fear in fact suggest that teams in the fear condition were less emotionalized than teams in the sadness condition. That is, we cannot definitely say whether, for instance, a four out of ten scoring for self-reported sadness captures more sadness than a three out of ten score for self-reported fear captures fear. However, our finding of more repetitive, quicker, and more reliable routine development in the sadness condition in contrast to comparatively more attentiveness in action in the fear condition is not consistent with explanations that point to differences in the strength of our emotional manipulations. Sadness and fear clearly differ in their effects on different dimensions of routine development. In fact, our findings become more meaningful when we consider that the emotional manipulations in our experimental setting are likely to be rather weak when compared to emotions that, for instance, are experienced in actual change processes. The levels of sadness and fear that we induced in the laboratory are very

likely to be experienced as less intense than the levels of sadness and fear one could expect someone to feel who just lost or is going to lose his or her job. Hence, it appears reasonable to assume that our findings are attenuated rather than inflated. We nevertheless suggest validating the present research in field studies.

Second and finally, some findings of this study are bound by the methodological design and specifically by our experimental task. We decided to conduct a lab experiment, as this approach represents "an excellent way to address questions of causality" (Bono & McNamara 2011: 658). Yet, despite plenty of evidence that effect sizes observed in the laboratory tend to be correlated with effect sizes observed in the field (Anderson et al. 1999), our experimental setting might be limited in its explanatory power, as it isolates teams from the 'messiness' that typically characterizes work life. In our experimental setting, we replicated Cohen and Bacdayan's (1994) experimental setting, which did not feature any obvious form of authority and which prohibited participants from talking during the experimental session. At a first glance, this may seem counterintuitive, given that Cohen and Bacdayan (1994: 558) refer to "organizational routines [… as …] patterned sequences of learned behavior involving multiple actors who are linked by relations of communication and/or authority." We nevertheless decided to observe routine development isolated from direct authority and open communication to highlight a characteristic of routines that is often overlooked in empirical studies—the routine as an "'organizational unconscious,' a body of largely inarticulate know-how that underpins so much of an organization's capabilities" (Cohen & Bacdayan 1994: 566). Alternative empirical research methodologies, such as interview- and questionnaire-based analyses often overlook this important aspect of routines. Our experimental approach in turn shows how emotions may empower routine development even in the absence of direct authority and open communication. Our setting illustrates that in such an environment, teams may both develop stable operating routines and coordinate on modifications of these routines in situations where they would lead to undesirable performance. This coordination is enabled by implicit authority and hidden

communication. Specifically, in the TTT card game, authority is represented by the distinct functions to which team members are assigned. In each team, there is a Numberkeeper and a Colorkeeper with unique authorities who coordinate their actions through implicit forms of communication, e.g., by using certain 'signal cards' to inform the team member about intended actions (Egidi 1996; Egidi & Narduzzo 1997). Future research should nevertheless shed more light to the interplay of emotions, open communication and direct authority in routine development processes.

## 4.6. Conclusion

The present study represents an important step toward an understanding of the causal influence of sadness and fear on routine development, which represents a crucial mechanism behind organizational change processes. Using a laboratory experiment in which we induced distinct negative emotions in teams, we find that sadness and fear have distinct effects on routine development. Whereas sadness in teams leads to the development of comparatively more repetitive, quicker, and more reliable operating routines, fear enables teams to better recognize and react to 'performance traps', i.e., situations in which pre-established operating routines are ineffective. Our findings enable researchers and practitioners to better understand and predict the effects of sadness and fear in change processes and contribute towards new theories and practices that will enable organizations to better harness the emotional capacities of their members (Hodgkinson & Healey 2014).

## 4.7. References

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# 5. Overall discussion

Successful organizations tend to find an effective balance of change and stability (O'Reilly & Tushman 2008). They do so through organizational routines. On the one hand, routines engender change and flexibility (Feldman & Pentland 2003). On the other hand, routines may stabilize with frequent use and may lead to rigidity and inertia (Hannan & Freeman 1984; Staw et al. 1981). Thus, routines, are key to understanding organizational change and stability. Since Nelson and Winter (1982) have brought attention to routines, organizational researchers steadily enriched the routine concept. Yet in doing so, they have created various ambiguities and inconsistencies (Becker 2004; Parmigiani & Howard-Grenville 2011; Winter 2013), which hindered the development of practicable theories of organizational change. To this day, our knowledge about how routines can be managed and changed actively is quite limited. To close this research gap, this study offers three essays, of which each employs a lab experiment. The findings of these lab experiments lead to a better understanding of routines and their antecedents. Specifically, the three essays explore the effects of *performance feedback*, *conflict*, and *negative emotions* on routines and routine change. All three factors can be managed and instrumentalized in organizational settings. Yet, so far, our understanding of their effects has been too vague to prescribe these three factors as means to manage routines. Taken together, this thesis presents several important findings that contribute to the routine literature and to the extant management theory. The findings provide a better understanding of how performance feedback, conflict, and negative emotions can be used to manage routines and routine change in order to balance change and stability.

## 5.1. Summary of findings

First, regarding the relationship between performance feedback and routines, the findings of the first essay suggest that performance feedback differentially affects change in higher-level and lower-level routines, task complexity moderates these effects, and not only negative

performance feedback but also positive performance feedback may trigger routine change. Accordingly, the first essay provides a detailed understanding of the top-down effects of performance feedback. Its findings suggest that, to some extent, team-level and individual-level routine change can be predicted by organizational-level theories. The essay supports the conclusion that performance feedback shapes team-level routines not only in a bottom-up fashion but also in a top-down fashion. Hence, managers can use top-down performance feedback to trigger organizational change across different levels within the organization.

Second, regarding the relationship between conflict and routines, the findings of the second essay suggest that, when teams can freely decide between routine and creative project action trajectories, task and interpersonal conflicts respectively increase the likelihood that teams break from routines, while the combination of task and interpersonal conflict increases teams' tendency to enact routines. The findings oppose the notion that conflicts result in the development of routines as truces (Nelson & Winter 1982). Instead, they suggest that the truces provided by routines are 'endangered' by conflict and that conflict prevents routine formation, and instead leads to non-repetitive 'creative projects'. Accordingly, the second essay contributes to a more precise theory that uncovers the microfoundations of organizational change. It identifies conflict as a motor of routine change and suggests that managers can instrumentalize conflict in order to break from routines and to stimulate creative action.

Third, regarding the relationship between negative emotions and routines, the findings of the third essay suggest that sadness in teams promotes the development of comparatively more repetitive, quicker, and more reliable operating routines, which receive less attention. In contrast, the findings suggest that fear enables teams to regulate operating routines more attentively and to avoid 'performance traps'. Accordingly, the findings suggest that distinct negative emotions may have distinct effects on different dimensions of routine development. The third essay hence provides better understanding of how emotions affect change processes in organizations. It reveals that (distinct negative) emotions guide organizational evolution

through routine development, and that sadness and fear may at the same time be beneficial and harmful to organizations. The third essay suggests that distinct negative emotions are not negative per se and that managers can harness these emotions to enable teams to better cope with the dynamics of their environment.

### 5.2. Implications for theory

***Understanding and predicting organizational change and stability:*** Organizational researchers often aimed to understand and predict organizational change (Greve 1998; Nelson & Winter 1982). This study contributes to this effort. It enables researchers to understand and predict better under which conditions organizations tend to change or remain stable. Our first essay provides causal evidence that performance feedback triggers team-level routine change, our second essay provides causal evidence that internal conflicts among team members lead to the abandonment of existing routines, and our third essay provides causal evidence that distinct emotions, such as sadness and fear, may lead to more (or less) stability in organizational action.

Jointly, these findings enable us to enhance the established organizational-level capability perspective of routines (Nelson & Winter 1982) for lower levels of analysis. Specifically, we enhance this perspective for the team and individual level. Based on our findings, researchers can instrumentalize micro-level factors, such as top-down performance feedback, team conflicts, and negative emotions, in order to model under which conditions teams are more or less likely to seek for change. Thus, we enhance previous research that often considered macro-factors, such as competitive dynamics between organizations (Greve 1998; Nelson & Winter 1982), in order to predict changes of whole economic systems and organizations. Our findings reveal important microfoundations of organizational change. We reveal how influences that often come along with external pressures to change, such as top-down performance feedback, conflicts, and negative emotions, are internalized by teams and individuals and how they ultimately lead to change in team-level and individual-level

behaviors. With our findings, we contribute to previous efforts to bridge the currently existing micro-macro divide in management research (Salvato & Rerup 2011).

Our micro-level findings also add to the practice perspective of routines, which has focused on exploring the microfoundations of routines. This perspective often assumes that routine change takes place largely unpredictably (Pentland et al. 2011; Rerup & Feldman 2011). Generally, our results offer some support to this notion. That is, we find that our models are generally limited in their explanatory power and can only explain a small share of the overall variance in routines. Yet, at the same time, our findings contrast with the practice perspective of routines in that they suggest that routine change can be predicted to some extent. Our findings clearly suggest that routine change involves some extent of homogeneity, which enables researchers to predict when routine change is more or less likely to happen. We find that routine change involves both heterogeneous and homogeneous aspects. We encourage followers of the practice perspective of routines to shed more attention to the homogenous aspects of routine change, as these are likely to be more fruitful in the development of change practices that enable practitioners to manage change more effectively.

***The positive power of negative affective experiences:*** Previous research about organizational change has often associated negative experiences with negative outcomes (Kiefer 2005). This study adds to the growing body of change research that suggests that under certain conditions negative experiences may result in positive outcomes. For instance, Schein (1996: 3) noted, "[i]t is my belief that all forms of learning and change start with some form of dissatisfaction or frustration", Andersen (2006) suggest that constructive conflict can be a facilitator of organizational change, and Huy (1999) suggests that freedom to display (negative) emotions increases likelihood of learning in times of radical change. All three separate lab experiments, through which we collected data, suggest that seemingly negative emotional experiences may be beneficial for change. In our first essay, we observe a positive effect of negative performance feedback on the likelihood that teams change certain (higher-level)

routine components. This finding is consistent with previous research, which has stressed that negative feedback may cue and motivate routine change (Greve 2008). In contrast, the findings of our second essay are comparatively less intuitive. We find that both task and interpersonal conflict increase a team's tendency to abandon routines and pursue change by enacting creative projects. In our third essay, we find that teams which experience the negative emotion sadness tend to develop comparatively more repetitive, quicker, and reliable routines, whereas teams experiencing the negative emotion fear tend to react better to 'performance traps' in which pre-established routines would lead to sub-optimal outcomes. Thus, all three essays suggest that in change contexts, certain negative (emotional) experiences may lead to organizational change. The findings suggest that, depending on the goals of an organization, negative experiences, such as negative feedback, conflicts, or negative emotions, may have positive effects. For instance, in our third lab experiment sad teams managed to earn more money than teams in the remaining conditions.

Accordingly, this study adds an emotional layer to the existing, mostly cognition-focused routine literature (Adler & Obstfeld 2007). It combines prevailing cognition-focused streams of routine research with individual and organizational psychology (Barsade & Gibson 2007; Dewey 1922; Winter 2013). In combination, our findings suggest that routines are not only shaped by top-down (Greve 2008) and bottom-up (Wee & Taylor 2018) pressures for change, but also by irrationality and by predominantly emotional experiences. The present study hence offers a differentiated viewpoint of negative experiences in change contexts and it responds to several calls for more research about the (positive) effects of negative experiences on behavior and performance (Ashkanasy et al. 2017; Barsade & Gibson 2007).

In summary, the present study contributes to a unified theory of routine change, which, first, takes capability and practice perspectives of routines into account, second, is valid across different units of analysis, and third, enables more precise predictions based on relevant cognitive, social and emotional drivers of routine change and stability.

## 5.3. Implications for practice

This study provides important practical implications. Jointly, the three essays enable managers to better understand under which circumstances team-level routines are more or less likely to develop, change, and dissolve. Moreover, they offer concrete suggestions how practitioners can affect these circumstances to manage routines more effectively in order to innovate and/or increase the efficiency of existing processes.

The first essay suggests how managers can systematically use top-down performance feedback in order to align the routines of teams and individuals with their goals. Our findings reveal that both positive and negative performance feedback can be used to steer routines. They suggest that performance feedback is generally more effective for managing higher-level routines (routines that assign responsibilities and functions) than lower-level routines (routines that store concrete actions and interactions). Moreover, the first essay suggests that the effects of performance feedback vary strongly with task complexity. Accordingly, in order to successfully promote (or avoid) routine change through performance feedback, managers are advised to relate individual performance feedback interventions to specific tasks (rather than giving general feedback), and to account for the complexity of these tasks.

The second essay proposes that managers can make use of conflicts in order to shift teams between routines and creative projects, e.g., in order to increase efficiency or innovation. Specifically, the findings suggest that devil's advocacy style discussions lead to task conflict and that they can be used to stimulate routine abandonment and creative action. Moreover, the findings suggest that, by enabling teams to act out their interpersonal conflicts, managers may induce teams to break out of their routines to engage in creative action instead. Moreover, our findings suggest that both task conflicts and interpersonal conflicts should not be avoided as they enable teams to try out different ways of doing things. Overall, our findings suggest that conflict is a powerful means to manage team-level routines and creative action, and that

organizational design decisions should account for conflict as a potentially beneficial driver of organizational action.

In the third essay we find that negative emotions, such as sadness or fear, enable teams to better cope with the dynamics of their environment. Our findings provide managers with better understanding of the effects of distinct negative emotions on routine development, which forms a crucial part of change processes. They suggest when managers of change processes should tolerate or even encourage negative emotions in order to harness the potentially beneficial effects of these emotions. Our findings suggest that sadness and fear vary in their effects on routines, and that, by varying the timing of negative announcements, managers may substitute fear for sadness in order to foster routine development (at the cost of attentiveness in action).

All three essays suggest that negative experiences may have positive outcomes for organizations. Please note that these findings are not to be understood as a recommendation to stimulate negative experiences in organizations. Such negative experiences are likely to have negative side effects that are not fully known yet. Instead, our findings may be taken as guidance on how to deal with situations, in which negative experiences, such as performance feedback, conflicts, and negative emotions, cannot be avoided (e.g. change projects). Our findings enable managers to gain more control over such situations and to successfully guide teams through difficult and hurtful change processes.

### 5.4. Limitations

This study is subject to several important limitations. First, this study relies on three distinct lab experiments which simulate typical organizational tasks. Technically, our experimental approach enables us to draw causal conclusions. However, this benefit comes at a cost. First, our research settings might be prone to oversimplification. That is, our experimental tasks are quite simple, and the participants of our studies were mostly students, whose incentive to

perform was rather modest, and who interacted in comparatively rigid settings (namely, in computer labs). With our methodology, we suppressed various confounding factors, such as subjectivity, agency, power, hierarchy, authority, and goal conflicts, which contribute to the overall complexity and "messiness" of routines in the field (D'Adderio 2014; Feldman & Pentland 2003). These simplifications enabled us to isolate selected mechanisms of routine development and change and to explore these mechanisms in depth. However, as a consequence of our simplified settings, our conclusions might to some extent be bound to these settings and to the behaviors that we observed in these settings. Second, our findings might be bound to small teams. In all three essays, we observe the actions of dyads of participants. Although Cohen and Bacdayan (1994) noted that such small teams can be regarded as organizations, it is often noted that little teams may be subject to different dynamics than larger groups (Forsyth 2018). Accordingly, some of our interpretations and recommendations may be limited to small teams. Third, our observations refer to comparatively short time spans. In all three lab experiments, we observed freshly formed teams over a comparatively short period of time. All three experiments lasted less than 1.5 hours and it can be argued that such a short time frame is quite short to observe the development, enactment, and abandonment of routines. To counteract such concerns, we conducted various additional analyses, which document the formation of routines in our experimental settings. Nevertheless, we acknowledge that routines that have formed over months or years might be subject to different dynamics or different levels of rigidity and inertia than routines that formed within a few minutes in a lab setting. Accordingly, some of our conclusions might be bound to freshly formed teams. And fourth and finally, the effects that our experimental manipulations had on teams are potentially quite weak compared to the effects that such influences have in the field. For instance, performance feedback that refers to months of hard work is more likely to lead to substantial pressure to act than performance feedback that refers to five minutes of work in a lab experiment. Conflicts that refer to established interpersonal relations are more likely to leave a mark than conflicts that

result from lab instructions. Negative emotions that result from significant events (e.g., the threat of imminent job loss) are more likely to lead to strong emotional reactions than experimentally induced emotions that were caused by music or stimulating pictures. Yet, the fact that our findings refer to rather weak experimental manipulations may also represent a strength of this study. That is, even in response to rather weak manipulations in a lab setting, we observe significant differences in routines and in their enactment. This fact supports the argument that the observed effects might turn out a lot stronger in actual work settings.

### 5.5. Directions for future research

This study adds several important pieces that may contribute to a more unified theory of routine change. Yet, before such a theory of routine change can be developed, further research is required. First, ontological differences between capability and practice research of routines need to be overcome. The routine research is split into at least two different streams (Parmigiani & Howard-Grenville 2011) and the ontological differences between these research streams make it more and more difficult to integrate the rich findings of the individual contributions in the field into one comprehensive theory. The present study follows a routine concept that is deeply rooted in the (macro-oriented) capability tradition of routine research (cf. entity perspective), but it also borrows from practice perspectives of routines (cf. generative systems perspective) (Parmigiani & Howard-Grenville 2011). By exploring the causal mechanisms that shape and change routines, this study represents an empirical effort to close the gap between the capability and practice perspectives of routines. We strongly believe that, in order to increase the theoretical and managerial relevancy of the routine literature, it is crucial to reduce inconsistencies between the different streams of routine literature. Moreover, we are convinced that empirical studies are a great way to do so (Parmigiani & Howard-Grenville 2011). Hence, we encourage future research to look for further connecting factors between the different

streams of routine literature and to provide empirical evidence with regard to these connecting factors in order to overcome the current division in the routine literature.

Second, we firmly believe that the interactions between the various psychological factors through which routines are shaped and changed deserve more attention. Dewey (1922) stressed that human conduct is shaped by an interplay of three factors, cognition, emotion, and habit, with habit as "the dominant aspect of the tripartite account" (Cohen 2007: 777). Over time, there have been various calls to account for these three factors when researching routines (Adler & Obstfeld 2007; Cohen 2007; 2012; Winter 2013). Yet, so far, most of the empirical routine research has focused on the cognitive roots of routines (Laureiro-Martínez et al. 2015) and has overlooked emotions and habits. Cohen (2007: 779) refers to this phenomenon as the "postwar enthronement of cognition". This is not to say that routine researchers have not attempted to account for emotions and habit at all. In fact, the routine literature offers some valuable accounts of emotions (Døjbak Håkonsson et al. 2016) and habit (Cohen & Bacdayan 1994; Gersick & Hackman 1990). Yet, to this day, not much is known about the interplay between these factors. The present study is among the first to shed some attention to selected aspects of the interplay of cognition, emotion, and habit. For instance, we explore the interplay of emotions and cognition, first, by revealing interactions between emotional and cognitive conflicts, and second, by revealing the distinct effects of selected emotions on cognitive processes (cf. attentiveness in action). Accordingly, this study offers a good point of departure for future empirical studies in the field to develop more theory to explain how cognition, emotion, and habit jointly shape routines. Nevertheless, the present study offers just a starting point and we encourage future research to explore the interactions of these factors in more depth.

And third, the boundaries of routines remain 'under-researched'. While microfoundational studies of routines opened the 'black boxes' of routines (Felin et al. 2012), they often created new 'black boxes' for actions that take place beyond the boundaries of

routines (Weick & Sutcliffe 2006). The present study draws from Obstfeld's (2012) action trajectory framework in order to integrate routine action and non-routine action. We demonstrated how Obstfeld's (2012) framework can be operationalized in order to empirically explore routines and their boundaries. Yet, while Obstfeld's (2012) framework provides a promising starting point for efforts to integrate routine and non-routine action, there still remain many unanswered questions regarding the transition of routine and non-routine action. For instance, we do not know enough about how creative action develops into routine action and how routines may comprise creative elements. Moreover, Obstfeld's (2012) framework does not account for the notion that routine and non-routine action may take place simultaneously (cf. "organizational ambidexterity", O'Reilly & Tushman 2008)). We therefore encourage future research to continue on Obstfeld's (2012) path and to integrate models of routines with models of creativity, innovation, and ambidexterity.

### 5.6. Concluding remarks

This study provides experimental evidence about routines and their antecedents. Specifically, it explores three 'low hanging fruits' in routine research. By means of three lab experiments (presented in three different essays), we test the effects of performance feedback, conflict, and distinct negative emotions on routines. Our findings enhance extant organizational-level models of change. They contribute to recent efforts to bridge the prevalent micro-macro divide in management research. All three essays provide empirical evidence that supports the notion that under certain conditions negative experiences may result in positive outcomes. We discuss the practical implications of our findings and propose ideas how managers can leverage performance feedback, conflict, and negative emotions in order to manage organizational routines and to stimulate change in organizations more effectively.

## 5.7. References


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# Appendix

## Appendix A: Reference for the first essay

Oehler, P. J., Stumpf-Wollersheim, J., & Welpe, I. M., (2018). Never change a winning routine? How performance feedback affects routine change. Industrial and Corporate Change

## Appendix B: Reference for the second essay

Oehler, P.J, Stumpf-Wollersheim, J., Welpe, I.M., & Obstfeld, D. (Revise and Resubmit) War and peace: How conflict affects teams' decisions whether to enact routines or creative projects. Industrial and Corporate Change

## Appendix C: Reference for the third essay

Stumpf-Wollersheim, J., Oehler, P., Welpe, I. M., & Spörrle, M. (Reject and Resubmit). When is it good to feel bad? How sadness and fear differ in their effects on routine development. Strategy Science

## Appendix D: Author contributions to the essays in this dissertation

***Essay 1: Never change a winning routine? How performance feedback affects routine change:***

Patrick Oehler developed the research question and the research design under supervision of Jutta Stumpf-Wollersheim and Isabell M. Welpe. The experimental software used for this essay was provided by Jutta Stumpf-Wollersheim and adjusted by Patrick Oehler. The lab experiment and the analysis of data was conducted by Patrick Oehler, who also wrote the manuscript with suggestions and feedback from Jutta Stumpf-Wollersheim and Isabell M. Welpe. Patrick Oehler carried out the correspondence with reviewers and editors with suggestions and feedback from Jutta-Stumpf-Wollersheim and Isabell M. Welpe.

***Essay 2: War and peace: How conflict affects teams' decisions whether to enact routines or creative projects***

Patrick Oehler developed the research question and the research design under supervision of Jutta Stumpf-Wollersheim and Isabell M. Welpe. The experimental software used for this essay was conceived and developed by Patrick Oehler. The lab experiment and the analysis of data was conducted by Patrick Oehler, who also wrote the manuscript with suggestions and feedback from Jutta Stumpf-Wollersheim, Isabell M. Welpe, and David Obstfeld. Patrick Oehler carried out the correspondence with reviewers and editors with suggestions and feedback from Jutta-Stumpf-Wollersheim, Isabell M. Welpe, and David Obstfeld.

***Essay 3: When is it good to feel bad? How sadness and fear differ in their effects on routine development***

Jutta Stumpf-Wollersheim developed the research question and the research design in collaboration with Isabell M. Welpe and Matthias Spörrle. The experimental software used for this essay was provided by Jutta Stumpf-Wollersheim. The lab experiment was conducted by Jutta Stumpf-Wollersheim. Patrick Oehler analyzed the generated data and wrote the manuscript with suggestions and feedback from Jutta Stumpf-Wollersheim, Isabell M. Welpe, and Matthias Spörrle. Patrick Oehler carried out the correspondence with reviewers and editors with suggestions and feedback from Jutta-Stumpf-Wollersheim, Isabell M. Welpe, and Matthias Spörrle.