# EXPLORATION VERSUS EXPLOITATION: EMOTIONS AND PERFORMANCE AS ANTECEDENTS AND CONSEQUENCES OF TEAM DECISIONS


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# EXPLORATION VERSUS EXPLOITATION: EMOTIONS AND PERFORMANCE AS ANTECEDENTS AND CONSEQUENCES OF TEAM DECISIONS


## ABSTRACT

We analyze performance and emotions as antecedents and consequences of team strategic decisions to explore a new routine versus exploit an existing routine. In a laboratory study, we examine team decision making over time and draw causal inferences about the relationships among team emotions, team performance, and explore-exploit decisions. We use self-report data to measure team emotions, and validate results with psychophysiological data. We find that declines in performance increase the likelihood that teams decide to explore new routines rather than exploit existing ones. We also find a marginal positive effect of positive emotions, as measured by both self-report and psychophysiological data, on team decisions to explore a new routine. Further, teams successful at implementing the new routine report increased positive emotions, as measured by the self-report data. This relationship is fully mediated by performance change.


**Keywords:** Teams, emotions, performance, exploration and exploitation, decision making

## INTRODUCTION

Teams face the strategic decision about whether to refine existing competencies or develop new ones. This dilemma of choosing between experimenting with new alternatives versus exploiting existing alternatives is referred to in a variety of disciplines as the dilemma of choosing between exploration and exploitation (Gittins, 1979; Krebs, Kacelnik, and Taylor, 1978; March, 1991). The returns to exploitation are positive and predictable while the returns to exploration are uncertain (March, 1991).

Decisions to adopt and implement innovative routines or continue exploiting known routines are examples of the explore vs. exploit dilemma. Routines are repetitive patterns of interdependent actions carried out by multiple individuals (Feldman and Pentland, 2003). Routines facilitate coordination (March and Simon, 1958) and adaptation (Nelson and Winter, 1982) and therefore, are important components of organizations. Decisions about the adoption of routines are critical to organizational performance, yet difficult to make, because the outcome of adoption is uncertain.

To deal with decisions that are characterized by uncertainty, decision makers have been theorized to evaluate current performance against past performance and interpret any discrepancies between the two as a signal of either the need to change or the need to persist with a current routine (Cyert and March, 1963; Hu, Blettner, and Bettis, 2011). Recent evidence from the psychological literature, however, indicates that decisions are influenced not only by human's limited information-processing abilities (Simon, 1945) but also by emotions (Bechara, Damasio, and Damasio, 2000; Forgas and George, 2001). Despite comprehensive reviews and integrated frameworks that have enhanced our general understanding of emotions in organizations (Elfenbein, 2007), emotions remain an underexplored influence on behavioral strategy and decision making (Huy, 2012; Powell, Lovallo, and Fox, 2011) as well as on strategic adaptation and implementation (Hodgkinson and Healey, 2011; Huy, 2011). Thus, we study how past performance and emotions dynamically influence and are influenced by teams' decisions to adopt and implement an innovative routine.

Further, previous studies on emotions and decision making have focused on self-reported emotions. As argued by Barsade, Ramarajan, and Westen (2009) affective processes can also be implicit, and occur outside conscious awareness. Therefore, we combine self-reported measures of emotions with psychophysiological measures of emotions to examine whether our results hold for both types of data.

In addition, we examine the effect of emotions and performance on decisions made by teams. Many strategic decisions are made in organizations by top management teams. Although teams are increasingly used in organizations for making decisions and accomplishing tasks (Leavitt, 1996), little is known about how performance and emotions affect team decisions. Thus, we focus on the team level of analysis to advance understanding of strategic decisions.

We analyze the decision of teams to adopt and implement a new routine in the controlled setting of the laboratory, which permits causal inferences (Croson, Anand, and Agarwal, 2007). Our design allows us to analyze the dynamics of decision making and performance over time, and thereby gain insights into the causal sequence of these variables. Further, we develop a method to compare emotions over time using Russell's (1980) circumplex model, which allows us to investigate performance and emotions as both antecedents and consequences of team decisions to adopt a new routine.

The paper proceeds as follows: First, we present our theory and develop hypotheses about how and why performance changes and emotions could affect and be affected by decisions made by teams about whether to adopt innovative routines. We then describe the method and empirical results. The paper concludes with a discussion of the implications of our findings for both theory and practice.

## THEORY AND HYPOTHESES

The relationship between the decision to explore or exploit was demonstrated by March (1991) to be a trade-off: an organization choses either to explore or to exploit. Other researchers have found that exploitation and exploration are independent dimensions rather than a trade-off (e.g. Katila and Ahuja, 2002). Researchers finding that the two dimensions are independent have typically worked at the organizational level of analysis, where arguably some parts of the organization could be tasked with exploitation and others with exploration. Because our focus is on a particular decision made by a team that requires team members to act in concert, decision makers in our study can *either* explore *or* exploit. Thus, we adopt the original conception of March (1991) that implies that the decision to explore versus exploit is an either/or decision.

Strategic decisions to explore or exploit are essential to organizations. Further, explorative and exploitative decisions have to be implemented. Emotional management has been found a key facilitating factor in organizational adaptation (Huy, 2002). But how can managers foster exploration? And how might they manage emotions? Do emotions and performance affect the willingness to explore or exploit? And how do explore or exploit decisions influence emotions? These are questions that we investigate in our research. We study emotions and performance as antecedents and consequences of team decisions to adopt a new routine of exploration or stay with an exploitative routine.

We draw on two theoretical perspectives, theories of search in response to performance changes and theories of emotion, in order to increase our understanding of the team strategic decision-making process related to adopting and implementing a new routine. Problemistic search (Cyert and March, 1963) is stimulated by a problem, such as disappointing performance, and is directed toward finding a solution to that problem. In theory, the performance shortfall could be relative to the team's own past performance or those of comparable teams. We focus on current performance relative to past performance and argue that the relationship between current and past performance influences team decisions to make changes and take risks (Cyert and March, 1963; March and Shapira, 1987, 1992). When current performance is poor relative to past performance, decision makers are more likely to take risks and change (i.e., explore) than when current performance exceeds past performance.

Research has shown that performance shortfalls affect outcomes such as a firm's overall strategy (Audia and Greve, 2006; Lant, Milliken, and Batra, 1992; Miller and Chen, 1996), risk taking in decisions relating to organizational partnership agreements (Baum *et al.*, 2005), and research and development and innovation launches (Greve, 2003). Similar arguments have been made on risk taking (Kahneman and Tversky, 1979) where decision makers who anticipate returns below the level of their aspiration levels have been found to be risk and innovation seeking, and those who anticipate returns above their aspiration levels have been found to be risk and innovation avoiding (Bromiley, Miller, and Rau, 2001; Miller and Chen, 2004; Nickel and Rodriguez, 2002). There are numerous findings both at the firm and the individual level, but not at the team level. We add insights to this work by studying the effect of performance changes at the team level of analysis.

Although research has not examined the effect of performance shortfalls on teams' decisions to explore vs. exploit, research that compares the riskiness of individual and team decisions can inform how teams might make the decision. Studies have found evidence that teams tend to make more extreme and more risky decisions than do individuals (e.g. see Cartwright, 1971; Myers and Lamm, 1976 for reviews), in part because team members feel less personal responsibility for actions of the team (Wallach, Kogan, and Bem, 1964). Relatedly, Whyte (1993) extended an explanation for escalation of commitment to the team level and found team decision making amplifies trends apparent at the individual level in terms of the frequency with which escalation occurs and its riskiness. On the other hand, Zander and Medow (1963) compared teams and individual aspiration level formation, and found that teams and individuals reacted similarly to positive performance (i.e., raised their aspiration levels in response to positive performance), but that teams tended to lower their aspiration levels more than individuals in response to negative performance. These studies did not examine team decisions to explore versus exploit. Evidence on how teams make explore versus exploit choices and how those choices are affected by performance is lacking. We extend previous research to teams by examining how teams' current performance, relative to past performance, influences their decisions to explore and adopt an innovative routine. We therefore hypothesize:

Hypothesis 1: *Teams whose recent performance improved on past performance are less likely to adopt a new routine than teams whose recent performance did not improve on past performance.*

A growing number of studies have also convincingly demonstrated that emotions are essential for understanding decision making (Bechara *et al.*, 2000). Behavioral strategy applies cognitive and social psychology in an effort to make realistic assumptions about strategic management and strategic decision making (Powell *et al.,* 2011). Nevertheless, relatively little is known about the potential effect of emotions on strategic decision making and strategic implementation.

Previous studies have demonstrated that individuals experiencing positive emotions make optimistic judgments and decisions whereas individuals experiencing negative emotions make pessimistic judgments and decisions (Loewenstein *et al.*, 2001). Further support for this line of argument is provided by research on the effect of emotions on creativity and novel thinking. For example, according to the broaden-and-build theory (Fredrickson, 2003), positive emotions increase exploration and broaden the range and novelty of one's thoughts and actions. Also, Amabile *et al.* (2005) found a positive, linear relationship between positive affect and creative thoughts by individuals. A meta analysis of the effect of emotions on creativity found a generally positive effect of positive emotions on creativity (Davis, 2009). There is some literature that would predict that individuals who experience positive emotions might want to prolong their positive emotions and not incur the risk of change (Gross and John, 2003), just as there is research showing that people who experience negative emotions are more likely to change in order to improve their emotional state (e.g. Isen, 1990; Saavedra and Earley, 1991). Nevertheless, the preponderance of evidence suggests that individuals who experience positive emotions generally evaluate information more positively and are more explorative in their behavior than individuals who experience negative emotions.

Although the above studies focus on individuals' emotions, it has been demonstrated that emotional contagion occurs within teams (Barsade, 2002; Bartel and Saavedra, 2000). Based on the concept of primitive emotional contagion (Hatfield, Cacioppo, and Rapson, 1992, 1993), both Barsade (2002) and Bartel and Saavedra (2000) demonstrated how the human tendency to automatically mimic and synchronize facial expressions, bodily movements, and vocal intonations of the people with whom one interacts led to emotional contagion within teams. Positive emotional contagion has been found to lead to increased cooperation, decreased conflict, and increased perception of task performance, and vice versa for negative emotional contagion (Barsade, 2002). Relatedly, Huy (2011) studied group-focus emotions, i.e., emotions related to social identities, and found that these emotions influenced strategy implementation by influencing middle managers' decisions to either support or dismiss particular strategic initiatives.

We expect emotions to both influence and be influenced by team decision making and implementation. Because positive emotional contagion has been found to increase cooperation and optimism, we expect positive emotions to make teams evaluate a new, innovative routine more optimistically than teams experiencing negative emotions. This more optimistic evaluation of the new routine's potential would lead to more frequent adoption of the new routine by teams experiencing positive emotions relative to those experiencing negative emotions. Furthermore, interpreting that others share the same emotion would likely increase this action propensity. Therefore, we hypothesize:

*Hypothesis 2: Teams experiencing positive emotions are more likely to adopt a new routine than teams experiencing negative emotions.*

In terms of predicting how explore-exploit decisions influence emotions, we expect that positive emotions will result when the adoption of a new routine improves performance. When the adoption of a new routine improves performance, positive emotions are likely to develop. For example, researchers have theorized (March and Simon, 1958) and found (Lawler and Porter, 1967) that satisfaction, a positive emotion, was caused by good performance. In addition to any extrinsic rewards that might result from good performance, performing the task well can in itself be intrinsically rewarding and lead to increased satisfaction. This is consistent with Bandura's (1997) claim that mastery experiences are essential to create self-efficacy. Similarly, Duckworth *et al.* (2007) found that 'grit,' which they defined as perseverance and passion for long-term goals, was related to success in the achievement of difficult goals over time. Indeed, we expect that performance increases associated with a new routine that teams implement successfully will increase positive emotions. Thus, we hypothesize that the influence of adoption of a new routine on positive emotions is explained by performance improvements associated with adopting the routine:

<u>Hypothesis 3:</u> *Teams that adopt a new performance-enhancing routine are more likely to experience an increase in positive emotions than those that do not.*

<u>Hypothesis 4:</u> *The effect of adopting a new routine on emotions is mediated by performance changes.*

## METHOD

We induced positive emotional states in half of the groups and negative emotional states in the other half. The task participants produced was origami sailboats in an interdependent assembly line. After three production periods, participants were introduced to a different routine through a video. The routine was described as having been developed by researchers in R&D who believed that it could increase productivity. Thus, teams were faced with a decision about whether to adopt an innovative routine that could possibly improve their performance in the long run but would likely disrupt it in the short run, or to continue using the old production routine with more certain outcomes. Our primary dependent measure was whether the teams adopted the innovative production routine.

### Participants

The participants were 153 Danish university students (78 male, 75 female) who responded to an electronic recruitment flyer. Participants were paid 214 DKK (approximately 36 USD) to participate in the study. The study was run using same-gender teams. Within each gender, participants were randomly assigned to the experimental conditions, to three-person teams, and to roles within the teams. The teams were evenly distributed across gender and inducement conditions. There were 13 male teams in the positive condition and 13 male teams in the negative condition; 13 female teams were in the positive condition, and 12 female teams were in the negative condition.

**Task**

The experimental task, which was adapted from Kane, Argote, and Levine (2005), required team members to construct origami sailboats. The task of constructing an origami sailboat was unlikely to be familiar to participants. Thus, the design of the experiment controlled for prior task experience. The task was divided into three roles, which team members worked on in a sequentially interdependent order. Each team member was assigned to one of the three roles and was not allowed to swap roles with other members. Teams were promised that the best performing team would win a prize equivalent to 30 USD. Teams could not monitor other teams' performance, only their own performance, relative to previous trials. Teams earned one point for each sailboat that met product specifications.

Teams performed for a total of five production periods that each lasted four minutes. After the third period, team members were shown a video of a new production routine. The new production routine was described as having been invented by researchers in R&D who believed that it could increase productivity. Teams produced for two periods after they were shown the video. The timeline in Figure 1 illustrates the different parts of the experiment.

- Insert Figure 1 about here -

**Procedure**

*Introduction.* After participants had been assigned to their respective roles in the assembly line, they were seated next to each other at a table, in the order dictated by their sequential roles. In order to obtain psychophysiological measures of emotions, electrodes were attached to participants at the start of the study. We measured electromyographic data relating to activity in zygomaticus major ('smile muscle') and currogator supercilii ('frown muscle') in order to capture the valence aspect of emotion[1]. A baseline measure, which lasted five minutes, was obtained for each participant.

After the baseline period, participants individually filled out a questionnaire including measures of Russell's (1980) circumplex model of emotions that required them to respond to 28 emotional terms and indicate the extent to which they felt that way at the present moment ($Q_1$ in Figure 1). Further, participants were asked to fill out Cloninger, Przybeck and Svrakic's (1991) tridimensional personality questionnaire[2]. Next, experimenters introduced the study to the three participants in a team with the explanation that they would produce origami sailboats in an assembly line.

*Emotional manipulation.* Our conception of emotion is based on Russell's circumplex model of affect (Russell, 1980) that is depicted in Figure 2. As can be seen from Figure 2, Russell's (1980) model, in contrast to some others (e.g., Watson, Clark, and Tellegen, 1988), distinguishes between pleasant and unpleasant (high/low valence) emotions, and active and passive (high/low arousal) emotions.

- Insert Figure 2 about here -

We focused on emotions in the upper right and lower left quadrants of Russell's model (Figure 2). Thus, our distinction between positive and negative emotions relates to whether teams were induced to feel either high valence/high arousal (positive) or low valence/low arousal (negative) emotions.

The emotional inducement was achieved by the experimenters following the facial, vocal, and postural instructions to induce different emotions developed in Bartel and Saavedra (2000). For example, in the positive condition, the experimenter smiled, established

[1] Appendix A contains detailed information about how these data were acquired and analyzed. We also tried to measure electrodermal activity and heart rate to capture arousal but were not able to measure these variables reliably at the team level. In addition, our self report measures of arousal did not evidence an effect of the manipulations.

[2] A subset of the participants (123 out of the 159 participants) filled out Cloninger et al.'s (1991) tridimensional personality test.

eye contact often, was animated and slightly breathless, and oriented his or her posture toward team members. By contrast, in the negative condition, the experimenter yawned, seldom established eye contact, spoke in a monotone tone, and oriented away from team members. Thus, just as Sy, Côté and Saavedra (2005) found emotional contagion between a leader and team members, we rely on emotional contagion between the experimenter and team members to manipulate emotions. The experimenters, who were coached by a trained actor prior to the experiments, behaved consistently throughout the study in order to continue the emotional inducement from the start of the study to its conclusion.

There are many ways of inducing emotions. For example, Isen, Daubman and Nowicki (1987) and  Isen, Nygren, and Ashby (1988) manipulated positive moods via the distribution of candy. Gross and Levenson (1995) examined the efficacy of films in inducing distinct emotions, an induction method also used by Fredrickson and Branigan (2005), Schaefer, Nils, Sanchez, and Phillippot (2010), and Isen, Daubman and Nowicki (1987). Lang, Freenwald, Bradley and Hamm (1993) used pictures, and Yu, Yuan and Luo (2009) used sounds. Other studies have used positive performance feedback to participants (Isen and Means, 1983) . Strack, Martin, and Stepper (1988) used pencils to have participants control and relax different facial muscles to promote positive vs. negative emotions.

We used Russell's circumplex model to capture emotions, which was also used by Huy (2002). We chose an inducement that has previously been used effectively (Barsade, 2002) for studying Russell's circumplex model. Having experimenters induce the emotional states by way of their facial, vocal and gestural expressions was an indirect and subtle inducement, which seemed appropriate to us, because we were studying strategic decision making. Stronger inducements could be argued to not be realistic or appropriate for 'real life' strategic decision-making situations. Further, because our interest was in team emotions, not intrapersonal emotions, we believed that interactions with others would be a more realistic manipulation. Indeed, previous research has argued that emotional elicitors do not have to be direct interventions, but can be relatively stable features of the environment, such as interactions with coworkers (Brief and Weiss, 2002) and in our case experimenters. Furthermore, we hoped that creating an emotional inducement that the participants were not aware of would make our participants' self-report responses less subject to social desirability biases.

Experimenters taught the teams how to fold the origami sailboats and led them through a practice session. Each team then worked together to produce as many sailboats as possible during four-minute production periods that were separated by 30-second breaks during which participants were not allowed to talk.

After the third production period, a questionnaire to measure emotions developed by Russell (1980) was again administered ($Q_2$ in Figure 1). Participants individually completed the questionnaire. Teams were then introduced to a new production routine through a video of a person of the same gender as the team members. The experimenter indicated that R&D researchers believed that the new routine could possibly increase productivity. The actor in the video was neutral about the new routine, neither extolling nor denigrating its virtues. The new routine involved a smaller number of folds to complete a sailboat than the routine teams were trained to use, and thus had the potential to increase productivity. The performance benefits of the routine, however, were not obvious. One of the folds, a sink fold (Kane *et al.*, 2005), was difficult to execute and resulted in a four-layer diamond at an interim stage of production whose correspondence to a sailboat at a final stage was not obvious. Thus, participants faced the dilemma of whether to continue producing the routine they knew well and realize productivity gains through learning by doing or to adopt a new routine with potential – but uncertain – performance benefits.

After the new routine was introduced to the team, team members worked together for two four-minute production trials. Participants were not told in advance that the experiment would end after the fifth production period. In Trials 4 and 5, we recorded whether the teams decided to adopt the new routine or not. After the fifth and last production period (Trial 5), participants individually filled out a questionnaire that included items designed to measure Russell's (1980) circumplex model of emotions for a third time ($Q_3$ in Figure 1) as well as other items. After completing the questionnaire, participants were thanked and debriefed.

*Performance development*. We measured the performance of the teams in each production trial by counting the number of sailboats made during the trial. Hence, performance was calculated at the end of each trial. This enabled us to study development in performance as the increase or decrease in total boats produced from one trial to the next.

*Adoption of new routine.* The primary dependent measure was whether the team adopted the new routine in Trials 4 or 5. Our dependent variable was the outcome of a team, not an individual decision. Following Figure 1, teams were given the chance to adopt the routine at two different times. In $A_1$ (Trial 4), they could either choose to adopt the new routine for the first time (1), or to continue with the old routine (0). In Trial 5 ($A_2$) there were four possible situations. Either teams could adopt the new routine for the first time (01), they could not adopt it again in this second option period (00), they could continue with the new routine which they first adopted in Trial 4 (11), or they could return to the old routine (10). The new routine required two team members to execute different tasks. Using the new routine resulted in a product that met specifications but looked somewhat different from the routine on which members were trained. Thus, our measure of routine change was determined objectively.

*Emotion measures*. We used two measures of team emotions: Self-report measures and psychophysiological measures. For the self-report data, we measured the emotional states of the teams at three times: immediately after the baseline ($Q_1$), immediately after the first three production trials ($Q_2$), and finally at the end of the experiment, immediately after the fifth production trial ($Q_3$) (see Figure 1). Participants' emotions were measured as self-assessments on a questionnaire that included 28 emotional items designed to measure Russell's (1980) circumplex model of emotions. The questionnaire read: 'This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment.' Each item was rated on a five-point Likert scale (1 = very slightly or not at all; 2 = a little; 3 = moderately; 4 = quite a bit; 5 = extremely). Descriptive analyses, including calculations of changes in participants' emotions as the experiment evolved over time, are contained in Appendix B. Descriptions of calculations from individual to group level emotional measures are explained in Appendix C.

For the psychophysiological measures, we used measures previously established to correlate with self-report data (Lang, Greenwald, Bradley, and Hamm, 1993). Participants had electrodes attached on the forehead to capture activity in the currogator supercilii (frown) muscle, and on the cheek to capture activity in the zygomaticus major (smile) muscle. Electromyographic measures of participants' facial muscle activity were used to capture valence. Previous studies have supported that patterns of facial action can be ordered along the valence dimension such that unpleasant imagery (Fridlund, Schwartz, and Fowler, 1984) or pictures of angry faces (Dimberg, 1986) increases currogator activity, whereas pleasant imagery (Fridlund *et al.*, 1984) or pictures of happy faces prompts zygomatic tension (Fridlund *et al.*, 1984). Finally, Lang et al. (1993) found similar effects in a study of pictorial stimuli from the International Affective Picture System on electrodermal activity of both corrugator supercilli and zygomaticus major[3].

[3] Appendix B contains descriptive analyses on the means, standard deviations and correlations of these variables.

## RESULTS

### Calculation of emotions

For the self-report data, we developed a method that would allow us to compare emotions over time, using Russell's (1980) model. This method is described in detail in Appendix C.

### Manipulation checks

Consistent with our manipulations, participants in the positive (high valence/high arousal) condition reported higher agreement in their self-reported data with the words related to positive valence than participants in the negative (low valence/low arousal) condition[4]. As appears from Table 1, this inducement lasted throughout the experiment ($p \quad 0.032$). Our manipulations did not seem to affect the experience of arousal ($p \quad 0.225$). Thus, according to the self-report data the manipulation was effective on the valence dimension, but not on the arousal dimension.

- Insert Table 1 about here –

The psychophysiological data showed similar results[5]. Here, data relating to activity in zygomaticus major (smile muscle) showed that the manipulation affected valence during the baseline period, and that participants who were positively induced smiled more than those who were negatively induced ($p = 0.048$). While this tendency remained over the experiment, it diminished after the baseline period. The relationship between inducement and currogator supercilii (frown muscle) activity was not significant ($p = 0.205$).

### The effects of performance on adoption of a new routine

We first examined whether performance differences between teams in the experimental conditions on the three trials prior to the introduction of the new routine mattered to teams'

[4] We further tested whether our inducement affected the variation within conditions (i.e., positive valence/high arousal vs. negative valence/low arousal). Results showed that the differences in variation between teams within conditions were not significant ($p > 0.25$ in all instances).

[5] We were not able to measure arousal reliably at the team level from the psychophysiological data. The movements participants made to assemble products disconnected many of the electrodes, resulting in large amounts of missing data.

decision to adopt. Results showed that there were no differences in performance between the teams in the different experimental conditions during the first three production trials. Our theory, however, predicted that adoption of the new routine would be affected by the change in performance over time rather than absolute levels of performance. Thus, to test hypothesis one, we calculated the change in performance in the periods immediately preceding the adoption decisions. We found a significant relationship between performance changes and the adoption decision.

- Insert Table 2 about here -

As appears from Table 2, we found that negative performance development from Trial 2 to Trial 3 predicted adoption of the new routine in Trial 4 ($A_1$). That is, teams whose performance declined from Trial 2 to Trial 3 were more likely to adopt the new routine when presented with the opportunity after Trial 3 than teams whose performance improved from Trial 2 to Trial 3. Similarly, for Trial 5, we found that a negative performance development from Trial 3 to Trial 4 predicted changes in routine. More specifically, when performance declined from Trial 3 to Trial 4, teams that did not adopt the new routine in Trial 4 ($A_1$) adopted the new routine in Trial 5 ($A_2$), and teams that did adopt the new routine in Trial 4 ($A_1$), but experienced a subsequent performance decline, changed back to the old routine in Trial 5 ($A_2$). Teams that experienced a performance increase after having adopted the new routine in Trial 4 persisted in using the new routine. Performance development explains 29.3 percent of the team's propensity to adopt the routine for Trial 4 ($A_1$), and 75.1 percent of the variance in the team's decision to adopt in Trial 5 ($A_2$). These results are consistent with Hypothesis 1, which predicted that teams whose recent performance improved on past performance would be less likely to adopt a different routine than teams whose recent performance did not improve on past performance.

Figure 3 contains descriptive evidence of this argument. As can be seen from Figure 3, teams that experienced a performance decline in Trials 2–3 were more likely to adopt in Trial 4, whereas teams that experienced a performance increase were less likely to adopt. Teams that had been unsuccessful in their implementation of the new routine and experienced a performance decline tended to revert back to the old routine in Trial 5 while those that had been successful in their implementation of the new routine persisted in using it. Finally, teams that did not adopt at all had a small, increasing performance increase over the five trials, as a result of exploitation benefits[6][7].

- Insert Figure 3 about here -

**The effects of emotions on adoption of a new routine**

To test hypothesis two, we initially examined whether emotional valence predicted adoption of the new routine. Neither the effect of self-reported valence at $Q_2$ ( $p = 0.757$ ) nor physiological measures of valence were  significant. We tested whether psychophysiological measures of valence (i.e., activity in zygomaticus major and currogator supercilii), measured by their respective average values in the four minutes period ( $t_3$ ) prior to the adoption decision would predict adoption. The relationship between zygomaticus major (smile muscle) activity and adoption was in the predicted direction, but did not reach conventional levels of significance ( $p = 0.102$ ) while the relationship between currogator supercilii (frown muscle) activity and adoption did not approach significance ( $p = 0.696$ ).

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[6] There was no difference in the performance of adopters and non-adopters in the first three production periods. The p-value was in all instances above 0.13 when conducting a standard t-test.

[7] Appendix B also includes gender differences. As appears from the correlations (Table B1) there was a positive relationship between female teams and productivity, such that female teams were more productive than the male teams. This is confirmed in results in Table B3. However, as also appears from Table B3, the difference between male and female participants in the change in number of boats  produced (performance change) over time was not significant. We hypothesized and found that adoption decisions are predicted by performance change in the period before the adoption opportunity (see Table 2) rather than by the number of boats produced. Thus, even if female teams were more productive than male teams, it was the performance changes (increases or decreases) that influenced teams' decisions to adopt. Furthermore, a $^{2}$ test showed independence between gender and adoption ( $p = 0.499$ ). That is, gender did not predict the adoption decision. Table B3 also shows that female teams scored significantly higher on harm avoidance and reward dependence than male teams. However, as appears from Table B1, the correlations between harm avoidance and reward dependence on the one hand, and performance change, on the other, were not significant. The personality differences between male and female teams therefore did not influence our results.

We then tested whether emotions measured immediately after the baseline period would predict adoption. Results showed that self-reported valence at $Q_1$ had a marginally significant ($p = 0.091$) effect on adoption. Similarly, the psychophysiological measures for this period ($PP_2$) showed a marginally significant relationship between zygomaticus major activity and adoption ($p = 0.056$)[8], such that those who smiled more in the beginning of the experiment were more likely to adopt the new routine later on than those who did not smile[9]. The relationship between the frown muscle and adoption was insignificant ($p = 0.537$). Therefore, Hypothesis 2, which predicted that emotions would affect the adoption decision, was not supported with either the self-report data at $Q_2$ or the psychophysiological data from the four-minute period ($t_3$) immediately preceding adoption decisions. However, both self-reported emotions at $Q_1$ and psychophysiological measures relating to smiling at $Q_1$ ($PP_1$) showed a marginally significant relationship to adoption in the predicted direction.

As a control, we ran a logistic regression with adoption as the dependent variable and the three Cloninger (1991) personality dimensions (Harm Avoidance, Novelty Seeking, and Reward Dependence) as independent variables. These relationships were insignificant with all $p > 0.553$, indicating that these personality dimensions did not influence decisions to adopt.

**The effects of adoption of a new routine on valence**

We tested hypothesis three by examining whether adoption of the new routine affected emotions. As appears from row 2 of Table 3, teams that adopted the new routine in Trial 4 experienced a self-reported valence increase from Trial 3, where $Q_2$ was administered, to Trial 5, where $Q_3$ was administered. This lends support for Hypothesis 3, which predicted that

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[8] Because we made directional predictions, it could be argued that we should use one-tailed tests in which case the results are significant at conventional levels ($p < 0.05$). For zygomaticus major ($p = 0.028$) and for self-reported data ($p = 0.046$).

[9] We further tried to replicate the results of the logistic regression relating to the effect of valence on willingness to adopt (contained in Table 3). Mean values for zygomaticus major activity for non-adopters = 0.003, and for adopters =0.004. The $p$-value of the logistic regression was 0.062.

teams that adopted the new routine would be more likely to experience an increase in positive emotions than those that did not. This relationship was not significant ( $p > 0.22$ ) for the psychophysiological data.

- Insert Table 3 about here -

**Mediation analysis**

Our fourth hypothesis proposed that the effects of adopting the routine on valence increase would be mediated by performance. To test for mediation, we conducted a series of regression analysis using the method suggested by Baron and Kenny (1986).

Following Baron and Kenny (1986) four conditions are required for mediation (Baron and Kenny, 1986; Edwards and Lambert, 2007; MacKinnon, Fairchild, and Fritz, 2007; Zhao, Lynch, and Chen, 2010). These are the following: (1): ‘Adoption of new routine’ should be significantly related to ‘Valence development.’ (2): ‘Adoption of new routine’ should be significantly related to ‘Performance development’. (3): ‘Performance development’ should be significantly related to ‘Valence development’ when controlling for ‘Adoption of new routine.’ (4): ‘Adoption of new routine’ should be related to ‘Valence development’ in such a way that the direct effect is non significant or significantly smaller than the total effect when controlling for ‘Performance development.’[10]

An overview of the results of the mediation analysis is shown in Table 3. From Table 3 it is evident that the analysis satisfies the above conditions for mediation and that this is a case of full mediation because ‘Adoption of new routine’ becomes insignificant when ‘Performance change from Trial 3 to Trial 4’ is included. This means that the effect of ‘Adoption of new routine’ on ‘Valence change’ is fully mediated by ‘Performance change.’ That is, once changes in performance associated with the new routine are accounted for, the effect of adopting the routine is no longer significant.

[10] Baron and Kenny (1986) further recommend using the Sobel test to verify that the indirect effect $a$ $b$ is significantly different from 0 (Baron and Kenny, 1986; Sobel, 1982; Zhao *et al.*, 2010).

In order to accommodate criticisms (Zhao et al., 2010; Hayes, 2009; Stone and Sobel, 1990) against Baron and Kenny's (1986) method[11] we conducted a bootstrap test of the indirect effect between 'Adoption of new routine' and 'Valence development.' In this context we used the SPSS approach developed by Preacher and Hayes (2004). The results of the bootstrap analysis showed that there was a significant indirect effect because the lower limit of the 99 percent confidence interval for the bootstrapped effect was positive (0.0021), thus substantiating the results from the Baron and Kenny approach. The results of the mediation analysis are illustrated in Figure 4.

- Insert Figure 4 about here -

Our results therefore suggest that performance development fully mediates the effect of adoption of the new routine on self-reported valence increases. Thus, Hypothesis 4 that the effect of adoption of the new routine on emotions occurs through performance was supported for the self-reported data. When examining this relationship with the psychophysiological data, however, it was not significant ($p > 0.22$)[12].

[11] Baron and Kenny's approach to establishing mediation has been subjected to criticism on at least three different points. First, Baron and Kenny's distinction between partial and full mediation has been disputed with the argument that the effect of mediation should be evaluated by the presence of an indirect effect and not by the absence of a direct effect (Zhao *et al.*, 2010). Secondly, the emphasis on the first condition, that there is a direct effect to be mediated, has been disputed since the only requirement needed ought to be that the indirect effect $a$ $b$ is significant (Zhao *et al.*, 2010). It is possible to have a significant indirect effect even if one of its component paths is not significant, and it therefore makes sense to minimize the number of hypothesis tests that one must make to establish mediation (Hayes, 2009). Finally, the Sobel test has been criticized because it has low power compared to a bootstrap approach and requires a fairly large sample size (Hayes, 2009; Stone and Sobel, 1990).

[12] An analysis where the adoption of the new routine was the dependent variable and self-reported valence, performance change, and the interaction of performance change and valence ($Q_2$) were the predictor variables was conducted, and the effects of self-reported valence ($p = 0.345$) and the interaction of performance change and valence ($p = 0.359$) were insignificant while the effect of performance change was significant. The same analysis was conducted with psychophysiological data for valence (zygomaticus major) at $PP_2$, and here the effects of valence (zygomaticus major) ($p = 0.150$) and the interaction of performance change and valence ($p = 0.445$) were insignificant while the effect of performance change was significant. When conducting the analysis on self-report data from $Q_1$ the effects of valence ($p = 0.282$) and the interaction of performance change and valence ($p = 0.898$) were not significant while the effect of performance change was significant. For the psychophysiological data for valence (zygomaticus major) at $PP_1$ the effects of valence (zygomaticus major) ($p = 0.184$) and the interaction of performance change and valence ($p = 0.906$) were insignificant while the effect of performance change was significant. Thus, when both performance change and emotion are included as predictors of decisions about whether or not to adopt a new routine, performance change is significant and emotion is not.

## DISCUSSION AND CONCLUSION

We investigated the effects of performance change and emotions as antecedents and consequences of teams' decisions to explore or exploit. We included both factors in the same study to advance understanding of behavioral strategy and implementation. Both emotions and performance changes are likely to be operative in real teams. Yet studies to date have not examined these factors together. Further, our experimental design allowed us to study not only the correlations between team emotion, adoption and performance, but also to analyze their dynamics over time.

Relating to our hypotheses, we found, supportive of hypothesis one, that performance declines led to a higher likelihood that teams adopted an innovative routine and that performance increases led to a lower likelihood of adoption. We found this for two adoption decisions ($A_1$ and $A_2$). Teams that adopted the new routine in the fourth period ($A_1$) but did not experience performance improvements reverted to the old routine in the fifth period ($A_2$). Thus, we find support for our hypothesis one with two adoption decisions and two routines. Teams experiencing performance decreases in the period immediately preceding their opportunity to explore adopted a new routine while those experiencing performance increases exploited the existing routine, independent of the content of the routine as well as independent of performance in earlier periods.

This finding adds specificity and immediacy to Cyert and March's (1963) more general theory as we find that the relationship between performance outcomes in the two periods immediately preceding the change opportunity predicted the adoption decision, while the relationship between performance outcomes in earlier periods did not. Thus, we find that recent changes in performance figured more significantly in the decision to explore than earlier changes. Further, to the best of our knowledge, our study is the first to demonstrate that the relationship between performance shortfalls and the behavior of adopting a new routine holds at the team level of analysis. Thus, our study demonstrates that the use of aspiration levels as reference points also occurs at the team level.

Contrary to hypothesis two, we did not find evidence that either self-reported emotions or the psychophysiological data in the period preceding adoption decisions ($Q_2$)/($t_3$) affected the decision to adopt. Interestingly however, we found some support of hypothesis two for both self-reported and physiological emotions at $Q_1$. This relationship, even if only marginally significant, suggests that people who reported higher valence and smiled more at the beginning of the experiment were more likely to adopt later on than those who did not report high valence and did not smile a lot at the beginning of the experiment. Therefore, even if the effect of emotion was dominated by the effect of performance relative to aspirations, there appears to be a subtle effect of early emotions on adoption.

Supportive of hypothesis three, we found that the adoption of the new routine led to an increase in the experience of self-reported positive emotions. In support of hypothesis four, this increase was due to improved performance associated with the new routine. Performance development mediated the effect of adopting the new routine on increases in positive, self-reported emotions. Teams that adopted the innovative routine experienced more positive emotions because their performance increased. Thus, the successful adoption of the new routine caused teams to experience more positive emotions. This finding indicates that 'mastery experiences' (Bandura, 1997) , not just succeeding in itself, increase team valence. We did not find support for this relationship based on our psychophysiological measures. This suggests that self-reported emotions, which are subject to cognitive appraisal, are more influenced by whether or not adoption leads to performance increases than are psychophysiological measures of emotions, which are assumed unconscious. Our finding points to the importance of better understanding the antecedents of team decision processes and the outcomes of these decisions in creating team emotions. Such decision outcomes are usually outside of the direct control of managers. Nevertheless, managers may be able to shape the emotional experience of their employees. As Huy (2002) argued, emotional management is important for strategic management and change. Therefore, knowing more about how to create positive team emotions, both explicit and implicit, is important for strategic change and implementation. Our results suggest that factors affecting explicit emotions might differ from those affecting implicit emotions.

Our study adds to strategic management research by examining the effect of both explicit (self-reported) and implicit (psychophysiological) emotions on teams' decisions to adopt an innovative routine.  Previous research has indicated that implicit emotions (i.e., affective processes activated outside of conscious awareness) may be at least as important as explicit emotions (Barsade, Ramarajan, and Westen, 2009). To gain an understanding of how both types of emotions influence behavioral strategy, we used self-reported (explicit) measures and psychophysiological (implicit) measures of emotion. To analyze the self-report data, we developed a method that allowed us to compare team emotions over time. For the psychophysiological data, our study is, as far as we know, the first study to use such measures at the team level.

The experimental method we used enabled us to induce different emotions and study their effects on the adoption of an innovative routine. Thus, our study has the benefits of experiments discussed by Croson, Anand, and Agarwal (2007), including the elimination of confounds through random assignment of participants to conditions and the ability to establish causality for variables that are manipulated. Further, we studied decision making at the level of the team, which arguably relates more directly to decision making in firms than studies of decision making by individuals (Croson *et al.*, 2007). And we had an objective behavioral measure of exploration or the adoption of a new routine. Our longitudinal design also provided data that enabled us to investigate the dynamics of performance changes as well as routine adoption and emotion over time. Further, we studied two decisions and found that both were predicted by the same factor: whether performance in the period preceding the adoption opportunity declined relative to previous performance.

The longitudinal analysis of the laboratory experiments allowed us to gain insights into the causal relationships among variables. Had we only looked at total productivity and the mean self-reported valence of the teams after the final stage of the experiment, we might have erroneously concluded that teams with higher self-reported valence would be more productive. Our longitudinal analysis revealed, however, that the causal sequence was that teams with higher productivity experienced more positive emotions rather than the reverse sequence.  Thus, our experimental approach allows us to reveal insights into a long standing debate as to whether or not happy workers are productive workers (e.g. Lawler and Porter, 1967). Interestingly however, for the psychophysiological data, successful implementation of the new routine did not lead to valence increases. Hence, managers might influence explicit, self-reported, and more conscious emotional states by fostering the opportunity to explore and succeed, whereas implicit emotional states might not change as a result of such efforts.

## LIMITATIONS AND FUTURE RESEARCH

One issue that could be studied further is what would happen if the experiment had lasted for more trials. It would be interesting to examine whether the results obtained would persist for longer time periods. A second issue that would benefit from future research would be to vary properties of the routines to which participants are exposed and have opportunities to adopt. An interesting factor to investigate would be the uncertainty characterizing the performance benefits of the routines and how that affected the adoption decision.

Another issue would be to manipulate arousal as well as valence. Although our manipulation was successful in affecting the experience of valence, the manipulation did not appear to affect participants' arousal. One reason could be that our experimenters' displays of high or low arousal, even if their behavioral expressions were plausible, may have been deemed inappropriate, and therefore paid less attention to by our participants (see Barsade, 2001, for a similar discussion). Alternatively, whether valence and arousal are indeed independent dimensions and therefore dissociable is a long standing debate in the literature (see e.g., Kron, Goldstein, Lee, Gardhouse, Anderson, 2013; Lang, Greenwald, Bradley, Hamm, 1993; Watson and Tellegen, 1985; Russell, 1980).

Further research should be conducted using field methods to determine the generalizability of our results to other contexts. Although the laboratory method we used has many advantages, it raises issues of external validity. We attempted to mitigate this concern by using manipulations, such as our manipulation of emotion, which one might find in the field. The concern about external validity is also mitigated by results of studies comparing outcomes from the laboratory and field. Anderson, Lindsay and Bushman (1999) reviewed meta analyses that examined whether results from the laboratory and field differed, and determined that results across the two methods were very similar. Although these comparisons suggest that our findings are likely generalizable to the field, field studies would be valuable in establishing the generalizability of the results and identifying boundary conditions under which they occur.

Finally, it has recently been argued (e.g. Barsade *et al.*, 2009) that research has failed to properly illuminate the influence of implicit processes, including implicit affective processes in management research. Our paper represents one way to capture such implicit emotional states. More research is needed on the measurement of these implicit emotional states (e.g., methods to standardize psychophysiological data or to explore the results with data that are not individually scaled). Because psychophysiological data by nature are an ongoing time series, it would also be interesting to capture the dynamic effects of ongoing interpersonal emotions and their potential influence on strategic decisions. Finally, it would be interesting to better understand the relationship between implicit and explicit emotions as well as the predictors of each. We hope our research leads to additional study of these important issues.

**IMPLICATIONS**

Our study complements existing research by demonstrating how emotions are created and influence team decisions to explore or exploit. Our results are of practical importance for managers of teams because they provide insights into the dynamics of creating positive emotions as well as their influence on team decisions. In contrast to previous work that studied established teams, teams in our experiment were newly formed. Thus, our findings are especially relevant for newly created teams, such as entrepreneurial ventures.

Our results showed that while productivity gains were achievable from both exploration and exploitation decisions, teams that experienced the highest productivity gains were those teams that had experienced a performance decline in the period prior to adoption as well as successfully adopted the new routine. These teams were also the teams that experienced self-reported valence increases. Teams that had increased their performance based on exploitation benefits did not adopt the routine, and also did not experience self-reported valence increases. Similarly, teams that adopted the new routine, but were unsuccessful at its implementation, did not experience self-reported valence increases either.

Additionally, our results suggest that there was a subtle effect of early stage emotions on adoption decisions, even if adoption decisions were dominated by performance relative to aspirations. This was the case for both explicit, self-report, and implicit, psychophysiological measures of team emotions. This suggests that managers should also be aware of early stage emotional states, as these can influence exploration decisions at later stages.

Our results illustrate the costs of being a fast learner. Researchers have theorized that fast learning can lead to specializing in a suboptimal strategy and to poorer performance over the long run (Herriot, Levinthal, and March, 1985; Levinthal and March, 1985; March, 1991). The fast learners in our study whose performance improved from the second to the third trial did not explore and adopt the new routine. The performance of these teams that exploited the original routine throughout the experiment (teams in the upper left quadrant in Figure 3) was lower in trial five than the performance of teams that adopted the new routine in trial 4 and gained experience with it (teams in the lower right quadrant of Figure 3). Our results also illustrate that the benefits of exploration are uncertain. Teams in the diagonal quadrants did not experience performance benefits from adopting the new routine. Thus, our study provides empirical evidence of the long-run costs of being a fast learner.

Our study adds to the strategic management literature by showing how managers can foster exploration. Our results suggest that projecting positive emotions can have a subtle effect on team exploration. A more powerful way for managers to foster exploration is to provide teams opportunities to explore a new routine and resources to use the routine successfully. Once a new routine has been successfully implemented, positive emotions at the team level ensue. Because emotional management is a key factor in strategic change and implementation (Huy, 2002), our findings add important insights for strategic management in terms of how to manage emotions. Our findings also provide important insights into how to foster exploration and improve performance.

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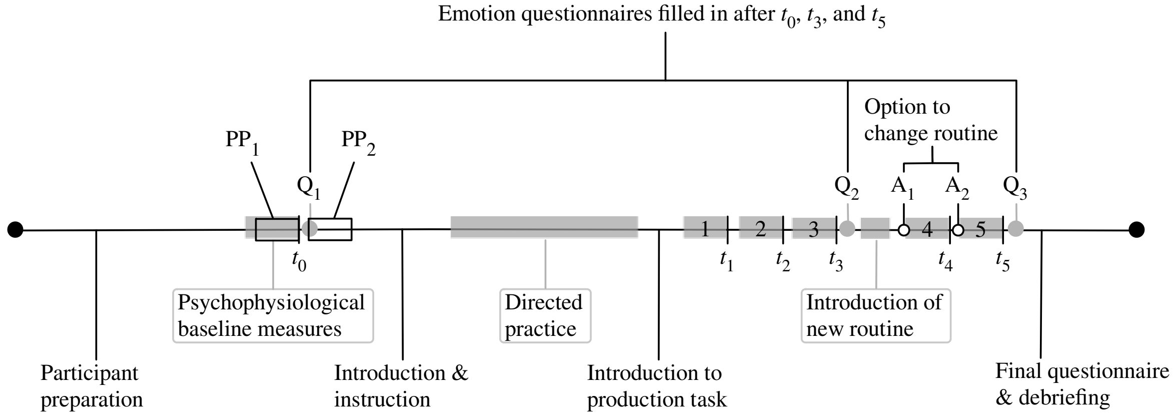


**Figure 1**. **Time line of the experiment**

Time line of the experiment from the initial meeting of the experimenter with the participants until the participants leave (shown as solid black dots at each end of the time line). The time line is divided into segments that represent the phases in the experiment. The gray segments represent phases where we have information about the time at which each phase starts and ends. The five 4-minute trials are the gray segments labeled 1–5. The intervals between the gray segments are phases of preparation, instruction, pauses between trials, and debriefing. The emotion questionnaires $Q_1$, $Q_2$, and $Q_3$ are filled in immediately after times $t_0$, $t_3$, and $t_5$ respectively. For the psychophysiological data, we report data from during the baseline $PP_1$, immediately after the baseline ($PP_2$) and from during the 5 trials ($t_1$, $t_2$, $t_3$, $t_4$, and $t_5$).

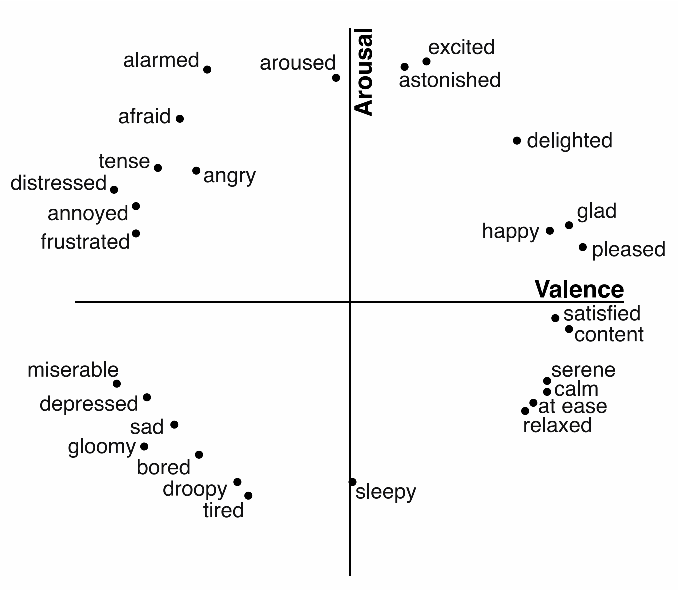


**Figure 2. Russell's circumplex**

Russell's results from multidimensional scaling (Russell, 1980, p. 1168). This MDS solution is derived from judged dissimilarities of pairs of emotion terms, and thus represents how similar subjects rate the concepts. Accordingly, it is termed the semantic circumplex model of affect. Russell obtained different, but similar, configurations based on self-report.

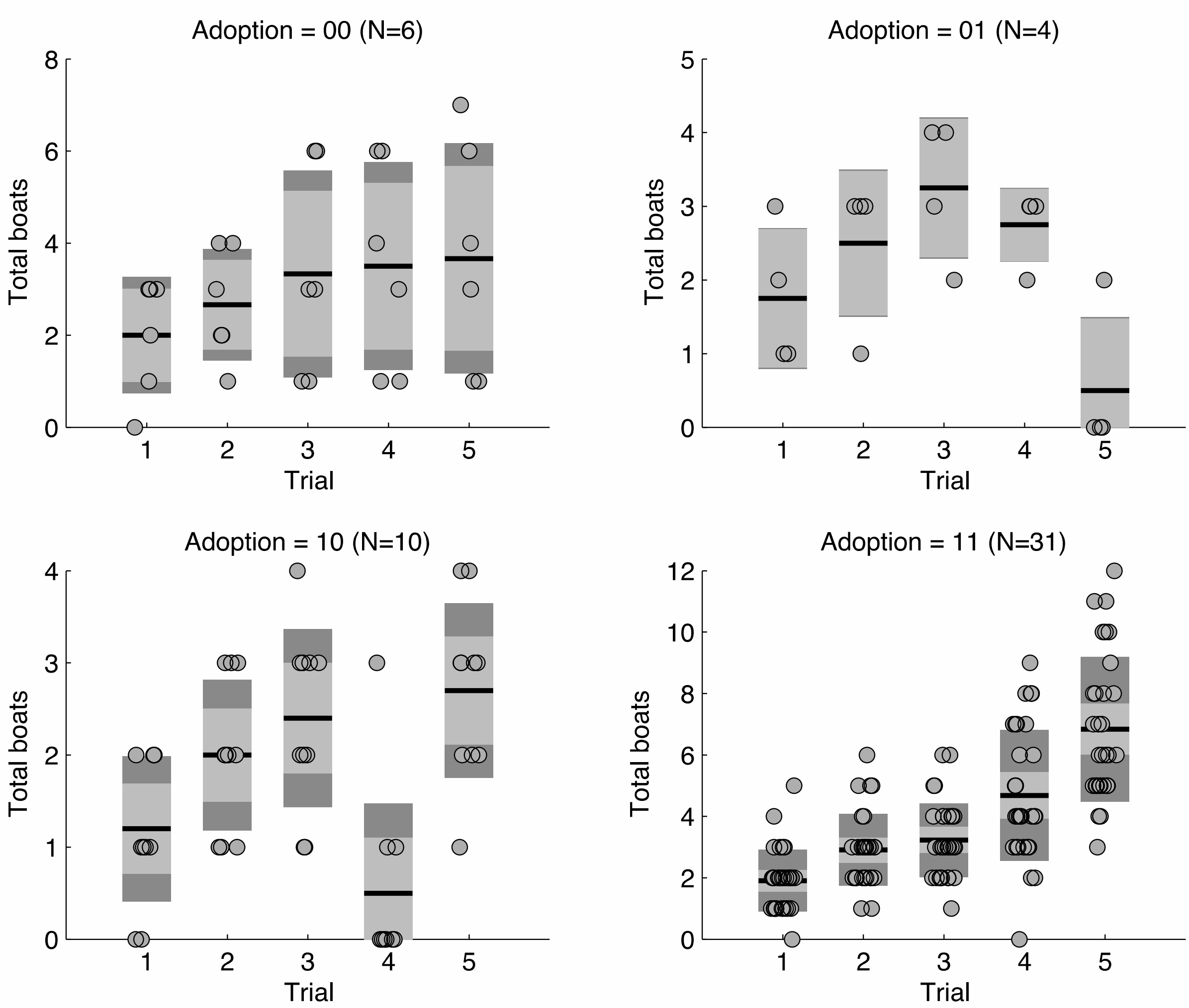


**Figure 3: Performance relative to adoption decisions**

The Figure illustrates how performance (measured by total boats) developed over time for teams within each of the four adoption profiles (00, 01, 10, 11). For each of the five trials each individual group's performance is shown as a solid circle. The mean is shown as a horizontal black line; the 95 percent confidence interval of the mean is indicated by the light gray area; and the standard deviation is indicated by the dark gray area. Notice that the plots have different vertical scales.

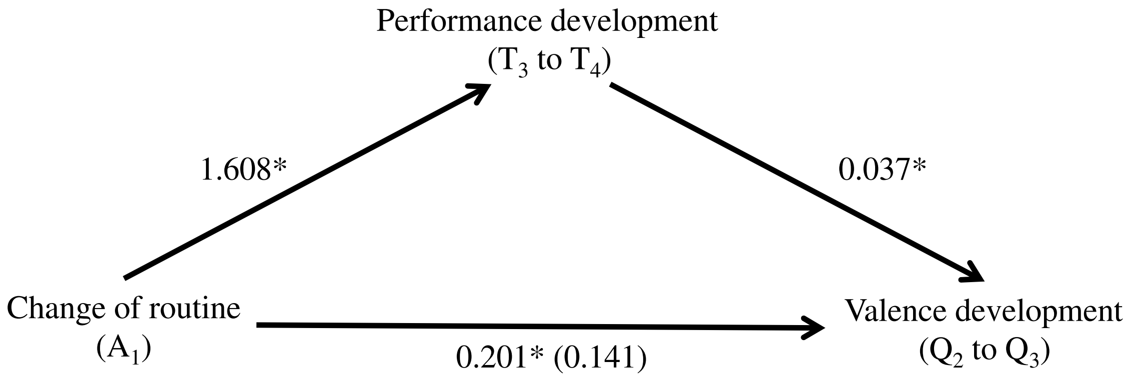


**Figure 4. Results of the mediation analysis**

* $p < 0.05$

**Table 1. The effect of emotional inducement on valence and arousal**

| | Positively induced | | Negatively induced | | F-test | Significance |
|---|---|---|---|---|---|---|
| | Mean | Std.dev. | Mean | Std.dev. | | |
| Valence $Q_1$ | 0.920 | 0.191 | 0.773 | 0.232 | 6.117 | .017 |
| Arousal $Q_1$ | -0.575 | 0.271 | -0.663 | 0.241 | 1.511 | .225 |
| Valence $Q_2$ | 0.955 | 0.198 | 0.827 | 0.186 | 5.680 | .021 |
| Arousal $Q_2$ | -0.053 | 0.370 | 0.006 | 0.402 | 0.296 | .589 |
| Valence $Q_3$ | 1.048 | 0.197 | 0.904 | 0.266 | 4.895 | .032 |
| Arousal $Q_3$ | -0.094 | 0.394 | -0.154 | 0.378 | 0.300 | .586 |

**Table 2. The effect of performance development on the willingness to adopt a routine**

| | Adoption $A_1$ (1 or 0) | Adoption $A_2$ (01 or 10) |
|---|---|---|
| Constant | 2.481 | -2.050 |
| Performance change from trial 2 to trial 3 | -1.462** (S.E. 0.562) | |
| Performance change from trial 3 to trial 4 | | -2.672** (S.E. 0.913) |
| Nagelkerke $R^2$ | 0.293 | 0.751 |

* $p < 0.05$

** $p < 0.01$

**Table 3. The relationship between adoption of a routine (A1), performance development, and emotions**

| | Performance change from trial 3 to trial 4 | Valence change from the period immediately following trial 3 ($Q_2$) to the period immediately following trial 5 ($Q_3$) | Valence change from the period immediately following trial 3 ($Q_2$) to the period immediately following trial 5 ($Q_3$) | Valence change from the period immediately following trial 3 ($Q_2$) to the period immediately following trial 5 ($Q_3$) |
|---|---|---|---|---|
| Constant | -0.620 | -0.076 | 0.055 | -0.053 |
| Adoption of a routine in trial 4 ($A_1$) | 1.608* (S.E.=0.712) | 0.201* (S.E.=0.081) | | 0.141 (S.E.=0.081) |
| Performance change from trial 3 to trial 4 | | | 0.045** (S.E.=0.015) | 0.037* (S.E.=0.015) |
| $R^2$ | 0.094 | 0.113 | 0.156 | 0.207 |

* $p < 0.05$

** $p < 0.01$