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Disentangling Emotional and Cognitive Factors of Escalation of Commitment: Evidence for a Psychophysiological Link

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DISENTANGLING EMOTIONAL AND COGNITIVE FACTORS OF ESCALATION OF COMMITMENT: EVIDENCE FOR A PSYCHOPHYSIOLOGICAL LINK

Research Paper

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Abstract

Escalation of commitment - the tendency to persist with failing courses of action - can determine whether a distressed Information Systems (IS) project can be turned around. To disentangle the emotional and cognitive factors that give rise to escalation we conducted a between-subject randomized controlled laboratory experiment with 75 Master, MBA, and Ph.D. students, including data triangulation between neurophysiological and behavioral measures. This study successfully replicates the bias in the context of IS project distress, provides evidence for a psychophysiological link, supports the predictions on the role of negative and complex emotional states of self-justification theory over coping theory, and adds to a better understanding of how escalation tendency changes over time due to learning effects. Our findings contribute to enhancing decision-making in uncertain environments by using cognitive and emotional markers and thereby provide the foundation for developing neuro-adaptive de-escalation strategies.

Keywords: *Escalation of Commitment, IS Project Distress, Emotion, Cognition, Neuro IS.*

1 Introduction

Escalation of commitment - the failure to withdraw from losing courses of action - is a major challenge in Information Systems (IS) projects that can determine whether a distressed project can be turned around (Staw, 1976; Marx and Uebernickel, 2022). IS projects play a crucial role in shaping organizations' strategic directions and helping them to gain and sustain a competitive advantage (Baghizadeh, Cecez-Kecmanovic and Schlagwein, 2020). Still, they are observed to fail at exceptionally high rates, run over budget, and frequently extend past schedules (Keil and Mähring, 2010; Doherty, Ashurst and Peppard, 2012). Due to the generativity of digital artifacts, and the high level of ambiguity and complexity during IS design, development, and use, IS projects in a state of distress are particularly prone to escalation of commitment (Marx and Uebernickel, 2022). Thus, understanding what gives rise to escalation of commitment - a phenomenon that can determine whether IS project distress turns into failure is of utmost academic and practical relevance.

Several theories have been proposed to explain escalation of commitment. However, they mainly concentrate on the cognitive processes of decision-makers (Arkes and Blumer, 1985; Brockner, 1992). Comparatively, despite the powerful influence of emotions on decision-making (Walsh, 1995; Bazerman, Tenbrunsel and Wade-Benzoni, 1998; Fineman, 2000), the role of emotions in escalation situations has received limited academic attention (Loewenstein and Lerner, 2003; Huang, Souitaris and Barsade, 2019; Sarangee, Schmidt and Calantone, 2019). We argue that while the examination of emotions is much needed to advance our understanding of escalation of commitment in the context of IS project distress, the role of emotions in understanding escalation of commitment still requires further investigation for the following reasons:

First, competing theories and empirical research exist with conflicting results regarding the effect direction of negative emotions. On the one hand, coping theory predicts that people who experience negative emotions are less likely to escalate because they withdraw entirely to avoid an unpleasant situation (Endler and Parker, 1990). On the other hand, self-justification theory argues that negative emotions resulting from belief-behavior discrepancy prevent people from performing against their prior beliefs, hence enforcing escalation tendencies (Pepitone and Festinger, 1959; Brockner, 1992). For both conflicting theories, empirical support exists. For instance, one of the first studies investigating the role of emotion in escalation situations found that negative affect reduced escalation of commitment when being personally responsible for the failing decision, hence supporting coping theory (Wong, Yik and Kwong, 2006). In contrast, Roeth, Spieth, and Joachim (2020) report empirical evidence for a positive effect of negative affect on escalation of commitment, which supports self-justification theory. Second, in the past, most studies took a valence-based approach when considering the influence of affect on decision-making (Wong, Yik and Kwong, 2006), which emphasized that "the only relevant aspect of emotion is their valence" (Elster, 1998, p. 64). However, the valence-based approach has been criticized for "sacrific[ing] specificity in the service of parsimony" (Lerner and Keltner, 2000, p. 475). Therefore, examining more than negative affect by looking at concepts like emotional complexity and the role of discrete emotions yields potential. Third, the majority of studies investigating the role of emotions in understanding escalation of commitment rely on self-reported measures without making use of neurophysiological measures and the advancements of Neuro-IS tools (Riedl et al., 2020). And fourth, most existing research examines emotional factors separately from cognitive factors without acknowledging the reciprocal relationship between cognition and affect (Kret and Bocanegra, 2016).

To address these shortcomings and opportunities, we examined the *influence of emotion and cognition on escalation of commitment in the context of IS project distress* using a between-subject randomized controlled laboratory experiment including data triangulation between physiological (electrodermal activity, electrocardiogram, facial expression analysis) and behavioral measures (decision-making simulation in the form of a vignette experiment). This procedure allowed us to disentangle the complex effects of negative emotions, emotional complexity, and discrete emotional states as emotional determinants and cognitive flexibility and learning as cognitive determinants of escalation of commitment simultaneously. In the context of IS project distress and failure, a better understanding of the psychological phenomenon that can determine whether distress turns into failure may generate more effective strategies for reducing destructive personal and organizational consequences.

The remainder of this study is organized as follows: First, we summarize the relevant theory and existing research and introduce the developed hypotheses. Second, the methodological procedure is given, followed by the empirical analysis. We conclude by discussing our results and implications for theory and practice.

2 Theoretical Background and Hypotheses Development

2.1 Escalation of Commitment in the Context of IS Project Distress

All too often, decision-makers are reluctant to change courses of action, even when abundant evidence points towards the dysfunctionality of that exceeded persistence. Instead, they commit to those failing courses of action (Staw, 1976; Staw and Ross, 1987). Escalation situations include continuation during decision-making in the face of negative feedback about prior resource allocations, uncertainty surrounding the likelihood of goal attainment, and a real choice scenario (Barton, Duchon and Dunegan, 1989; Staw, 1997). In a recent literature review, Marx and Uebernickel (2022) suggested that IS development projects are particularly prone to states of distress and that the behavioral, mental, emotional, and structural dimensions of escalation of commitment fundamentally determine whether decision-makers can rescue a distressed IS project from turning into a failure.

Feeling personally responsible for the initial path of action or decision is regarded as the most robust determinant of escalating behavior (Arkes and Blumer, 1985; Sleesman et al., 2012). Once people establish that feeling of personal responsibility, they are more likely to ignore negative feedback

(Sleesman et al., 2012). Hence, high personal responsibility for the initial course of action should increase the probability to escalate commitment to a failing course of action. Following standard procedures in experimental escalation of commitment research where personal responsibility is manipulated to evoke the general bias (Wong, Yik and Kwong, 2006; Jackson et al., 2018), we regard high personal responsibility as a significant determinant triggering escalating behavior. *H1: People who are personally responsible for initiating the project are more likely to escalate their commitment than people who are not personally responsible.*

2.2 Disentangling Cognitive Factors of Escalation of Commitment

Cognition involves the mental processing that uses, changes, enacts, recalls, stores, senses, and transforms knowledge in a dynamic, recursive manner (Brymer, Hitt and Schijven, 2011). Cognitive theories assume that factors, such as thoughts, beliefs, and emotions, are fundamentally present during decision-making in general and the design, development, and use of IS in particular (Russell et al., 2020). Within the process of thinking, a person becomes aware of stimuli, recognizes their significance, and evaluates possible behavioral responses. We aim to explore the effects of two cognitive factors that hold the potential to determine escalating tendencies: Learning and cognitive flexibility. Both factors are particularly relevant in the context of project escalation as their investigation could solve paradoxes: Being aware of one's dysfunctional behavior and learning adaptively based on the negative feedback that is received repeatedly have could function as cognitive mechanisms counteracting escalation tendencies. Still, decision-makers escalate their commitment despite learning and being aware of their dysfunctional behavior (Betsch et al., 2001; Wong and Kwong, 2018). By investigating the effects of adaptive learning on the decision strategy level and differences in individual cognitive flexibility simultaneously with the presented emotional factors we propose solutions for those paradoxes and strengthen the insights gained from testing coping against self-justification theory.

Learning: When making several decisions over time and receiving negative feedback in the form of decision consequences, learning is inevitable. According to the law of effect, decision-makers should withdraw. Solving the paradox of escalation despite learning, Wong and Kwong (2018) showed that while on the individual decision level, adaptive learning increases the awareness about negative consequences related to persistence and thereby counteracts escalation, on the decision strategy level, escalating behavior is consistent with the law of effect. Hence, when facing multiple decisions over time, escalation of commitment should dominate the overall decision strategy, while when looking at the single decisions forming this strategy, escalation tendencies should decrease over time. Recent experimental studies on sequential decision-making support this view indicating a general decline in escalation of commitment over time (Roeth, Spieth and Joachim, 2020). Therefore, in addition to replicating the general escalation of commitment bias, we pose the following hypothesis regarding the effect of learning. *H2: Escalation of commitment decreases over multiple decisions.*

Cognitive flexibility: Cognitive flexibility is the ability to switch cognitive sets to adapt to changing environmental stimuli (Dennis and Vander Wal, 2010). Even when decision-makers are aware that their behavioral pattern is dysfunctional, the potential for change is limited if they fail to adjust their cognitive processing (Betsch et al., 2001; Dane, 2010). Cognitive flexibility should help overcome escalation of commitment by allowing decision-makers to adjust their processing mode to different situations (Rothman and Melwani, 2017; Laureiro-Martínez and Brusoni, 2018). Hence, we hypothesize the following: *H3: People with high cognitive flexibility are less likely to escalate their commitment than those with low cognitive flexibility.*

2.3 Disentangling Emotional Factors of Escalation of Commitment

While the most escalation of commitment literature has focused on cognitive elements only, we argue that a more complete picture is needed. The key to such a picture lies in "illuminating the ways the individuals and groups […] are governed by thoughts and feelings: always boundedly rational, but manifestly driven by emotion" (Hodgkinson and Healey, 2011, p. 1512). Emotions and their interplay with cognition play a crucial role in decision-making and should ideally be investigated simultaneously

(Russell et al., 2020). Cognition drives emotion, emotion drives cognition, and both impact attitudes and behavior (Kret and Bocanegra, 2016; Healey and Hodgkinson, 2017). Hence, the relationship between cognition and emotional states is best characterized as reciprocal. Ekman and Cordaro (2011, p. 364) define emotions as "discrete, automatic responses to universally shared, culture-specific and individual-specific events". Emotional states like anger, fear, or sadness are a "function of the interaction of cognitive factors with a state of physiological arousal" (Schachter, 1964, p.49). Following the circumplex model of affect, arousal and valence are frequently used as the main axes for determining emotions (Tellegen, Watson and Clark, 1999). In the following, we outline the potential effect patterns from two competing perspectives: coping theory and self-justification theory, each predicting a distinct relational pattern between emotional states and escalation of commitment.

On the one hand, coping theory relates to avoidance mechanisms and predicts withdrawal strategies in stressful or negative situations. The likelihood of applying an avoidance strategy increases with the strength of a person's negative affect (Endler and Parker, 1990; Wong, Yik and Kwong, 2006). In the presence of negative feedback, which indicates that the prior decision might have been incorrect, escalation situations can be perceived as emotionally unpleasant experiences threatening the self-image of the decision-maker (Baumeister, 1993). Potential adverse emotional reactions as a result of (anticipated) failure reach from decreased psychological well-being (Shepherd and Cardon, 2009) to frustration (Singh, Corner and Pavlovich, 2007). Hence, according to coping theory, negative emotional states would make individuals more uncomfortable, resulting in coping by withdrawing entirely from the negative situation to avoid the stressful and unpleasant experience.

On the other hand, self-justification theory describes the tendency to interpret one's behaviors and beliefs in a way that maintains a good and consistent self-image and is related to the strive to avoid cognitive dissonance (Festinger, 1957). The underlying motive is the mechanism of self-justification (Brockner, 1992), which suggests that negative feedback to previously made decisions would threaten the decision-maker's self, thereby triggering the need to self-justify. Instead of engaging with the possibility of a bad previous decision and its consequences, individuals might de-emphasize the importance of negative feedback or justify past decisions. Cognitive dissonance may lead individuals to experience psychological discomfort (Pepitone and Festinger, 1959), negative affect (Harmon-Jones, 2000), and physiological arousal (Elkin and Leippe, 1986). The unpleasant emotions arising from the inconsistency with one's beliefs or cognition motivate the decision-maker to reduce the dissonance by achieving consistency between past and future decisions and preventing people from performing against their prior beliefs (Harmon-Jones, 2000). By justifying prior actions and further persisting with previously made decisions despite negative feedback, the decision-maker allows herself to escape cognitive dissonance and the negative emotional consequences of admitting failure. Hence, according to self-justification theory, we hypothesize that negative emotional states resulting from negative project feedback increase escalation of commitment. *H4a: People who experience negative emotions are <u>less</u> (coping theory) / <u>more</u> (self-justification theory) likely to escalate their commitment than people who experience less negative emotions.*

Further, being personally responsible for the initial path of action should increase the emotional attachment and consequently alter the threat to the decision-maker's self in the presence of negative feedback. Hence, according to self-justification theory, when being personally responsible, the effect of negative emotions on escalation of commitment should be more substantial. In contrast, when not being responsible, the threat to the decision-maker's self should be minimal, likewise the effect of negative emotional states on escalation tendency. According to coping theory, the combination of high personal responsibility and negative emotions should have the opposite effect: When being responsible for the initial path of action, the adverse emotional reactions resulting from negative project feedback increase the likelihood of coping by withdrawing. *H4b: People who experience negative emotions are <u>less</u> (coping theory) / <u>more</u> (self-justification theory) likely to escalate their commitment when personally responsible for the initial path of action than people who experience less negative emotions.*

Given that emotional states typically involve two or more different affective experiences (Filipowicz, Barsade and Melwani, 2011), we argue that only looking at negative or univariate emotions is too narrow and that emotional complexity - feeling several emotional states at the same time - might be a better

predictor of escalation of commitment. Emotional complexity has been defined as a state involving "the simultaneous or sequential elicitation and experience of at least two different emotions during the same emotional episode" and is likely to be associated with a sense of conflict within the individual experiencing them (Rothman and Melwani, 2017, p.259). While this sense of conflict is expected to mimic the influences on escalating behavior of negative emotions, the capacity for more complex emotional experiences may be functionally related to more resiliency (Ong and Bergeman, 2004) and cognitive flexibility (Rothman and Melwani, 2017). Hence, given that emotional complexity better portrays real-life reactions to negative feedback and the additional evidence that links emotional complexity with factors that should reduce escalating behavior, it is particularly interesting to test whether the predictions of self-justification and coping theory still hold. Along the same lines of argumentation for the assumed effect relationships of negative emotions, we hypothesize that higher emotional complexity would lead to more escalation of commitment according to self-justification theory. In contrast, it would lead to less escalation of commitment according to coping theory. *H5a: People who experience emotional complexity are less (coping theory) / more (self-justification theory) likely to escalate their commitment than people who experience less emotional complexity.*

Feeling personally responsible for the project's performance and its outcome while repeatedly receiving negative feedback evokes strong emotional responses. Personal distance from the project, for instance by not having initiated it, should consequently lessen the emotional attachment and general emotional response when the project is getting out of hand. Given that emotional complexity is linked to a sense of conflict within the experiencing individual (Rothman and Melwani, 2017), it can be seen as an emotional response to high levels of cognitive dissonance. However, with the general emotional response being stronger when feeling attached based on greater inconsistency-triggered psychological discomfort, also the level of emotional complexity should depend on the degree decision-makers feel responsible for the project. Thus, being personally responsible for the initial path of action should lead to stronger emotional complexity in the presence of negative feedback because the general emotional response is expected to be stronger compared to individuals who have not initiated the course of action. In the absence of personal responsibility, however, emotional complexity should be lower. Along the same lines, coping in the form of avoidance withdrawal would not be very useful as the source of emotional complexity is not self-relevant when not being responsible for the initial decision. *H5b: People who experience emotional complexity are less (coping theory) / more (self-justification theory) likely to escalate their commitment when being personally responsible for the initial path of action than people who experience less emotional complexity.*

3 Methodology

During a randomized, controlled laboratory experiment, 75 participants were recruited for an individual, computer-based decision-making simulation in the University of St. Gallen, Switzerland's Behavioral Lab, between January and March 2022.

3.1 Procedure and Sample

Following past research (Eliëns et al., 2018; Sleesman, 2019), we presented our participants with scenarios in the form of vignettes and asked them to make decisions based on the information provided to them. Simultaneously, we measured physiological signals and filmed participants' facial expressions. Including preparation and debriefing, each participant spent, on average, 47 minutes on the experiment. Within the decision-making simulation, participants took the role of a senior manager responsible for deciding about the continuation of an IS development project for the aviation industry. We adopted the decision-making vignettes and the feedback prompts from the "blank radar plane" case originally presented by Arkes and Blumer (1985), which is widely used to study escalation of commitment (Jackson et al., 2018). Participants received background information about the project and feedback on the project's performance at multiple points in time. The feedback was without exception negative, including for instance, the information that a competitor has launched a similar radar system or that the project completion will be significantly delayed due to major technical difficulties. In five sequential

decisions, the participants had to decide whether to "*authorize more funding"* or *"abandon the project"* and, if they decided to continue, how much money they were willing to invest additionally given the predefined budget. To avoid framing and social desirability bias, the question's wording was neutral and identical for each decision round: *"The decision you face now is to either abandon the project or authorize more funding to continue the project. How do you decide?"*

An a priori power analysis using G*Power version 3.1 (Faul et al., 2007) suggested that the required sample size to achieve 95% power for detecting a small effect at a significance criterion of $\alpha = .05$ was N=56 for linear multiple regression analysis. We initially recruited 75 participants using the Sona Systems recruitment platform, as we expected that we would have to exclude participants due to the challenges of physiological measurement. After excluding two participants who failed the attention check and 9 participants because of technical problems during physiological data collection, the final dataset used for analysis consisted of 64 participants. The participants were Master, MBA, or Ph.D. students, 61% were female, the average age was 26 years, and the participants had an average professional experience of 3.5 years. All participants had a degree in a business-related field or were currently enrolled in a business program and had at least two years of professional experience. We further required fluent English or German speaking skills and asked the participants to choose between the experiment's English and German versions. These requirements ensured that the participants could relate to the decision context and increased data quality.

3.2 Variables

Personal responsibility: Each participant was randomly assigned to one of the two responsibility conditions (low, high). In the high personal responsibility condition, participants were asked to initiate the project themselves and to make an initial budget decision within a given range. In the low responsibility condition, the participants did not initiate the project. Participants were told in the first decision round that they were taking over the project from someone else who had initiated it and given it a primary budget. In a manipulation check, participants answered on a seven-point scale how responsible they felt for the previous investment and for starting this project.

Cognitive flexibility: We measured cognitive flexibility as an independent variable using the standardized cognitive flexibility inventory (CFI) (Dennis and Vander Wal, 2010). After completing the decision-making simulation, participants were asked to self-assess their cognitive flexibility along the 20 items using a seven-point Likert scale. We chose this scale over the cognitive flexibility scale (Martin and Rubin, 1995), the personal psychological flexibility index (Kashdan et al., 2020), and the Wisconsin Card Sorting Test (Berg, 1948) as a meta-review by Cherry et al. (2021) indicated that the CFI is the best measure to assess cognitive flexibility in self-assessments. Further, the CFI explicitly measures cognitive flexibility without including overlapping constructs and without evoking cognitive load due to lengthy measurement.

Emotional states: We used a combination of different physiological methods to measure emotional states over time for the following reasons. Firstly, physiological measurement methods offer a possibility to "zoom into" the physiological, potentially unconscious mechanisms that underlie human behavior, which is challenging, if not impossible, to capture with other methods. Further, compared to self-reported data, there is no need for coding, deliberate falsification is excluded, and statements can be made about otherwise hidden underlying decision-making processes and reactions to change. It also eliminates a potential source of error or inaccuracy that cannot be completely ruled out with behavioral data. Moreover, possible confounding effects, such as socially desired behavior or manipulation, can be excluded. Compared to behavioral measures, the physiological measures applied in this study also provide continuous data availability and allow for dynamic stimuli. We measured electrodermal activity (EDA) using galvanic skin response and electric activity from the heart using an electrocardiogram (ECG). EDA measurement and the ECG were simultaneously conducted using the COBALT Bluebox, which is based on the BITalino hardware reference (Courtemanche et al., 2022a). For this, participants had electrodes attached to their non-dominant hands, chests, and rips while conducting the computer-based experiment in the laboratory. The COBALT Bluebox is part of the COBALT ecosystem, a set of

psychophysiological instruments and analysis software designed and developed by the HEC Montréal Tech3Lab and the UX Chair (Léger et al., 2021). Participants were filmed during the experiment to enrich the physiological data sources with intensities of discrete emotions. We applied facial expression analysis using the artificial intelligence (AI)-based facial coding software FaceReader™ Version 9 (Noldus Information Technology BV, Wageningen, Netherlands). After the face is detected by the software, an artificial face model is created describing 468 key points in the face and a trained deep artificial neural network classifies the changes into basic emotions (Ekman and Cordaro, 2011). Besides the intensities of individual facial expressions and their classification, the software calculates overall valence using the intensities of discrete positive and negative emotions and arousal levels based on the activation of 20 *Action Units* of the *Facial Action Coding System* (Ekman, Friesen and Hager, 2002). FaceReader™'s deep artificial neural network technology has proven to be a reliable indicator of basic emotions (Lewinski, den Uyl and Butler, 2014) and is used in various emotion research (Chentsova-Dutton and Tsai, 2010). Using the cloud-based data processing and analysis platform COBALT Photobooth we integrated the physiological data sources with the analysis results from the facial expression software and the behavioral data in the form of the participant's decisions and screen recordings. As a result of the data triangulation, we retrieved a nuanced, highly sensitive, and milliseconds-based journey of the participants' emotional states, including valence and arousal levels and intensities for seven discrete emotional states over time. A time-stamped screen recording using COBALT Capture (Courtemanche et al., 2022b) allowed us to dynamically code the changes according to the natural decision-making habits of the participants without them being restricted to time limits or pre-defined clicking paths. We aggregated negative emotions using the harmonic mean of feeling sad, angry, disgusted, frustrated, or any combination of those emotions weighted by simultaneous arousal as a measure of intensity. We also used the harmonic mean and a weighting factor of arousal for calculating the emotional complexity score but included only those combinations of emotions that contain conflicting potential (e.g., feeling angry and happy simultaneously).

Escalation of commitment: Most existing measures of escalation of commitment use a single decision or investment to measure participants' commitment and treat it as a dummy variable (Huang, Souitaris and Barsade, 2019). However, concerns about the simplicity of such an operationalization, especially in the context of sequential decision-making, have been raised (Bateman, 1986). To address those problems, we propose a more elaborate calculation that acknowledges the multi-step decision design, the complex and continuous nature of the phenomenon, and the understanding of escalation of commitment as being formed by both the decision (continue funding) and the judgment (proportion invested). The core underlying assumption we apply for this is that people can differ in how much they escalate their commitment to a failing course of action. In line with this continuity assumption and our conceptualization, we developed a formula and included not only whether the participant withdrew or continued the project but also acknowledged the number of decision rounds that the participant decided to persist with the failing course of action and the total amount of additional money invested in the project relative to the average and the maximum. The escalation of commitment score thereby captures the overall escalation tendency in sequential decisions. It allows for comparisons between participants withdrawing at different points in time and differing in the extent to exceed budget overall and per decision. The score was calculated for each participant based on the following formula and has been rescaled between 0 (no escalation tendency) and 1 (maximum escalation tendency).

$$Escalation\ of\ commitment = \frac{m}{M} \cdot \frac{d}{D} \cdot \frac{S}{32} \cdot f_d$$

d refers to the decision score measured by the decision round in which the participant decided to withdraw from the project ranging from 0 to 4 with 4 indicating no abandonment of the project in any round. *D* refers to the average decision score over all participants. *m* is the rescaled mean of the budget proportions over all decisions for a participant. *M* refers to the mean of *m* over all participants. *f* is the Pearson correlation coefficient between *d* and the sum of the invested budget (S). The maximum budget a participant could invest throughout the simulation equals $32 million.

Control variables: We further included age and gender as part of a demographic questionnaire at the end of the decision-making simulation as those variables have been shown to affect escalation tendencies in past research and consequently should be controlled for in the regression (Sleesman et al., 2018).

3.3 Analysis

The analysis following data gathering can be grouped into two phases: Data processing, including data triangulation and emotional decoding, and the statistical analysis phase.

The initial step of the processing phase was to decode the raw data from the ECG and EDA measurements and the videos of the participants into arousal and valence levels over time. Additionally to the physiological data measured with the COBALT Bluebox, we generated arousal, valence, and intensity levels for a set of seven basic emotions (angry, disgusted, happy, neutral, sad, scared, surprised) by processing the participant videos using the FaceReader™ software. Based on the screen recordings we created labels for key events in the decision-making journey for each participant by decision round (e.g. baseline measurement, receiving negative feedback, decision-making, reflection) in COBALT Capture. All data sources were then merged and synchronized using COBALT Photobooth. After merging the data sources, valence and arousal values were rescaled for later analysis and adjusted according to the baseline measurements. We further excluded outliers and incomplete measurements based on predefined criteria and created the aggregated variables of *negative emotions* and *emotional complexity*. The last part of the processing phase was the creation of individual emotional journey maps mapped to the dynamically labeled events in the decision simulation and grouped by the level of responsibility and behavioral escalation tendency.

The second phase (statistical analysis) consisted of two main steps: First, to replicate the escalation effect and investigate behavioral changes over time, we used a Mann-Whitney test comparing the low and high personal responsibility groups, and the ordinary least squares (OLS) method for linear regression to analyze changes over time in the probability of persisting and the relative investment per decision. Second, we applied moderated multiple regression analysis (Aguinis and Gottfredson, 2010) using OLS regression equations for testing the hypotheses about the role of cognitive and emotional factors including the aggregated and non-aggregated values for emotional and cognitive factors.

4 Results

We defined a significance criterion of $\alpha = .05$ for testing the hypotheses. A Mann-Whitney Test indicated that the responsibility manipulation was successful: Perceived personal responsibility was significantly higher for decision-makers who initiated the project (Mdn = 6) than for decision-makers who were told to take over the already initiated project from someone else (Mdn = 3), $U=9.2905$, $p < .001$. Being personally responsible for the initial decision and escalation of commitment was positively correlated, $r(62) = .36$, $p = .004$ (Pearson correlation). We compared the median escalation of commitment level of the two independent groups (low personal responsibility and high personal responsibility) using a Mann-Whitney Test. The test showed that the tendency to escalate was significantly higher for decision-makers who were personally responsible for the project initiation (Mdn = .388) than for decision-makers who were not personally responsible (Mdn = .147), $U = 740.5$, $p = .001$. *Hence, Hypothesis 1 was supported.*

To test whether escalation of commitment decreases over multiple decisions, we examined the effect of time in two ways. First, considering all participants, we looked at the probability of persisting for each decision round and analyzed changes over time. Second, considering only those participants that decided to persist in the specific decision round, we analyzed differences over time in the average investment proportions per decision to also capture the extent of escalation. While the average probability of escalating commitment was 89.04 % in the first decision, it continuously decreased to a probability of 32.88 % to further persist with the failing course of action in the fourth decision round. This declining effect is also visible when looking at the responsibility conditions separately. Also when considering the extent of escalation by looking at the relative investment per decision compared to the maximum investment and under consideration of the given range the participant could operate in, we see a decline

of escalation tendency over time, except for the fourth decision, where there is a slight increase in the relative investment proportion. Using the OLS method for linear regression, the best fit indicates a linear decline with a negative coefficient, β = -5.701, SD = .721, p =.001. *Hence, Hypothesis 2 was supported.*

As a foundation for testing the hypotheses regarding the role of emotions, we created emotional journey maps for every participant where we could analyze the changes in discrete emotional states over time before losing information by aggregating them into negative emotions and emotional complexity and into event markers. We randomly selected one participant from each escalation of commitment score quartile for in-depth visual analysis and compared their emotional journey maps. The journey maps showed patterns of decline in surprise before de-escalation and generally higher relative values of surprise over other emotions, especially for participants with lower escalation of commitment scores. Further, the visual analysis indicated a dominance of negative over positive emotions regardless of the escalation of commitment score and peaks in anger and sadness at the beginning of the decision phases. For further analysis, we only incorporated the events labeled as the actual decision-making phase, excluding the following reflection part where participants additionally answered questions about their confidence level and motives, baseline measurements, and the post-simulation surveys about cognitive flexibility and demographics.

As we argued for a theoretical model where cognitive and emotional factors should be considered simultaneously, we applied moderated multiple regression analysis (Aguinis and Gottfredson, 2010) using OLS regression equations to test Hypothesis 3 to 5b. We included the control variables age and gender in all models as their inclusion led to a higher predicted variance in the dependent variable. All variables, including escalation of commitment, were standardized to a level between 0 and 1 for easier interpretation and comparability of coefficients.

	Dependent Variable: Escalation of Commitment		
	Model 1	**Model 2**	**Model 3**
Age	0.013**	0.012**	0.012**
Gender (female = 0, male = 1)	-0.082*	-0.079	-0.082*
Personal Responsibility (No = 0, Yes = 1)	0.117**	0.073	0.043
Cognitive Flexibility	-0.060	-0.064	-0.066
Negative Emotions	0.345***	0.304**	0.374***
Emotional Complexity	0.444***	0.450***	0.348**
Negative Emotions X Personal Responsibility		0.120	
Emotional Complexity X Personal Responsibility			0.171
Constant	-0.326**	-0.304*	-0.280*
Observations	64	64	64
R^2	0.482	0.485	0.490
Adjusted R^2	0.428	0.420	0.426
Residual Std. Error	0.172 (df=57)	0.173 (df=56)	0.172 (df=56)
F Statistic	8.852*** (df=6; 57)	7.522*** (df=7; 56)	7.692*** (df=7; 56)
*Note: *p<0.1; **p<0.05; ***p<0.01*			

Table 1. Standardized beta coefficients of the moderated multiple regression analysis.

To test the main effects of cognitive flexibility, negative emotions, and emotional complexity on escalation of commitment when controlling for personal responsibility, age, and gender, a multiple regression model was calculated using OLS equations (Model 1). A significant regression equation was found ($F(6,57) = 8.852$, $p < .001$), with a R^2 of .482. To test the unique contribution of the interaction effects of negative emotions and emotional complexity with personal responsibility for predicting escalation of commitment, we added them separately to Model 1 and calculated the changes in adjusted R^2 using F-statistics. The procedure followed the best-practice recommendations for estimating interaction effects by Aguinis and Gottfredson (2010). We created Model 2, which included the interaction between personal responsibility and negative emotions. A significant regression equation was found ($F(7,56) = 7.522$, $p < .001$), with an increased R^2 of .485. In the last step, we created Model 3, which additionally included the interaction between personal responsibility and emotional

complexity. A significant regression equation was found ($F(7,56) = 7.692$, $p < .001$), with an increased R^2 of .490. In the following, we will present the results of the moderated multiple regression analysis.

Cognitive flexibility did not significantly predict escalation of commitment when controlling for all other factors included in Model 1, $\beta = -.060$, SE = .109, $p = .586$. *Hence, we rejected Hypothesis 3.*

Controlling for all other factors included in Model 1, we found a significant positive effect of negative emotions, $\beta = .345$, SE = .120, $p = .006$ on escalation of commitment. *Hence, Hypothesis 4a was supported.* While the main effect of negative emotions remained significant in Model 2 compared to Model 1 ($\beta = .304$, SE = .147, $p = .043$), the interaction effect of negative emotions and personal responsibility did not significantly predict the changes in escalation of commitment when controlling for all other factors in Model 2 ($\beta = .120$, SE = .242, $p = .622$). Adding the interaction term in Model 2 did not contribute a significant proportion of the accounted variance, $\Delta R^2 = .003$, $p = .621$. *Hence, we rejected Hypothesis 4b.*

Controlling for all other factors in Model 1, we further found a significant positive effect of emotional complexity, $\beta = .444$, SE = .097, $p < .001$ on escalation of commitment. *Hence, Hypothesis 5a was supported.* The standardized coefficients of the combined model (emotional complexity = .444, negative emotions = .345) and the significant change in R^2 when only adding emotional complexity ($\Delta R^2 = .190$, $p < .001$) showed that emotional complexity contributes a higher proportion of the accounted variance in escalation of commitment than negative affect. The main effect of emotional complexity also remained significant in Model 3 ($\beta = .348$, SE = .142, $p = .017$). However, the interaction effect of emotional complexity and personal responsibility did not significantly predict the changes in escalation of commitment when controlling for all other factors in this model ($\beta = .171$, SE = .184, $p = .357$). Similar to Model 2, adding the interaction term in Model 3 did not contribute a significant proportion of the accounted variance, $\Delta R^2 = .008$, $p = .357$. *Hence, we rejected Hypothesis 5b.*

Main Bias	**Personal Responsibility**	**H1:** People who are personally responsible for initiating the project are more likely to escalate their commitment than people who are not personally responsible.	**Supported**
Cognitive Determinants	**Learning**	**H2:** Escalation of commitment decreases over multiple decisions.	**Supported**
	Cognitive Flexibility	**H3:** People with high cognitive flexibility are less likely to escalate their commitment than those with low cognitive flexibility.	Rejected
Emotional Determinants	**Negative Emotions**	**H4a:** People who experience negative emotions are more* likely to escalate their commitment than people who experience less negative emotions.	**Supported**
		H4b: People who experience negative emotions are less / more likely to escalate their commitment when personally responsible for the initial path of action than people who experience less negative emotions.	Rejected
	Emotional Complexity	**H5a:** People who experience emotional complexity are more* likely to escalate their commitment than people who experience less emotional complexity.	**Supported**
		H5b: People who experience emotional complexity are less / more likely to escalate their commitment when being personally responsible for the initial path of action than people who experience less emotional complexity.	Rejected

** In alignment with self-justification theory.*

Table 2. Overview of supported and rejected hypotheses.

As described in the methodology section, we consider escalation of commitment as the overall tendency to persist with the failing project across all four decision points in the sequential decision-making scenario. Hence, an interaction effect may remain undetected as it only occurs in one (most likely in the first) decision round. To exclude this possibility and increase robustness, we repeated the moderated multiple regression analysis for each decision using two different dependent variables and the decision-specific values for negative emotions and emotional complexity. First, we included the binary decision of whether or not to continue as the dependent variables. In the second step, we repeated the procedure using the relative proportion invested for each decision. In both cases, the results mimic the findings from our initial analysis. We could not find significant interaction effects or significant increases in R^2 when adding the interaction terms, with one exception. In the third decision, when using the binary decision of whether or not to continue as the dependent variable, we found a significant positive interaction effect between personal responsibility and emotional complexity ($\beta = .380$, SE = .174, $p =$

.033). However, adding the interaction term did not contribute a significant proportion of the accounted variance, $\Delta R^2 = .025$, $p = .130$. Further, we could not find any significant interactions for the fourth decision. Consequently, a possible effect of time, suggesting that only later decisions show the interaction between personal responsibility and complex emotions, can be ruled out.

Aggregating distinct emotional states and their combinations into negative emotions and emotional complexity is necessary for testing the competing theories of self-justification and coping. However, this approach does not allow for insights into the role of the specific emotional states underlying negative emotions and emotional complexity. Breaking up the analysis into discrete emotional states and investigating positive and negative states simultaneously can help to obtain a more holistic. Hence, we additionally investigated the effects of discrete emotional states (angry, sad, scared, disgusted, surprised, happy) on escalation of commitment. Fitted linear regression lines in a scatterplot showing the relationship between each emotional state and escalation of commitment indicated a negative linear relationship with escalation of commitment for the emotions happy ($\beta = -.222$) and surprised ($\beta = -.498$). On the other hand, feeling sad ($\beta = .312$) and angry ($\beta = .334$) have a positive linear relationship with escalation of commitment. Correlation analysis using Pearson's Correlation Coefficient supported these indications: There is a nonsignificant negative correlation between feeling happy and escalation of commitment ($r(62) = -.21$, $p = .103$) and a significant negative correlation between surprised and escalation of commitment ($r(62) = -.36$, $p = .003$). Further, feeling angry ($r(62) = .36$, $p = .003$) and feeling sad ($r(62) = .28$, $p = .026$) are significantly positively correlated with escalation of commitment. To test the effect of those discrete emotions on escalation of commitment while controlling for confounding factors, we created a new multiple regression model in which we included as independent variables the emotions surprised, happy, sad, angry, disgusted, and scared together with emotional complexity, cognitive flexibility, and the control variables age, and gender. A significant regression equation was found ($F(11,52) = 5.652$, $p < .001$), with a R^2 of .545. Controlling for all other factors, we found a significant negative effect of surprised ($\beta = -.446$, $SE = .216$, $p = .044$), and a significant positive effect of sad ($\beta = .407$, $SE = .157$, $p = .012$) and emotional complexity ($\beta = .423$, $SE = .128$, $p = .002$) on escalation of commitment. Further, the control variable age significantly predicted escalation of commitment in this model, $\beta = .013$, $SE = .006$, $p = .040$.

5 Discussion

The present study helps to disentangle the emotional and cognitive factors behind escalation tendencies in sequential decision-making. Our results show that personal responsibility, as a result of being the project initiator, leads to higher escalation of commitment *(Hypothesis 1)*. This indicates a successful replication of the general bias and supports high personal responsibility as a major determinant of escalation of commitment, which is in line with the foundational studies (Staw, 1976; Arkes and Blumer, 1985; Brockner, 1992).

Further, we found support for the hypothesis that escalation of commitment decreases over time in the context of sequential decision-making *(Hypothesis 2)*, which is in line with previous empirical escalation of commitment research (Jackson et al., 2018) and research on adaptive learning (Shepherd and Cardon, 2009). As the project progressed and negative feedback continued, both the probability of further persisting with the failing project and the relative amount participants were willing to additionally invest slightly declined. This supports that learning from failure counteracts escalation of commitment over time at the single decision level, while escalation of commitment dominates when looking at the decision strategy as a whole (Wong and Kwong, 2018). The overall decline is also in line with self-justification theory, as over time, it may become increasingly difficult to rationalize one's actions to reduce cognitive dissonance (Brockner, 1992; Sleesman et al., 2012). These findings also indicate that escalation in sequential decision-making differs from single decisions and that this should be considered when designing escalation of commitment studies (Jackson et al., 2018). The escalation of commitment formula we developed to study emotional and cognitive determinants captures overall escalation of commitment and thereby accounts for potentially counteracting learning effects. The minor incline of escalation tendency in the penultimate decision round could be explained by the goal completion effect

evening out learning effects at a stage where the project completion seems particularly close (Lant and Hurley, 1999). In general, the support for decision-strategy leveled learning effects and the decline of escalation tendency shows the complexity of counteracting cognitive forces and rationalization approaches in escalating situations.

In contrast to our predictions, we could not find a significant negative effect of high cognitive flexibility on escalation of commitment *(Hypothesis 3)*. The natural conclusion from this finding is that a relationship between people's ability to adjust their processing mode to changing external stimuli - their level of cognitive flexibility - and escalation of commitment does not exist. However, further investigations using different measures of cognitive flexibility and different escalation scenarios (e.g., hiring decisions) could help rule out alternative explanations for the absence of the cognitive flexibility effect. Such investigations might be particularly interesting as we found indications that a potential undetected effect could have the opposite direction than assumed. One potential explanation is the mediating effect of decision confidence, which is supported by a significant positive correlation with both cognitive flexibility and escalation. Further research could test whether there is a positive effect of high cognitive flexibility on escalation of commitment mediated by an increase in decision confidence.

Our analysis of the emotional journey maps showed a general dominance of negative over positive emotions regardless of the escalation tendencies. The peaks in anger and sadness at the beginning of the decision phases can be interpreted as potential reactions to the negative project feedback. This supports the assumption that negative project feedback evokes primarily negative emotions and aligns with prior research (Shepherd and Cardon, 2009). Regarding emotional determinants, we found that both negative emotional states *(Hypothesis 4a)* and emotional complexity *(Hypothesis 5a)* resulting from negative feedback increase escalation. Hence, our findings present strong empirical support for self-justification over coping theory for explaining the role of emotional states. It is unpleasant if something is not congruent with our past behavior, attitudes, or beliefs. We adjust our current behavior, beliefs, or attitudes to counteract this unpleasant feeling. In a situation where we repeatedly receive negative feedback, this loop of self-justification reinforces holding on to past decisions and ignoring the signs to withdraw or change directions. The escalation enforcing effect of negative emotions is in line with empirical research on negative affect (Roeth, Spieth and Joachim, 2020) and discrete negative emotions (Tsai and Young, 2010). We explain the fact that our findings on negative emotions conflict with empirical results in favor of coping theory (Wong, Yik and Kwong, 2006) with our conceptualization of negative emotions as not following the criticized valence-based approach but being a combination of discrete negative emotional states, improved measurement accuracy due to the use of physiological measures and AI-based technology, and the application to a sequential decision-making scenario. Because people dislike internal inconsistencies (Pepitone and Festinger, 1959) and feel conflicted (Goetz, Spencer-Rodgers and Peng, 2008), self-justification theory predicts that they are striving to simplify their complex states to reduce the unpleasant feelings of conflict, tension, and discomfort. We provide empirical evidence for this prediction and show that emotional complexity is an even stronger determinant of escalation of commitment than the frequently studied negative emotional states. This supports our assumption that emotional complexity plays a crucial role in judgment and decision-making in general and in explaining how escalation of commitment evolves in particular.

Surprisingly, while the effects of personal responsibility, negative emotional states, and emotional complexity were significant, we could not find support for a moderating effect of personal responsibility *(Hypotheses 4b and 5b*). The additional analyses for each decision support the absence of interaction effects. Hence we interpret the results as robust. This means that negative emotional states and emotional complexity resulting from negative feedback increase the probability of project escalation, even when the decision-maker is not responsible for the initial course of action. Given that separating responsibility for project initiation and continuation is one of the most prominent strategies for achieving de-escalation (Pan, Pan and Flynn, 2004; Marx and Uebernickel, 2022), we consider this finding alarming. According to our results, low personal responsibility alone is not enough to de-escalate commitment. Given the strong effects of emotional states independent from personal responsibility, de-escalation strategies should consider actions and conditions that acknowledge the escalation triggering potential of how people feel about negative project feedback, even when they are not responsible for the initial decision.

The repetition of the analysis with the specific emotional states underlying negative emotions and emotional complexity helped to obtain a more nuanced picture of the emotional determinants and strengthened the previous findings. We were able to find additional support for self-justification theory over coping theory by analyzing the effects of anger, sadness, feeling scared, disgusted, surprised, and happy as discrete emotional states instead of aggregations. We found that feeling sad about negative project feedback leads to higher escalation of commitment. Also, anger was positively correlated with escalation of commitment which is in line with prior research (Tsai and Young, 2010). However, the effect was not significant when controlling for sadness. While sadness as a basic emotion so far received limited academic attention in the context of escalation of commitment, it is related to counterfactual emotions such as regret, which has been linked to escalating behavior (Ku, 2008; Sarangee, Schmidt and Calantone, 2019). Moreover, we found a pattern of decline in feeling surprised before de-escalation supported by a significant positive effect on escalation of commitment when controlling for all other basic emotional states. That feeling surprised leads to lower escalation behavior can be explained by the effects of self-justification (ignoring, disregarding, or justifying feedback that is not in line with prior beliefs or behavior). A higher feeling of surprise can indicate that the decision-maker engages in less self-justification as there is a higher awareness of negative feedback. Increased awareness about the problem, such as recognizing negative feedback, mostly contributes to the initial phase of de-escalation and thereby evidently reduces escalation tendencies (Montealegre and Keil, 2000; Pan, Pan and Flynn, 2004). While Ekman and Cordaro (2011) considered surprise a basic emotion, other researchers see a direct bridge between cognition and emotion in the state of surprise and suggest a more complex conceptualization (Mellers et al., 2013). Our findings regarding the relevant role of surprise during escalation of commitment underline the reciprocal relationship of cognition and affect and show that there is value in deviating from the valence-based approach. In general, the additional analysis of discrete emotions offers a more nuanced view and shows interesting paths for future research.

6 Conclusion

The evolution of new technologies constantly changes how IS are developed. Consequences are new opportunities, but also increasing complexity and room for failure. By disentangling the emotional and cognitive components underlying project escalation, we add to a better understanding of what gives rise to escalation of commitment. A full and nuanced understanding of this complex psychological phenomenon is the foundation to develop de-escalation strategies that help to turn distressed IS projects around. We thereby contribute to current research on managing and governing complex IS projects in organizations, which are particularly prone to escalation of commitment. Stakeholders involved in troubled IS projects should be aware of the escalation of commitment bias, the relevance of emotional and cognitive markers, and the fallacy to underestimate the psychological forces driving towards persisting with failing courses of action. In particular, we found that negative emotional states, emotional complexity, and feeling sad and surprised as a result of negative project feedback play a crucial role in understanding how escalation of commitment evolves. This study successfully replicates the escalation of commitment bias in the context of IS project distress, provides evidence for a psychophysiological link, supports the predictions on the role of negative and complex emotional states of self-justification over coping theory, and adds to a better understanding of how escalation tendency changes over time due to learning effects. In 2012, Dimoka et al. (2012, p. 700) hoped to "trigger a revolution in IS research", argumenting that "ignoring cognitive neuroscience could be a disservice to the [IS] field". With the application of neurophysiological tools, we were now able to uncover a link between behavioral escalation of commitment and physiological correlates. While the focus of this study was to disentangle cognitive and emotional determinants of escalation of commitment, the evidence we provide for the general psychophysiological link can be the foundation for developing neuro-adaptive support systems that can be applied in managerial decision-making, for instance by using real-time biofeedback to warn about escalation potential. Our findings thereby contribute to "enhancing [...] decision-making in uncertain environments by using both cognitive and emotional markers" (Dimoka et al., 2012, p. 689).

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