

EMOTIONS AND PSYCHOPHYSIOLOGICAL RESPONSES IN ORGANIZATIONAL SOCIAL INTERACTION

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Abstract

Emotions have various effects on work life and organizational social interaction. Daily work events evoke emotional reactions, which are communicated, either intentionally or unintentionally, to colleagues and clients. These communicated emotions may evoke corresponding affective responses in the perceiver, thus making the emotions social. An existing emotional state may affect the performance of work tasks such as decision-making. It may also affect social interaction, regardless of whether it happens face-to-face or is mediated by some communication technology. The hierarchical nature of organizations may often also result in implicit rules regarding the expression of certain emotions, depending on one's social status.

This dissertation uses self-reports and psychophysiological measurements to study emotions in organizational social interaction, in both controlled laboratory experiments and field studies in actual work settings. The four studies of the dissertation focus on two research lines: 1) The dispositional effects of personality and trait emotional intelligence on emotions during dyadic face-to-face social interaction, and 2) Emotional processes during technology-mediated social interaction when conducting work tasks such as planning and decision-making.

The current dissertation focuses on the emotions on four of the five organizational levels of Ashkanasy's (2003) model, namely the Within-person level, Between-person level, Interpersonal interaction level, and Group and team level. The work is organized into six research questions, which address the relationship between emotional expressions and internal motivation state, behavior in a social decision-making task, the role of trait emotional intelligence and personality in emotional processes during organizational face-to-face social interaction, emotional contagion and emotion regulation in technology-mediated social interaction, and the effects of a technology-mediated group emotional state on the individual.

Regarding the first research question, the research showed how during a social decision-making task with a computer-controlled virtual character, the participant's facial muscle activation, which is indicative of negative valence emotional expressions, was related to their decision to defect the possibility of cooperation. This defection enabled a higher pay-off in the task; the frontal asymmetry of the electroencephalogram, indexing approach motivation, was related to the anticipated high pay-off achievement rather than to establishing cooperation. During a performance review discussion, both trait emotional intelligence and the matching

levels of the Extraversion personality dimension was related to self-reports and physiological activity, indicating a positive valence emotional state, thus contributing to the second and third research questions. As regards the fourth research question, the results showed that emotional contagion occurred from a virtual character, as well as within a distributed group, via a technology-mediated cue of group emotional state. We also observed emotion regulation in the participant when they interacted with a virtual character, thus contributing to the fifth research question. Finally, the sixth research question was addressed by showing that contagious negative group emotional state had detrimental effects on confidence in the group.

In sum, this dissertation contributes to the field of organizational social psychology by showing the viability of the quantitative method of psychophysiology in the study of organizational behavior in real-life contexts.

Tiivistelmä

Tunteet vaikuttavat töissä tapahtuvaan sosiaaliseen vuorovaikutukseen. Päivittäiset tapahtumat töissä herättävät tunteita, joita, tarkoituksella tai tahtomattaan, viestitään sekä työtovereille että asiakkaille. Nämä välitetyt tunteet voivat herättää tunnereaktioita havaitsijassa ja näin tunteista tulee sosiaalisia. Vallitseva tunnetila vaikuttaa työtehtävistä suoriutumiseen. Tunnetila vaikuttaa myös sekä kasvokkain tapahtuvaan että teknologiavälitteiseen sosiaaliseen vuorovaikutukseen. Työorganisaatioiden hierarkkisen luonteen vuoksi henkilön sosiaalinen asema organisaatiossa saattaa vaikuttaa, usein sanattomien sääntöjen kautta, siihen, mitä tunteita on kulloinkin soveliaista ilmaista.

Käytän väitöskirjassani itseraportointeja sekä psykofysiologisia mittauksia tutkiessani tunteita organisaatioissa tapahtuvassa sosiaalisessa vuorovaikutuksessa. Väitöskirjan osajulkaisut koostuvat kontrolloiduista laboratoriokokeista ja oikeissa työympäristöissä tehdyistä mittauksista. Neljä osatutkimusta jakautuvat kahteen tutkimuslinjaan: 1) persoonallisuuden ja tunneälyn vaikutukset tunteisiin kahdenkeskisessä kasvokkain tapahtuvassa sosiaalisessa vuorovaikutuksessa, ja 2) tunneprosessit teknologiavälitteisen sosiaalisen vuorovaikutuksen aikana tehtäessä työtehtäviä, mm. suunnittelua ja päätöksentekoa.

Keskityn väitöskirjassani tutkimaan tunteita neljällä Ashkanasyn (2003) määrittelemästä viidestä organisaatiotasosta: Yksilötasolla, Yksilönvälisten erojen tasolla, Yksilöiden välisellä tasolla, ja Ryhmien tasolla. Väitöskirjan kuudessa tutkimuskysymyksessä tarkastellaan tunneilmaisujen ja motivaation yhteyttä käyttäytymiseen sosiaalisessa päätöksentekotilanteessa, tunneälyn ja persoonallisuuden vaikutuksia tunneprosesseihin kasvokkain tapahtuvan vuorovaikutuksen aikana, tunteiden tarttumista ja säätelyä teknologiavälitteisessä sosiaalisessa vuorovaikutuksessa, sekä ryhmän välitetyn tunnetilan vaikutusta yksilöön.

Väitöskirjani osatutkimusten tulokset osoittava mm., että sosiaalisessa päätöksentekotilanteessa virtuaalihahmon kanssa koehenkilöiden negatiivisiin tunteisiin liittyvä kasvolihaskäytös oli yhteydessä heidän päätökseensä hylätä mahdollisuus yhteistyöhön. Yhteistyön hylkääminen mahdollisti suuremman rahallisen palkkion; aivosähkökäyrästä analysoitu motivaatioon ja

lähentymistaipumukseen liittyvä vaste oli yhteydessä suuremman palkkion, eikä yhteistyön tavoitteluun. Koehenkilöiden osoitettiin myös säätelevän tunneilmaisujaan ollessaan vuorovaikutuksessa virtuaalihahmon kanssa. Tunteiden tarttumisen osoitettiin tapahtuvan sekä virtuaalihahmolta, että ryhmän tunnetilaa kuvaavista tekstivihjeistä ja välitetty ryhmän negatiivinen tunnetila heikensi koehenkilön luottamusta ryhmää kohtaan. Lisäksi kasvokkain käydyssä kehityskeskustelussa havaittiin keskustelijoiden ekstraversio-persoonallisuuspiirteiden samankaltaisuuksien ja tunneälyn yhteydet positiivisiin tunteisiin liittyviin itseraportointeihin ja kasvolihaskäytettiin.

Väitöskirjani edustaa organisaatiokäyttäytymisen ja sosiaalisen psykofysiologian tutkimussuuntia ja tarjoaa uutta tietoa tunteista organisaatioissa tapahtuvassa sosiaalisessa vuorovaikutuksessa. Esitetyt tulokset rohkaisevat käyttämään psykofysiologisia mittausmenetelmiä myös aidoissa työympäristöissä tehtävissä tutkimuksissa.

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Helsinki, August 2018

Mikko Salminen

List of original publications

In the text the publications are referred to by their Roman numerals I–IV.

- I Salminen, M., & Ravaja, N. (2017). The Positive Effects of Trait Emotional Intelligence during a Performance Review Discussion – A Psychophysiological Study. *Frontiers in Psychology*, 8(463).
<https://doi.org/10.3389/fpsyg.2017.00463>
- II Salminen, M., Henttonen, P., & Ravaja, N. (2016). The role of personality in dyadic interaction: A psychophysiological study. *International Journal of Psychophysiology*, 109, 45-50. <https://doi.org/10.1016/j.ijpsycho.2016.09.014>
- III Salminen, M., Ravaja, N., Kallinen, K., & Saari, T. (2013). Mediated Cues of Group Emotion during Knowledge-Work Tasks: Effects on Subjective and Physiological Responses. *Interacting with Computers*, 25(1), 60-73.
<https://doi.org/10.1093/iwc/iws006>
- IV Ravaja, N., Bente, G., Kätsyri, J., Salminen, M., & Takala, T. (2018). Virtual Character Facial Expressions Influence Human Brain and Facial EMG Activity in a Decision-Making Game. *IEEE Transactions on Affective Computing*, 9(2), 285-298. <https://doi.org/10.1109/TAFFC.2016.2601101>

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Abbreviations

Abbreviated	Unabbreviated
C-EASI	Cybernetic emotions as social information model
CSCW	Computer-supported collaborative work
EASI	Emotions as social information model
EDA	Electrodermal activation
EEG	Electroencephalography
EI	Emotional intelligence
EMG	Electromyography
LMM	Linear mixed models
NS.SCR.freq.	Frequency (per minute) of non-specific skin conductance responses
SCL	Skin conductance level
VC	Virtual character
VR	Virtual reality

1 Introduction

1.1 Emotions in organizational social interaction

Emotions play a central role in social behavior, including social interaction at the workplace. Events at work evoke emotions that may be communicated to colleagues (e.g., Elfenbein, 2014; Weiss & Cropanzano, 1996). These emotions may spread during face-to-face interaction or via technology-mediated communication, and may thus eventually affect a large group of co-workers in the organization. Affective states may have various effects on work life; for example, a prevailing positive mood state may lead to enhanced performance and helping behavior. On the other hand, emotion work or regulating expressed emotions to be organizationally desired may contribute to burnout (Weiss, Ashkanasy, & Beal, 2004; Weiss & Cropanzano, 1996; Zapf, 2002). Organizations also have hierarchical relations (e.g., between managers and employees) which shape the interpretation of affective events and influence emotional expressions. For example, the expression of anger may be permitted among higher-status managers, but not among lower-status employees (Carver & Harmon-Jones, 2009; Hess & Bourgeois, 2010). In addition, there may be differences between individuals in, for example, personality on how events at work influence their emotional responses and behavior (Weiss & Cropanzano, 1996; Weiss & Kurek, 2003). Thus, organizations offer a complex context in which to study emotions.

This dissertation uses psychophysiological methods to study emotions in organizational social interaction, through both controlled laboratory studies and field studies in actual work settings. These methods could provide novel findings regarding the role of emotions in organizational social interaction. After all, emotions are considered to consist not only of externally observable behaviors (studied by e.g. analyzing behavior from video recordings) and subjectively reported experiences (studied by e.g. self-reports), but also of physiological responses (e.g., Lang, 1995). In the field of organizational behavior a division between researchers utilizing qualitative methods and those using quantitative methods has been identified; the former emphasizing the contextual factors, and the latter pursuing the identification of more general, context-independent effects (Johns, 2006). The advent of modern mobile psychophysiological measurement devices opens new possibilities for studying emotions in organizational social interaction. This novel quantitative

approach can be used not only in a laboratory, but also in the field, in actual work settings.

The objective of the current dissertation is to provide new information on the role of emotions in organizational social interaction which occurs either face-to-face or is technology-mediated, that is, enabled by technology applications. The studies of the dissertation focus on two research lines: 1) The effects of individual differences in personality traits and trait emotional intelligence on emotional processes during dyadic face-to-face social interaction, and 2) emotional processes during technology-mediated social interaction while conducting work tasks (e.g., planning, decision-making). These two lines were selected to obtain diverse coverage of the field of organizational social interaction. They also include the study of certain phenomena that are well suited for psychophysiological methods, such as emotional expression and the spreading or socializing of emotions (Peterson et al., 2015).

1.2 Emotions

Emotions can be considered as biologically-based action dispositions that play an essential role in determining behavior. They consist of (at least) three reactive systems: 1) Expressive and evaluative language; 2) Physiological response; and 3) Behavioral response (Lang, 1995). Emotions are often defined as being of short duration and intense, with a well-defined cause and cognitive content, whereas moods have a lower intensity and are more enduring affective states, and may not have such a clearly identifiable cause (Forgas, 1995). Affect, on the other hand, is typically used as a more generic concept that encompasses both mood and emotions (Collins et al., 2013; Forgas, 1995). Appraisal theories of emotion posit that emotions are evoked (and differentiated) by an individual's evaluations of events and their consequences (Scherer, 2013). It has been suggested that in social contexts, not only events are appraised, but also the thoughts, feelings and actions of the others present in the emotional situation (Manstead & Fischer, 2001). These different types of appraisals together evoke emotional states in an individual.

Some theorists have suggested that certain emotions are inborn and distinct (e.g. happiness, surprise, anger, disgust, sadness, and fear), and that these have different physiological and behavioral responses (e.g. Ekman, 1992). A competing view offered by dimensional theories posits that all emotions can be located on a coordinate consisting of a set of dimensions. One popular suggestion describes two dimensions:

Arousal and valence (Lang, 1995). The valence dimension ranges from pleasant to unpleasant, whereas the arousal dimension indexes bodily activation and varies from excited to calm (Figure 1). However, not all emotions can be differentiated unambiguously by these two dimensions. For example, fear and anger are both high-arousal negative valence emotions (Knippenberg & Van Kleef, 2016), but they differ in, for example, motivational direction (avoidance/approach).

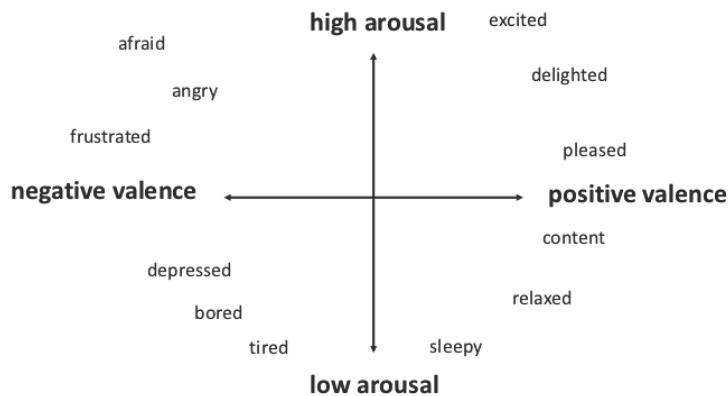


Figure 1. Schematic representation of valence and arousal dimensions of emotions, with selected subjectively reported words for emotional states. Adapted from: https://en.wikipedia.org/wiki/File:Valence-Arousal_Circumplex.jpg; Wikimedia Commons; CCBY-3.0

The current dissertation utilizes self-reports and previously identified physiological correlates of emotional valence and arousal, as well as approach/withdrawal motivation, as methods for measuring emotional processes.

1.3 Social emotions in organizations

Emotions play an essential role in social interaction. It has even been suggested that emotions are inherently interpersonal, and that most of them occur in the context of social interaction or relationships (Butler, 2011, 2015). Emotions can solve important problems in social relationships (Keltner & Haidt, 1999) through various mechanisms: Emotional expressions reveal not only the expresser's emotional state but also their social intentions and orientations towards the relationship (Ekman, 1993; Fridlund, 1992; Knutson, 1996). Emotions have a tendency to evoke complementary emotions in others and act as incentives, thus reinforcing certain

behaviors among others; for example, expressed gratitude may reward cooperation (Morris & Keltner, 2000).

Emotions have functions on four social levels: Individual, dyadic, group and cultural (Keltner & Haidt, 1999). These levels have counterparts in Ashkanasy’s five-level model of organizational emotions (2003), which covers the role of emotions at the: 1) Within-person, 2) Between-person, 3) Interpersonal interaction, 4) Group, and 5) Organizational levels (Figure 2). This five-level model acts as a scheme within which different theories relevant for organizational emotions can be placed on respective levels. The current dissertation studies the emotions at the levels of 1–4 of Ashkanasy’s model, in face-to-face (Studies I–II) as well as technologically-mediated social settings (Studies III–IV). Next follows a brief review of previous work on emotions in organizations following this five-level classification, with an emphasis on topics relevant to the studies of the current dissertation.

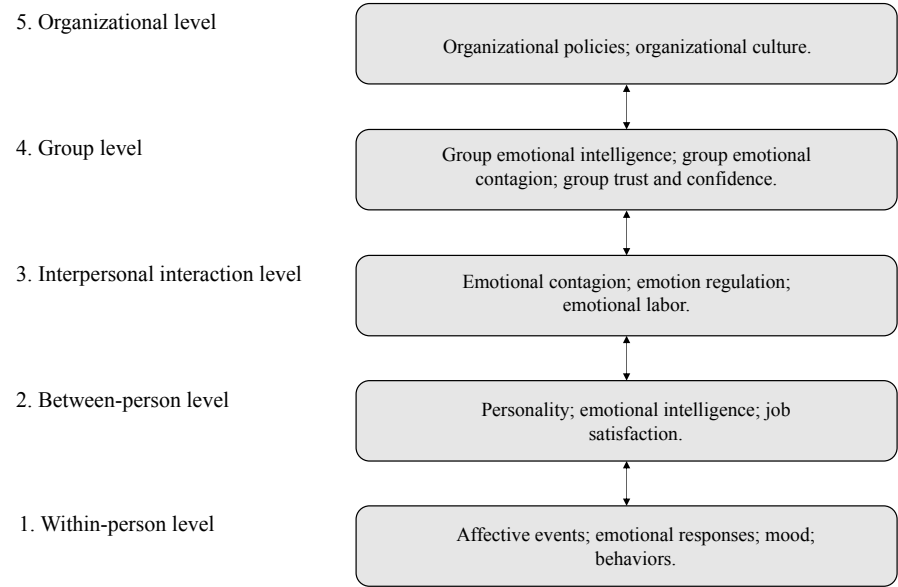


Figure 2. Five-level model of emotions in organizations. Adapted from Ashkanasy & Humphrey (2011).

1.3.1 Within-person level

On the Within-person level, the central issue is what kind of effects the evoked emotional states have on the behavior of the individual. Work life consists of

affective events that evoke either positive or negative affective states; these states then influence the attitudes (e.g., job satisfaction) and behavior (e.g., absenteeism, productivity) of employees and managers (Ashton-James & Ashkanasy, 2005; Weiss & Cropanzano, 1996). Affective events at the workplace also have several effects on decision-making (Ashton-James & Ashkanasy 2008), a task that is especially relevant for managers. Affective responses, or “gut feelings”, help in decision-making by acting as heuristics, thus narrowing down the number of alternative options (Damasio, 1994; Evans, 2002; Michael, 2011). Previous studies have suggested that positive mood tends to lead to overestimating the probability of positive events and underestimating the probability of negative events (George & Dane, 2016; Nygren, Isen, Taylor & Dulin, 1996; Wright & Bower, 1992). Evoked negative moods, on the other hand, may increase skepticism and lead to increased accuracy in detecting deception (Forgas & East, 2008), which may be central in a negotiation or social decision-making task.

As the current dissertation focuses on emotions during social interactions, social decision-making was selected as the type of task to study on this organizational level. Psychophysiological methods have proven to be useful tools in the study of the emotional and motivational processes during decision-making, for example in differentiating processes related to emotional expressions (important signals in all social interaction) and internal motivations. Facial expressions may be related to intentions and future actions (Fridlund, 1991). For example, frowning, which is typical of anger, would most probably be negatively related to willingness to cooperate. A previous study found anger to be a strong predictor of rejection in the ultimatum social decision-making game (Pillutla & Murnighan, 1996).

Approach motivation (measured as frontal asymmetry in electroencephalography, EEG) may be used to predict purchase decisions (e.g., Ravaja, Somervuori, & Salminen, 2013). However, frontal asymmetry could also, via emotional contagion, be related to a partner’s emotional expressions during social decision-making. For example, a partner’s anger (an approach-related emotional state) could be contagious and evoke greater relative left frontal activation in the participant (Harmon-Jones, 2003; Harmon-Jones & Sigelman, 2001; see also Section 1.4 on the relationship between emotions and frontal asymmetry). On the other hand, it is possible that when negotiating or bargaining, or during social decision-making, participants may focus on the goal of obtaining rewards, and that the EEG frontal

asymmetry preceding these decisions may be related to the anticipated rewards rather than to the emotional expressions of the partner. Therefore, the role of EEG frontal asymmetry and its relationship with the facial expression-related muscle activations during social decision-making should be studied further.

It must be noted that in their updated version of the five-level model, Ashkanasy and Humphrey (2011) differentiate between impulsive and considered behavior (including decision-making) and place these on the Within-person and Between-person levels, respectively. However, they place emotional reactions on the first level of the model (Within-person). Since the current dissertation studies the relation between decision-making and emotions, this work is placed on the Within-person level of the model.

1.3.2 Between-person level

The Between-person level of Ashkanasy's (2003) model covers trait-like personal outcomes that originate from within-person processes, such as job satisfaction, affective commitment to the organization, trait affect (personal tendency to be in a positive or negative state in the long term), and emotional intelligence (EI).

To the general audience, EI is probably one of the most well-known sets of affective theories in the organizational context. The concept of EI was first introduced by Salovey and Mayer (1990), but popular interest was sparked by the work of Goleman (1995; 1998). EI can be defined as a type of social intelligence that consists of abilities to "monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions" (Salovey & Mayer, 1990, p. 189). Various studies have been conducted to determine relations between emotional intelligence and different outcomes that would be relevant for organizational behavior such as work outcome, leadership success, organizational climate, or work wellbeing (e.g., Carmeli, 2003; Langhorn, 2004; Momeni, 2009; Martins et al., 2010). Considering the central role of emotions in social interaction, it is not surprising that people with high EI are perceived more positively (for a review, see Mayer et al., 2008). In addition, links have been established between EI and social skills, empathic perspective taking, prosocial behavior, and interpersonal sensitivity (Lopes, Salovey, & Strauss, 2003; Lopes et al., 2005; Petrides et al., 2016; Schutte et al., 2001).

The current dissertation focuses on the possible positive effects that trait EI could have in organizational social interaction; that is, whether high EI leads to more positive valence emotions and approach motivation (see Section 1.4) during interactions. Another focus area stems from the close relation between EI and charismatic leadership, which emphasizes inspirational and emotional influence, charismatic communication style, and has also been related to emotional expressiveness (Bono & Ilies, 2006; Conger & Kanungo, 1998; Riggio & Reichard, 2008). The current dissertation studies whether high EI can lead to increased expressiveness during interaction. The focus of the current dissertation is on trait EI, due to the nature of the used methods. Trait EI is considered to consist of behavioral dispositions and self-perceived abilities, which are measured using a self-report questionnaire; ability EI should be measured using a maximum-performance test (Petrides & Furnham, 2001).

In addition to EI, another trait construct that has been widely studied in organizational contexts is personality. Of all the different conceptualizations, the five-factor or Big five model has gained vast acceptance among researchers (Digman, 1990). The Big five personality model typically includes factors of Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to experience. Good work performance has been related to Conscientiousness (Hurtz & Donovan, 2000; Judge et al., 1999) and Extraversion (Boudreau & Boswell, 2001). Extroverts are typically described as assertive, energetic (John and Srivastava, 1999) and talkative and as having good social skills (Funder and Sneed, 1993). Conscientious people are considered to be orderly, responsible and hard-working (Peabody and Goldberg, 1989; John and Srivastava, 1999). Conscientiousness may also affect social interaction; a relation between conscientiousness and voice behavior (constructive, change-oriented communication) has been reported (LePine & Van Dyne, 2001). However, the manifestations of personality in organizational face-to-face social interaction have not been studied thoroughly. The current dissertation specifically focuses on the possible positive effect of personality similarity in organizational face-to-face social interaction. The effect of similarity attraction is one of the most robust, well-documented effects in social and behavioral sciences (Layton & Insko, 1974; Montoya et al., 2008). The effect of personality similarity has been previously studied also in the work life (e.g., Antonioni & Park, 2001). However, the current dissertation

studies the effects of personality similarity in the context of actual face-to-face leadership situations.

Performance review discussion was selected as the context in which to study the effects of emotions at the Between-persons level. These types of discussions are held regularly in most organizations and they play a central role as almost ritualistic leadership events. In addition, these discussions also act as important forums for giving and receiving feedback. Performance review discussions may play a positive role in job satisfaction and in trust in the management (Jawahar, 2006; Mayer & Davis, 1999), but some indications also show that they may be stressful (Carter & Delahaye, 2005), and some scholars have questioned the usefulness of traditional manager-to-subordinate discussions (Meyer, 1991). During the discussion, one may also receive negative feedback, not only on work performance, but on one's character. Performance review discussions also have functions similar to those of negotiations, in which issues such as pay rises, promotions, or other changes in position might be focal points. It is thus likely that performance review discussions evoke emotions in both the manager and the subordinate.

1.3.3 Interpersonal interaction level

The interpersonal interaction level considers the perception and communication of emotions on a dyadic level. This third level bridges together the micro level (Levels 1 and 2) with the group and organizational levels (Levels 4 and 5). Of all the various processes related to the communication and perception of emotions in social interaction, for the purpose of this dissertation I focus on emotional contagion and emotion regulation, because they have relevance in both organizational face-to-face and technology-mediated social interaction.

Emotional contagion, or the tendency to feel and express emotions that are similar with and influenced by the emotions of others, is the primary mechanism by which emotions become social (Barsade & Gibson, 2007). During social interaction, the partner's emotional facial expressions may induce a similar emotional state in the observer (Hess, Philipot, & Blairy, 1998). This effect has been observed even when interacting with virtual characters (VCs; Schrammel et al., 2009). The mere facial imitation of a partner's emotional expressions during social interaction may initiate an internal experience of the corresponding emotion (Tomkins, 1962). Positive

emotional contagion may lead to various beneficial effects, for example, less conflicts and improved cooperation (Barsade, 2002).

However, the social communication of emotions in organizations may be constrained by implicit or explicit display rules. Various aspects of organizational culture, for example, recruitment, socialization, rewarding and punishing conventions, shape the expectations of emotional expression for successful job performance (Daus, Dasborough, Jordan & Ashkanasy, 2012). Especially in a competitive setting, masking emotional expressions, a form of impression management, may be profitable (Leary & Kowalski, 1990). In the work context, two types of emotion regulation have been identified: Surface acting, which is response focused and merely forms expected emotional expressions; and deep acting, which also involves the internal experience or evoking of emotion (Coté 2005). Employees' emotional regulation is typically considered to benefit the organization but to harm the individual employee (Coté, 2005) by, for example, evoking emotional exhaustion and depersonalization (Zammuner & Galli, 2005). As well as deliberately controlling one's affective expressions, the display rules of emotions may also be applied automatically, without conscious awareness (Zaalberg, Manstead, & Fischer, 2004).

The rise of virtual reality (VR) technology has opened up possibilities for new forms of social interaction. For example, Facebook CEO Mark Zuckerberg stated that "VR is going to be the most social platform" (Chaykowski, 2016), and the company has invested in this new technology by acquiring a manufacturer of head-mounted displays (HMD) and forming a new Social VR group. It is thus possible that in the future VR will also be a more widely-used communication platform in organizational social interaction. In addition, VR offers a valuable tool for conducting basic research on organizational social interaction. In VR social interaction, it is common that a virtual character or an avatar represents a person. The avatar's appearance (including facial expressions) can even reflect those of the user. Thus, the current dissertation studies whether emotion regulation could also occur in a technology-mediated social setting, when interacting with a virtual character (VC).

Due to advances in communication technologies, an increasing amount of organizational social interaction occurs via some sort of technological mediation. One of the problems with technology-mediated communication is that the exchange of personal information may be inhibited, and this in turn may interfere with the process of building rapport (Morris, Nadler, Kurtzberg, Thompson, 2002). However, some

scholars suggest that the difference between forms of communication may not be so notable after all. Emotional communication in face-to-face and technology-mediated situations may be quite similar, and in computer-mediated communication, the expression of emotions may be even more frequent and explicit than in face-to-face interaction (Derks, Fischer, & Bos, 2008). Geographically dispersed teams conducting knowledge work may mainly operate via technological communication platforms and applications. Some of these applications may offer a real-time video connection in order to also access non-verbal communication (e.g., Skype), but other technologies may completely lack non-verbal cues (e.g., e-mail). This closely resembles the concept of minimal groups, a paradigm in which the minimal conditions required for discriminating between groups and defining group membership are under scrutiny (Tajfel, 1970, 1974; Brown, 2000; Böhm, Rusch, & Baron, in press). The current dissertation studies whether technology-mediated emotional contagion could occur in a minimal group while participants conduct tasks relevant for knowledge work.

1.3.4 Group level

The fourth level, also called the Leadership and team level (Ashkanasy & Humphrey, 2011), is about group- and team-level emotions. A person working in a group may experience both individual emotions and group emotions. According to one definition, group emotions should be distinct from, but related to, a person's individual-level emotions. For example, a person may experience emotions that are evoked by events that have happened to a team member but not directly to them (Smith, Seger, & Mackie, 2007; Smith & Mackie, 2016). In addition, group emotions depend on the degree of the person's identification with the group (e.g., stronger group identification could be related to more positive group emotions), and may also regulate intergroup attitudes (Smith, Seger, & Mackie, 2007).

Group emotions are shaped by the events that the group faces, but also by the attributes of the members. In organizations, selection criteria may influence the composition of a work team. It has been previously shown that organizations and work groups tend to choose and recruit people who are similar in terms of affect, but also that individual people also tend to choose work groups that are composed of people who are similar in terms of affect (Schneider, 1987; Barsade & Knight, 2015). This would lead over time to a group becoming increasingly homogenous with

respect to affect (Barsade & Knight, 2015; George, 1996), and members of such a group would thus respond similarly to emotion-evoking events.

Evoked group emotions may have various effects on a group's functioning. A positive induced group mood has shown to increase task engagement (Grawitch, Munz & Kramer, 2003), but the effects of a negative group affect may vary depending on contextual factors. For example, in a meta-analysis it was shown that shared negative feelings originating from a source outside the group may support social integration and performance, however, for negative feelings originating from a source inside the group the effect was opposite (Knight & Eisenkraft, 2014). Interestingly, previous studies have suggested that a group's positive mood benefits performance in creative tasks, and a group's negative mood benefits performance in analytical tasks (Klep, Wisse, & Van der Flier, 2011; Menges & Kilduff, 2015). Shared humor is a powerful example of the positive effects of group affective processes. Shared humor may serve to build group cohesion by evoking trust due to shared positive emotions (Romero & Cruthirds, 2006; Terrion & Ashford 2002).

In modern knowledge work, groups may be geographically dispersed and use different technological solutions for collaborative work. In the context of computer supported collaborative work, various technological solutions have been developed and studied for supporting the different forms of awareness that group members may have of others, such as workspace awareness (Gutwin & Greenberg, 2002), group awareness (Gutwin, Stark & Greenberg, 1995), awareness of participation in cooperation (e.g. Janssen, Erkens, Kirschner, 2011), awareness of social and cognitive behavior (e.g. Phielix, Prins, Kirschner, Erkens & Jaspers, 2011), and awareness of the emotional state of others (e.g., Eligio, Ainsworth & Crook, 2012).

The justification for enhancing emotional awareness in technology-mediated collaboration comes from the observation that shared emotions enhance coordination between individuals who work towards a common goal (Michael, 2011). The emotional displays of the team members play an important role in forming the observer's expectations of the functioning of the team (Homan, Van Kleef, & Sanchez-Burks, 2016). After all, observing an emotion in another person provides information regarding that person's thoughts and appraisals of the current situation (Keltner & Haidt, 1999). In addition, group affect has shown to strengthen group bonding and loyalty (Spoor & Kelly, 2004). I suggest that information regarding the

group's emotional state has relevance for individual group members. The current dissertation studies this effect.

1.3.5 Organizational level

The fifth and final level of Ashkanasy's (2003) model covers organizational culture and climate. On this level, the context is no longer face-to-face, person-to-person or person-to-group; it is much less clear. Organizational culture contains embedded assumptions, beliefs and values, whereas organizational climate is a less stable emotional phenomenon (Ashkanasy, 2003; Ashkanasy, Wilderom & Peterson, 2000; Schein, 1985). Ashkanasy suggests various level-combining linkages. For example, he posits that individual differences have an effect on all Levels 1 to 4 of the model. They have the most direct effect on Level 1, and through attitudes, they also have an effect on Level 2. Emotional intelligence, for example, affects the expression and perception of emotions (Level 2) and also affects leadership and group processes (Level 4).

Ashkanasy's five-level model classifies different existing affective theories into different organizational levels, and suggests connections between these five levels. As such, it is an important construct, which provides a common vocabulary and a taxonomy for researchers in the field. It also acts as a foundation into which future theoretical models and constructs could be integrated.

1.4 Psychophysiology in the study of emotions

Subjectively perceived emotional valence and arousal dimensions can be assessed using the self-report method, through for example, the self-assessment manikin (Bradley & Lang, 1994). Within psychophysiological methods facial electromyography (EMG) has been used as an index of hedonic valence (e.g. Cacioppo et al., 1986). Increased activation in the zygomatic major (cheek) and orbicularis oculi (periocular) muscle areas have been related to positive emotions, and increased activation of the corrugator supercilii (brow) muscle area has been associated with negative emotions (Van Oyen Witvliet & Vrana, 1995; Dimberg, 1997; Dimberg et al., 2000; Larsen, Norris, & Cacioppo, 2003).

There are different views of the role of facial expressions. For example, the emotion-expression view posits that facial expressions reflect the expresser's primarily internal emotional state (e.g., Ekman, 1994). In contrast, proponents of the behavioral ecology view suggest that facial expressions are other-directed social

signals that communicate expectations, social motives and intentions (e.g. Fridlund, 1991; Frijda & Mesquita, 1994; Keltner & Kring, 1998). It is likely that during social interaction, affective facial displays are controlled by both emotional and social factors (Parkinson, 2005). Especially relevant for the organizational context is the possibility that even though some facial expressions may occur automatically, without conscious control (Dimberg, 1997), they may also be selected and expressed deliberately, that is, following certain display rules, thus representing impression management (e.g. Johnson & Griffith, 2016).

Electrodermal activation (EDA) is a valid psychophysiological index for assessing emotional arousal. EDA has been related to self-reported emotional arousal in studies using affective pictures as stimuli (e.g. Lang et al., 1993). The EDA signal can be analyzed by, for example, studying the continuous skin conductance level, or by calculating the frequency of non-specific skin conductance responses.

Frontal asymmetry calculated from the alpha power band (8–12Hz or 8–13 Hz) of EEG is the most commonly used EEG response related to motivation and emotion (Coan & Allen, 2004). Anterior left and right brain areas have been related to the processing of approach and withdrawal motivations, respectively (Davidson, 2004). Approach related emotions (e.g. joy and anger) are related to relatively larger left frontal cortical activation, whereas withdrawal-related emotions (e.g. fear and disgust) are related to relatively stronger right frontal activation (Coan & Allen, 2003).

2 Aims of the work

The aim of the current dissertation is to study emotions in organizational face-to-face and technology-mediated social interaction. The work consists of four studies. All Studies I to IV utilize self-reports and psychophysiological measurements to assess emotional processes, using the two-dimensional (valence & arousal) emotion theory as a basis. Studies I and II focus on the effects that individual differences in personality traits and trait emotional intelligence have on emotional processes during dyadic face-to-face social interaction (Research line 1; see Section 1.1), and Studies III and IV focus on the emotional processes during technology-mediated social interaction while conducting work-relevant tasks (Research line 2). Studies I and II were conducted in real-life organizational contexts, whereas Studies III and IV were laboratory experiments.

Studies I and II examined the effects of individual differences on emotional processes during face-to-face social interaction, using dyadic settings. Thus, these studies contribute to Levels 2 (Between-persons) and 3 (Interpersonal interactions) of Ashkanasy's (2003) five-level model of emotions in organizations. The social settings of Studies III and IV were mediated by technology. In Study III, the participant was led to believe they were part of a four-person group, thus this study is related to Level 4 (Groups) of Ashkanasy's model. In Study IV, the setting was dyadic (Level 3, Interpersonal interactions), and the focus was also on the effects of the evoked emotional and motivational state of the individual on observable behavior, thus also contributing to Level 1 (Within-person).

The dissertation is organized as six research questions (*RQ1–6*), and the relevant theoretical background and previous studies for each question is reviewed in Section 1.3.

Study IV examined *RQ1* (Section, 1.3.1) regarding the relevant issues on the first organizational level, the Within-person level:

RQ1: How are a person's emotional expressions and internal motivation state related to their behavior in social decision-making?

Studies I and II examined *RQ2* and *RQ3* (Section 1.3.2) regarding the relevant issues on the second organizational level, the Between-person level:

RQ2: What role does EI play in organizational face-to-face social interaction?

RQ3: What role does personality play in organizational face-to-face social interaction?

Studies III and IV examined *RQ4* and *RQ5* (Section 1.3.3) regarding the relevant issues on the third organizational level, the Interpersonal interaction level:

RQ4: Does emotional contagion occur in technology-mediated social interaction?

RQ5: Does emotion regulation occur in technology-mediated social interaction?

Finally, Study III examined *RQ6* (Section 1.3.4) regarding the relevant issues on the fourth organizational level, the Group level:

RQ6: What effects does technology-mediated information regarding the group's emotional state have on an individual?

Table 1 summarizes the relations between Studies I–IV, the organizational levels and *RQs*.

TABLE 1. Relations between Studies I–IV, research questions, organizational levels, and lines of research.

Study	Organizational levels	Research questions	Line of research
I	2	2	1 – Face-to-face
II	2	3	1 – Face-to-face
III	3, 4	4, 6	2 – Technology-mediated
IV	1, 3	1, 4, 5	2 – Technology-mediated

Note. Organizational levels refer to the five levels of Ashkanasy's (2003) model. Lines of research: 1)

The effects of individual differences in personality traits and trait emotional intelligence on emotional processes during organizational dyadic face-to-face social interaction, and 2) emotional processes during technology-mediated social interaction while conducting work tasks.

3 Methods

3.1 Participants

The participants of Studies I and II were actual manager–subordinate dyads who, in return for participation, received feedback on their questionnaire scores. In addition, the managers received coaching in interaction skills and emotional intelligence which was based on their video-recorded performance review discussions and on their personal scores in the questionnaires. The participants of Studies III and IV were university students who received movie tickets in return for their participation. All participants gave their written informed consent in accordance with the Declaration of Helsinki.

Table 2 lists information on the demographics of the participants, study types, and participant compensation in Studies I–IV.

TABLE 2. Summary of participants of Studies I–IV.

Study	n	M / F	Age	Type of study	Setting	Compensation
I-1	118	49/69	45	Field	Dyadic	Coaching/feedback
I-2	88	46/42	42.5	Field	Dyadic	Coaching/feedback
II	88	46/42	42.5	Field	Dyadic	Coaching/feedback
III	33	8/25	23.8	Laboratory	Single	3 movie tickets
IV	37	10/27	24.5	Laboratory	Single	2 movie tickets (+ up to 3 tickets based on performance)

Note. n = number of participants; M/F = male/female; Age = mean age.

3.2 Tasks and procedures

3.2.1 Study I-1

Study I-1 was a field study utilizing mobile measurement of psychophysiological activity to examine the role of the manager’s emotional intelligence in a performance review discussion (*RQ2*). Each participating manager had two consecutive discussions with different subordinates. The total number of participants was 118.

The whole measurement session lasted approximately three hours. The measurement devices were attached to the manager and the first of the subordinates, and this was followed by a five-minute baseline recording. After this, video cameras were turned on and the participants were free to discuss for as long as they wished.

The manager was asked to lead a typical performance review discussion, following the structure and guidelines of the organization. All the measurements were conducted at the premises of the participating companies, either in a meeting room or in the manager's own office. The discussion participants were seated at a table, and a stand for two web-cameras was placed between them for collecting feedback material for them to analyze during a leadership development program. Additional back-up video cameras were placed next to each participant. The researchers waited in an adjacent room or in the hallway during all the recordings.

The manager was allowed a short rest after the first discussion and to prepare for the second discussion while the electrodes were being attached to the second subordinate. On average, the discussions lasted for 80 minutes ($SD = 28$ min), with a maximum duration of 2 hours 48 minutes and a minimum duration of 42 minutes.

3.2.2 Studies I-2 and II

As Studies I-2 and II were based on the same field study of 88 participants, focusing on *RQ2* and *RQ3*, the procedures were identical. We studied real-life performance review discussions between leaders and subordinates at the premises of the participating organizations, either in a meeting room or in the leader's personal office. Prior to the discussion, the participants were sent instructions describing the setting and measurement devices. These instructions asked them to choose two or three developmental issues for themselves and their discussion partner before the discussion. The participants were seated at a table during the discussions, and a stand for two web-cameras was placed between them for recording facial gestures for a later analysis. Additional back-up video cameras were placed next to each participant.

After the electrodes were attached and a baseline recording made, the participants were asked to discuss the developmental issues they had decided on before the discussion, in any order. This was to encourage a more dialogical discussion than traditional performance review discussions, in which forms and guidelines provided by the organizations are strictly followed. The researchers waited outside the room during the discussions to allow more natural communication between the participants.

The whole measurement session lasted approximately 2.5 hours. This included the attaching of the electrodes and preparing the recording devices, baseline recording

(5 min.), instructed discussion (30 min.), the removing of the electrodes, the filling in of the questionnaires, and a short briefing at the end.

3.2.3 Study III

A 2 (task type: Routine, planning) $\times 4$ (group emotion cue: Depressed, nervous/stressed, pleasantly excited, pleasantly relaxed) within-subject design was employed in a laboratory environment to study the effects of emotional contagion in a setting in which the participant was led to believe they would be part of a distributed group of four (*RQ4* & *RQ6*). Textual cues (in reality, pre-defined) of the group's prevailing emotional state were visualized at the top of the computer screen while the participant conducted grammar checks on texts describing technological topics (routine task) and planned cases for new mobile technologies (planning task). The participants ($n = 33$) were told that at the end of the experiment they would take part in a group discussion about each participant's answers and performance.

The setting's social aspect, or the illusion of a minimal group, was strengthened by two confederates who were introduced to the participant while they were being attached to the electrodes. A third group member was said to have arrived at the laboratory facilities during the baseline recording. In addition, the experiment included pauses during which the researcher said he had to visit the other participants to provide them with further instructions.

3.2.4 Study IV

In Study IV, a VC was used to study emotional processing during social decision-making, a task type that has relevance in the field of organizational behavior. It was anticipated that emotional contagion (*RQ4*) and impression management, or emotion regulation, would occur when interacting with a VC (*RQ5*). The way in which the participant's emotional expressions and internal motivation state (assessed using EEG frontal asymmetry) were related to the behavior in the social decision-making task (*RQ1*) was also studied.

An 8 (VC Facial Expression: Angry, happy, sad, pleasantly relaxed, neutral, no-face, congruent, incongruent) $\times 2$ (VC Gender: Male, female) $\times 2$ (VC Decision: Cooperate, defect) $\times 6$ (Repetition) within-subject design was employed to study the effects of the emotional facial expressions of a VC on human frontal EEG asymmetry (putatively indexing approach/withdrawal motivation), facial EMG activity (emotional expressions), and social decision-making (cooperation/defection).

The participants ($n = 37$) played the Iterated Prisoner's Dilemma game with a computer-controlled VC, whose facial expressions varied. The conditions were angry, happy, sad, pleasantly relaxed, neutral, no-face (VC was not shown), congruent expression (emotional expression corresponding to the participant's emotional state), and incongruent expression (emotional expression opposite to the participant's emotional state). In each trial, the participant and the VC decided to either collaborate or defect (the decisions of the VC were actually pre-defined).

The participants were told that they would receive additional movie tickets, depending on their total score in the game. This was to ensure their engagement in the game. Both players (the human participant and the VC) received three points if both collaborated; both received one point if both defected; and the defector received five points and the collaborator zero points in the case of incongruent decisions.

In total, 192 trials were presented in a random order. Each of the trials consisted of: a) The text "Be ready" being shown on a screen for one second, b) a VC with a facial expression and the text "Consider your decision" being shown for five seconds (pre-decision period), c) the text "Decide now whether you collaborate" to choose whether or not to collaborate, d) the outcome, revealed one second after the participant's decision and shown for five seconds (post-decision period), and e) a five- to seven-second inter-trial interval with a black screen.

Virtual characters. A female and male VC were created by Blender software (<http://www.blender.org>), using pictures of a real human female and male as references. The Blender Game Engine was used for the real-time presentation of the VCs. The facial expressions of the VC corresponded theoretically to the four quadrants of the affective space defined by valence and arousal (Russel, 1980): Angry (negative valence – high arousal), happy (positive valence – high arousal), sad (negative valence – low arousal), and pleasantly relaxed (positive valence – low arousal). A neutral facial expression was also included. In each trial, the VC's facial expression was initially neutral, but after one second, it dynamically changed into the targeted expression. During the trials, the VC moved its head slowly and its eyes blinked occasionally.

Adaptive VC facial expressions. In the adaptive VC facial expression conditions, the VC's expressions were dependent on the participant's facial EMG (putatively indexing emotional valence) and EDA (indexing emotional arousal) activations. In the congruent expression condition, the VC facial expression was

either happy, relaxed, angry, or sad when the participant's emotional state was assessed as being high-arousal positive, low-arousal positive, high-arousal negative, or low-arousal negative, respectively. In the incongruent expression condition, the VC facial expression was relaxed, happy, sad or angry when the participant's emotional state was assessed as being low-arousal negative, high-arousal negative, low-arousal positive or high-arousal positive, respectively. Alternatively, if the valence- and arousal-related criteria were not met, the VC showed a neutral expression.

3.3 Measures

3.3.1 Self-reports during the experiments

In Studies I–III, the participant's subjective rating of their emotional valence (1 = very negative, 9 = very positive) and arousal (1 = very calm, 9 = very aroused) was assessed using pictorial scales resembling those of Lang's (1980) self-assessment manikin. In Studies I and II, the assessment was conducted after the discussions, and in Study III it was conducted after each of the tasks. In addition, in Study III, stress level ("I felt stressed"), task performance ("I felt that I performed well"), and confidence in the other group members ("I trust the other group members") were rated using a four-level scale (1 = "I strongly disagree"; 4 = "I strongly agree").

3.3.2 Questionnaires for determining individual differences

Study I used two different methods to assess trait emotional intelligence. In Study I-1, the manager's trait EI was assessed using a 360-degree method with the Finnish EI360 questionnaire (Saarinen, 2007; Salminen et al., 2013), which consists of 37 statements rated on a five-point scale (1 = does not describe the person at all, 5 = describes the person very well). The current study used an overall EI score. The managers sent the link to the form to their self-selected subordinates, peers, and also their own managers. Each manager received, on average, 5.8 ratings, most of them from their subordinates. The analyses pooled all the ratings together and the alpha reliability for the total score of the EI360 questionnaire was 0.83.

In Study I-2, both the manager and the subordinate also filled in a self-reported 33-item trait EI questionnaire, developed by Schutte and colleagues (1998). The alpha reliability for the total score was .86.

Study II assessed the five-factor personality dimensions of Extraversion and Conscientiousness of both the manager and the subordinate using the PK5

(Psykologien Kustannus Inc., Finland) Finnish Big Five personality inventory. The PK5's five dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience, have altogether 150 items which are rated on a five-point scale (1 = totally disagree, 5 = fully agree). The test has been standardized using a sample of 1107 Finns of working age (Psykologien Kustannus Oy, 2007). In our sample, the alpha reliabilities were 0.93 for Extraversion and 0.85 for Conscientiousness.

3.3.3 Psychophysiological measurements

Studies I–IV used two different types of systems for recording psychophysiological signals. Study III used a laboratory-scale Psylab Model EEG8 amplifier (Contact Precision Instruments, London, UK). For facial EMG activity, surface Ag/AgCl electrodes with a contact area with a four-millimeter diameter (Med Assoc. Inc., St. Albans, VT) were attached to the left corrugator supercilii and zygomaticus major muscle regions, as recommended by Fridlund and Cacioppo (1986). The electrodes were filled with TD-240 electrode gel (Med Assoc. Inc.). The raw EMG signal was amplified and frequencies below 30 and above 400 Hz were filtered out. The raw signal was rectified and integrated over 1000 ms using Psylab8 software. EDA was recorded by the Psylab Model SC5 24-bit digital skin conductance amplifier, which applied a constant 0.5 V across the Ag/AgCl electrodes over a contact area with an eight-millimeter diameter (Med Assoc. Inc.). The electrodes were filled with TD-246 skin conductance electrode paste (Med Assoc. Inc.) and attached to the middle phalanges of the ring and little fingers of the participant's non-dominant hand, after their hands were washed with soap and water (the ring and little fingers were used to reduce the motor artefact's evoked by typing of responses). The digital data collection was controlled by a Psylab Stand Alone Monitor and Psylab8 software, and all physiological signals were sampled at a rate of 1000 Hz.

Studies I and II used two Varioport-B portable recording systems (Becker Meditec, Karlsruhe, Germany) to enable recordings outside the laboratory, in the premises of the participating organizations. Study I-1 recorded Facial EMG activity from the left corrugator supercilii and orbicularis oculi muscle regions, as recommended by Fridlund and Cacioppo (1986), using surface Ag/AgCl electrodes over a contact area with a four-millimeter diameter (Becker Meditec, Karlsruhe,

Germany). The electrodes were filled with Synapse conductive electrode cream (Med Tek/Synapse, Arcadia, CA). The raw EMG signal was sampled at 1024 Hz, and frequencies below 57 Hz and above 390 Hz were filtered out by the built-in analog filter of the Varioport device. The device was attached by a belt to each participant's chest. All data were stored on a CompactFlash memory card (2 GB) after digitizing by a 16-bit A/D converter. Electrodes were also placed on the left zygomaticus major muscle area. A ground electrode was placed on the right collarbone.

Study I-2 employed the same setup as that of Study I-1, except that EEG was added. EEG was recorded at six sites (F3, F4, C3, C4, P3, P4) using linked mastoids as the reference. The Ag/AgCl electrodes were placed on a stretch cap in accordance with the international 10/20 system. Electro-oculogram (EOG) was measured to help detect vertical and horizontal eye-movements to facilitate the removal of eye-movement related artefacts. Bipolar electrodes were placed above and below the right eye and on the outer canthi of both eyes, respectively. The EEG signal was sampled at a rate of 256 Hz, using 0.1-Hz high-pass and 100-Hz low-pass filters. Electrode impedances were kept below 5 k Ω .

In Study II, the setup of the measurement devices was the same as that in Study I-2, with the exception that EMG activity was recorded using electrodes placed on the zygomaticus major (cheek muscle), and orbicularis oculi (periocular muscle) regions, following the recommendations of Fridlund and Cacioppo (1986).

Study IV used the Varioport-ARM device with a 16-bit A/D converter (Becker Meditec, Karlsruhe, Germany) because this enabled the biofeedback functionality that was required in the experiment. The setup of the recording device was the same as that in Studies I-2 and II. However, EMG activity was recorded in the left corrugator supercilii, zygomaticus major, and orbicularis oculi muscle regions, and EDA was recorded by a Varioport digital skin conductance amplifier, which applied a constant 0.5 V across Ag/AgCl electrodes to a contact area with an eight-millimeter diameter (Becker Meditec). The electrodes were filled with TD-246 skin conductance electrode paste (Med Assoc. Inc.) and attached to the middle phalanges of the first and second fingers of the participant's non-dominant hand, after their hands were washed with soap and water. The EDA signal was sampled at a rate of 32 Hz. In addition to being stored on a memory card for offline analysis, the physiological data were also transmitted at a rate of 250 Hz to the Python script for real-time emotion assessment.

3.4 Data reduction and pre-processing

3.4.1 Study I-1

After initial filtering by the measurement device, Study I-1 data were analyzed using Matlab (v.7.7.0) software with an Anslab Professional (v.2.4) toolbox. The EMG signals were rectified and smoothed using a 50-ms moving average. The processed signals were saved using a sampling rate of 10 Hz. The mean values of the facial EMG signals throughout the discussion and also during the baseline period were calculated. Finally, these values were natural log-transformed to normalize the distributions (Tabachnick & Fidell, 2007).

3.4.2 Study I-2 and II

In Study I-2, the EMG data were analyzed using Matlab (version R2012b) with Signal Processing and Statistics toolboxes. A 50-Hz notch filter and a 90-Hz high-pass filter were applied, and the signals were rectified and smoothed with a 100-ms moving average window.

The EEG signal was analyzed using Analyzer 2 software (Brainproducts Inc.). A 50-Hz notch filter was applied and eye-movement artefacts were removed using an ocular correction algorithm (Gratton, Coles & Donchin, 1983). In addition, the one-second segments that contained activity exceeding $\pm 85\mu\text{V}$ were removed. For the remaining epochs, the power spectra were derived using fast Fourier transform (FFT), and by applying the Hanning window to the distal 10% at the ends of the epoch. The power values (μV^2) of the alpha band (8–12 Hz, Buzsaki, 2006) were extracted for each epoch. A frontal asymmetry index was calculated using natural logarithmic transformation, with an equation of $\ln(F4) - \ln(F3)$. Thus, higher scores indicated greater relative left frontal activity (e.g. Allen, Coan, & Nazarian, 2004). For the mean values of the signals, Δ values (mean of 30 min discussion – mean of 5 min baseline) were calculated.

3.4.3 Study III

In Study III the mean values for each physiological signal for the last seven minutes of the 7.5-minute experimental task were derived. Psylab8 analysis software was used to calculate both the SCL and frequency per minute of the non-specific skin conductance response (NS.SCR.freq.) indices from the EDA signal. The values of the physiological data were $(\ln + 1)$ transformed to normalize the distributions.

3.4.4 Study IV

The EEG data of Study IV were analyzed using BrainVision Analyzer 2 software (Brain Products, Gilching, Germany). A 0.1-Hz high-pass, a 100-Hz low-pass, and a 50-Hz notch filter were applied. An ocular correction algorithm (Gratton & Coles, 1983) was applied to remove eye-movement artefacts. The EEG data were segmented, for each trial, into a baseline (two seconds preceding the onset of the “Be ready” text), pre-decision (four seconds preceding the participant’s decision), and post-decision period (three seconds, beginning a second after the outcome was revealed). The power spectra were derived for these epochs using the fast Fourier transform (FFT) method, and by applying a Hanning window to the distal 10% at each end of the epoch. Power values (μV^2) were extracted for the broad alpha band (8–12 Hz), and frontal asymmetry index was calculated for each segment using the equation $\ln(F4) - \ln(F3)$, as suggested by Allen, Coan and Nazarian (2004), in which higher scores indicate greater relative left hemisphere activity.

The facial EMG data were processed using ANSLAB software (version 2.4, University of Basel, Germany). The signal was filtered with a 50-Hz notch filter and a 20-Hz high-pass filter, rectified, and smoothed using a 50-ms moving average window. The mean values for facial EMG were derived for each trial for a baseline (two seconds preceding the onset of the “Be ready” text), pre-decision (four seconds preceding the participant’s decision), and post-decision period (five seconds beginning from the 2nd second after the outcome was revealed). The values were logarithmic transformed to normalize the distributions.

3.5 Statistical analyses

3.5.1 Study I-1

The Study I-1 analysis used linear mixed models (LMM) in SPSS with restricted maximum likelihood estimation and Compound Symmetry: Heterogeneous covariance structure. The running number of the discussion was set as the subject variable, and Role (manager/subordinate) $\times$ Order of discussion (1st/2nd) was set as the repeated variable. The model included role, manager’s order of discussion, number of females in dyad (none, 1, or 2) and the 360-degree assessed manager’s trait EI and its interaction with role. The respective baseline value was also included when testing for psychophysiological mean values.

3.5.2 Study I-2

The analysis of Study I-2 were conducted with LMM in SPSS, following the suggestions of Kenny and colleagues (2006). All the values of the predictor variables were centered around their dyad means, as suggested by Kenny and colleagues. An actor effect is the effect of a predictor variable on the same person's outcome variable, whereas a partner effect is the effect of a person's predictor variable on his partner's outcome variable (Kenny et al., 2006, pp. 145). Thus, in the model, each participant served as both an actor and a partner. The dyad was set as the subject variable, and role (manager/subordinate) as the repeated variable. Compound Symmetry: Heterogeneous was used as the covariate structure. The actor and partner effects of EI and their interactions, and the number of females in the dyad were also included in the model, as were role, the interactions of the role with the actor, and the partner effects of EI. When testing for psychophysiological values, the respective baseline value was also included.

3.5.3 Study II

Like Study I-2, the analyses of Study II were conducted with LMM in SPSS, and the values of the predictor variables were centered around their dyad means. The dyad was set as the subject variable, and role (manager/subordinate) as the repeated variable. Compound Symmetry: Heterogeneous was used as the covariance structure. The actor and partner effects of Extraversion and Conscientiousness personality dimensions and their interactions were included in the model, as was the duration of the manager-subordinate relationship and the number of females in the dyad (0, 1, or 2). The model also included role and its interactions with each of the actor and partner effects of the two studied personality dimensions. Each of the Δ (discussion – baseline) psychophysiological values and self-report measures were set as a dependent variable, one at a time.

3.5.4 Study III

Study III's analyses were conducted using the General Linear Model (GLM) repeated measures procedure in SPSS, with two within-subject factors: Task (two levels: Routine, planning) and emotional state induction (four levels: Depressed, nervous and stressed, pleasantly excited, pleasantly relaxed). Planned contrasts were used for analyzing the hypotheses (Rosenthal, Rosnow & Rubin, 2000): Contrast 1:

Routine task versus planning task, Contrast 2: Positive cues of group emotion versus negative cues of group emotion, and Contrast 3: High-arousal cues of group emotion versus low-arousal cues of group emotion. The contrasts were orthogonal within the analyses of each dependent variable.

3.5.5 Study IV

The analyses for the pre-decision physiological data and the emotional ratings for the VC facial expressions were conducted using the LMM procedure in SPSS with restricted maximum likelihood estimation. The subject variable was the participant ID, and the trial number was set as the repeated variable. AR(1) was used as a covariance structure for the residuals. The following fixed effects were specified: Participant gender, VC, participant decision in Trial n-1, VC decision in Trial n-1, VC facial expression, pre-trial baseline physiological value, participant gender $\times$ VC interaction, participant decision (in Trial n-1) $\times$ VC decision (in Trial n-1) interaction, and participant decision (in Trial n- 1) $\times$ VC Facial Expression (in Trial n) interaction.

The Generalized Estimating Equations procedure in SPSS was used for predicting the cooperation/defection decision. Participant ID was set as the subject variable, the trial number was set as the within-subject variable, and a binomial distribution with a logistic link for the response variable (decision to cooperate/defect) was specified. Following the Corrected Quasi-likelihood under the Independence Model Criterion (QICC), independence was specified as the structure of the working correlation matrix. The gender of the participant, VC, participant decision in trial n-1, VC decision in trial n-1, VC facial expression, and the baseline and pre-decision physiological variables were included in the model. The following interactions were also included: Participant decision in trial n-1 $\times$ VC decision in trial n-1, participant decision in trial n-1 $\times$ VC facial expression, and VC decision in trial n-1 $\times$ VC facial expression. Bonferroni correction was applied when conducting the pairwise comparisons of the levels of the VC facial expression factor.

4 Results and discussion

4.1 Studies I-1 and I-2

Regarding *RQ2* concerning the role of EI in organizational face-to-face social interaction, the main finding of **Study I-1** was that high EI in the manager was related to increased orbicularis activity in the dyad; $F(1, 52.63) = 5.68, p = .02$. This suggests that the manager's high EI evoked more positive valence facial expressions among the dyad members. This finding also lends partial support to the suggestion that high EI may be related to increased expressiveness. The indisputably positive effects of the expressions of positive emotions in organizational settings have been reported in various previous studies; for example, followers' ratings of leadership quality are related to a leader's positive expressions (Lewis, 2000; van Kleef, 2014). Followers seek emotional information from the leader and are also affected by the leader via emotional and mood contagion. The mood transmitted from leader to followers may result in, for example, increased coordination and effort (Sy, Côté, Saavedra, 2005).

It is possible that the participants were affected by cultural, organizational and role-related display rules that discouraged the expression of negative emotions. Being able to control emotional expression is an important skill in work life (Gross, 1998), but although display rules, implemented through emotion regulation strategies, may be beneficial on the organizational level, on the individual level they can lead to emotional labor (Grandey, 2000). However, in certain situations, the leader's expression of negative emotions may have an energizing effect (Lindenbaum & Fielden, 2011) and may even evoke perceptions of honesty and credibility (Bucy, 2000; Bono & Ilies, 2006). Performance review discussion is potentially an event in which the leader could also express negative emotions, when providing constructive feedback for and suggesting developmental tasks to the follower.

In **Study I-2**, the managers had more approach motivation during the discussion, as measured by EEG frontal asymmetry; $F(1, 26.65) = 5.13, p = .03$. This suggests that the managers were more involved in the discussion since they were more in charge of the situation, and their behavior was, after all, under more scrutiny. This effect was more prominent among the managers with low EI (they had more EEG-asymmetry-indexed approach motivation), but was the opposite among the subordinates; $F(1, 34.33) = 6.47, p = .02$. One possible explanation for this could be that the managers with low EI tried to compensate for their lack of EI and related

skills with more active, engaging behavior. However, no role differences were observed in expressiveness.

Both actor and partner EI led to more positive valence ratings after the discussion; $F(1, 45.75) = 10.62, p = .002$, and $F(1, 44.35) = 12.31, p = .001$, respectively. This finding is rather novel, given that actor and partner effects have not previously been widely studied in observed or measured behavior during dyadic face-to-face interaction, especially in the organizational context. The role of actor EI in social processes has, however, been reported in previous studies of marital interaction and satisfaction: Actor EI has shown to be related to the relationship satisfaction of heterosexual couples (e.g., Smith, Heaven, & Ciarrochi, 2008), and to constructive conflict resolution strategies (Zeidner & Kloda, 2013). Partner effects of EI on couple's perceived relationship quality have also been reported (Schröder-Abé & Schütz, 2011). Thus, Study I contributes to the growing field of actor and partner effects of EI during dyadic interaction.

An interaction effect indicated that if actor EI was low, high partner EI had a more positive effect on the valence rating; $F(1, 29.57) = 4.75, p = .037$. A somewhat similar effect has been reported, in which low EI employee's job satisfaction was associated more positively with the manager's EI than high EI employee's work satisfaction did (Sy, Tram, & O'Hara, 2006). The authors offered an explanation whereby the manager's beneficial role in emotion regulation was of more use for the low EI employees because their own emotion regulation skills were not as developed as those of the high EI employees. This finding also highlights the possible role of interaction effects in all studies of dyadic social interaction.

4.2 Study II

Regarding *RQ3* (What role does personality play in organizational face-to-face social interaction?), the main finding of Study II was that personality similarity in the Extraversion personality dimension had a positive effect. The actor and partner effects of Extraversion had an interaction effect on zygomaticus major and orbicularis oculi muscle activations during the discussion; $F(1, 28.60) = 4.19, p = .05$, and $F(1, 26.92) = 8.83, p = .006$, respectively. In both these facial EMG sites indicating positive emotional expressions, matching levels of Extraversion between the actor and the partner led to increased activation (Figure 3). These findings are in line with the notion that "personality similarity helps extroverts" (Cuperman & Ickes, 2009).

Extroverts are considered to have good social skills and enjoy social interaction (Funder & Sneed, 1993). During interaction, extroverts smile, laugh and exhibit enjoyment (Leikas, Lönnqvist, & Verkasalo, 2012). However, interaction between two extroverts can also have negative outcomes (Antonioni & Park, 2001), and extroverts have also been described as dominating during interaction (Funder & Sneed, 1993). This effect may also be visible on a team level, when highly extroverted members may evoke conflicts for leadership (Barry & Stewart, 1997). It is possible that in the current setting, the participants followed the prescribed hierarchical roles and there were no conflicts of leadership, possibly partly due to the discussion being video recorded and the participants having electrodes attached to them. It is also possible that the format of a performance review discussion is, after all, such that it encourages the participants to act according to their roles. The fact that the positive effect of personality similarity was also observed among the introverted participants points to the different interaction styles of extroverts and introverts, hindering interactions between these two (Cuperman & Ickes, 2009). Introverts may be more sensitive to interpersonal personality traits and may thus form more negative impressions of extroverts during interaction (Erez et al., 2015).

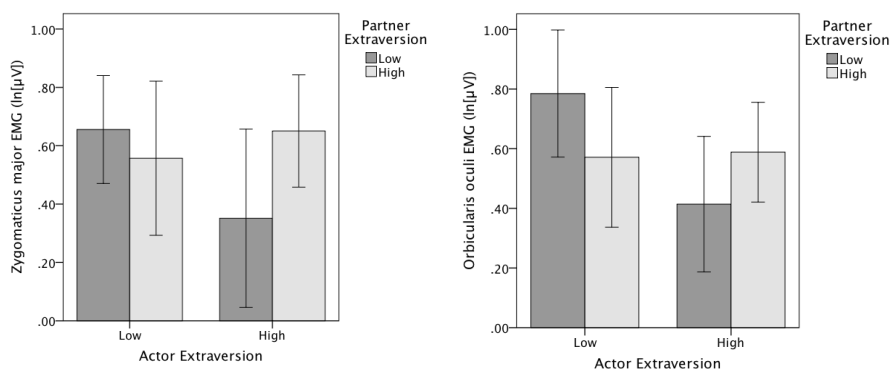


Figure 3. Actor × partner interaction effect of Extraversion on cheek muscle (left) and periocular muscle (right) activations. Reproduced with permission of copyright holder (Study II; Salminen, Henttonen, & Ravaja, 2016).

4.3 Study III

Positive cues of group emotion (pleasantly excited, pleasantly relaxed) evoked more positive self-reported emotional valence; $F(1,31) = 9.15, p < .01, \eta^2 = .23$;

higher perceived confidence in the other group members; $F(1,31) = 5.13, p < .05, \eta^2 = .14$; lower corrugator supercilii activation; $F(1,30) = 8.41, p < .01, \eta^2 = .23$, (Fig. 4); a lower skin conductance level; $F(1,30) = 11.78, p < .01, \eta^2 = .28$; and a lower frequency of non-specific skin conductance response (NS.SCR); $F(1,30) = 4.64, p < .01, \eta^2 = .13$ than negative group emotion cues (depressed, nervous/stressed). Thus, regarding *RQ4* (Does emotional contagion occur in technology-mediated social interaction?), the valence of the group emotional state was contagious to the individual. However, no effects indicating emotional contagion were observed for the arousal of the group emotional state. It is possible that the participants did not consider the information regarding the group's state of emotional arousal as important as the information regarding the group's emotional valence. After all, negative emotions are effective warning signals, and the quick spreading of these warning signals within the group is important for survival (Spoor & Kelly, 2004). It is possible that emotional valence, as a more salient signal, overrode the effect of emotional arousal. In addition, when the group status was nervous and stressed, the participants reported higher perceived stress. The participant may have interpreted that this stress experienced by other group members was due to the task being challenging; this in turn may have acted as a warning signal and thus evoked stress in the participant. It must be noted that not all stress is detrimental: Stress may increase the quantity of performance, but also decrease its quality (Kerr & Tindale, 2004). In groups, a moderate level of stress may increase effectiveness, whereas a high level of stress can lead to decreased performance (Adelman et al., 2003).

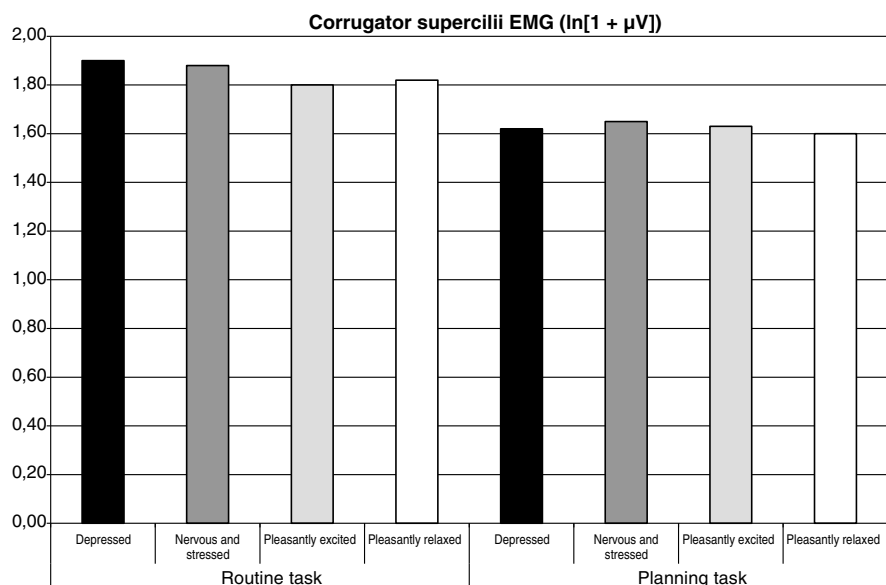


Figure 4. Mean values of corrugator supercilii activities for routine and planning tasks as a function of group emotion cue. Reproduced with permission of copyright holder (Study III; Salminen et al., 2013).

On the other hand, the observation (relevant for *RQ6*: What effects do technology-mediated information about the group's emotional state have on an individual?) that positive group emotional state led to higher experienced confidence in the other group members may have been evoked by positive emotional contagion. The mediated group positive emotional status may have led the participant to experience positive emotions. Existing positive emotional or mood state positively affects the experience of initial trust (Jones & George, 1998).

4.4 Study IV

Regarding *RQ4* (Does emotional contagion occur in technology-mediated social interaction?), emotional contagion from the VC was observed. Happy and positively relaxed VC faces evoked higher zygomaticus major: $t(4074.71) = 5.46, p < .001$; and orbicularis oculi: $t(4435.60) = 5.96, p < .001$; and lower corrugator supercilii: $t(5137.36) = -3.47, p < .001$ activities than the neutral VC face. In addition, angry and sad VC faces evoked higher corrugator supercilii activities than the neutral face: $t(5146.45) = 5.23, p < .001$.

An angry VC face evoked less zygomaticus major: $t(4030.90) = 2.60, p < .01$; orbicularis oculi: $t(4374.18) = 3.24, p < .01$; and corrugator supercilii: $t(5095.83) = 4.47, p < .001$ activities than the neutral VC face when the participant had defected than when they had cooperated in the previous trial. These findings support the notion that facial expressions evoked by VC emotional facial expressions depend not only on previous interaction, but also on display rules (see, for example, Zaalberg, Manstead & Fischer, 2004). This suggests that expressions of malicious pleasure, such as smiling at anger evoked by one's defection, may be inhibited due to display rules. In addition, the VC's anger at defection is justifiable, and is thus expected to evoke less frowning in the participant than the VC's unjustified expression of anger. This suggests, regarding *RQ5* (Does emotion regulation occur in technology-mediated social interaction?), that emotion regulation occurs via display rules of emotions not only during interaction between humans (face-to-face or technology-mediated), but also during interaction between a human and a human-like computer-controlled virtual character or agent.

Regarding *RQ1* (How are a person's emotional expressions and internal motivation state related to their behavior in social decision-making?), the participant's high corrugator supercilii activity during the pre-decision period was related to defection: $\chi^2 = 10.308, p = .001$. In addition, relatively greater EEG left frontal activation during the pre-decision period predicted defection; $\chi^2 = 34.439, p < .001$. These findings suggest that frowning expressions signal antagonism rather than willingness to cooperate, and that pre-decision frontal asymmetry is related to the anticipation of a high pay-off achievement rather than to the motivation to establish cooperation as such. After all, in the experiment, the pay-off matrix was built so that human defection was needed to achieve a high pay-off.

5 General discussion

5.1 Overview of the results

The results regarding *RQ2* and *RQ3* about the roles of EI and personality during performance review discussions contributed to the field of organizational face-to-face dyadic social interaction by providing new information on the effects of dispositional factors on emotional processes. They showed that trait EI (both actor and partner) had positive effects on subjectively reported emotional valence and psychophysiological measured emotional expressions during a performance review discussion (*RQ2*). The greater expressiveness suggested to be related to trait EI was not unequivocally validated, and needs to be studied further. However, the obtained results encourage further research on EI not only in a negotiation context, as in previous studies (e.g., Der Foo et al., 2004), but also in other work life interactions, as well as examination of specific forms of emotional expressions, as suggested by Morris and Keltner (2000).

The work contributing to the effects of personality during the performance review discussion (*RQ3*) continued on the path set by previous studies that have explored manifestations of personality during dyadic interaction (e.g., Cuperman & Ickes, 2009; Funder & Sneed, 1993; Leikas et al., 2012). However, the current study used psychophysiological measurements rather than analyzing video-coded behavior. The hypothesized similarity attraction effect was present in the Extraversion dimension of the Big Five personality construct. The psychophysiological methods utilized in the work for these RQs have not been widely used to study dyadic face-to-face social interaction since the studies of Levenson, Gottman and colleagues (e.g. Levenson & Gottman, 1983). The obtained findings also contribute to the growing field of dispositional factors' effects on different work outcomes by providing new information on the effects these individual differences may have on behavior on the dyadic level (see, for example, Tschacher, Ramseyer, & Koole, 2018; Wilson et al., 2016). In particular, the use of dyadic analyses and the inclusion of the effect of role enabled the study of the multifaceted effect of social power that a manager has over a subordinate. After all, social power affects not only displaying of emotions, but also the perception of the other's emotional expressions (e.g., Ragsin & Winkel, 2011).

Regarding the RQ about emotional contagion in technology-mediated social interaction (*RQ4*), the findings showed that emotional contagion may also occur from

a VC to a participant during a dyadic social decision-making task. The VC's facial expressions evoked congruent facial muscle activity among the participants. Emotional contagion also occurred from a simple textual cue in a distributed, computer-mediated setting, in a group in which the participants did not know each other. Emotional contagion was visible not only in self-reports, but also in psychophysiological activity. In addition, the group's negative emotional state led to decreased self-reported confidence in the group (*RQ6*).

The findings regarding the dissertation's RQ about emotion regulation during a technology-mediated social interaction (*RQ5*) suggest display rules for emotional expressions during the social decision-making task with the VC. This implies interesting similarities between interactions with a computer-controlled VC and those with a real human partner. Regarding the dissertation's RQ about the emotional expressions and internal motivational state during social decision-making (*RQ1*), the participant's frowning expression and EEG-measured approach motivation preceded defection in the study. This finding (and those related to *RQ4* and *RQ 5*) contribute also to the field of human – (computer controlled) agent interaction. Brain activity and facial expressions evoked by a VC's emotional expressions have not been studied widely, especially in the context of social decision-making (however, see Choi et al., 2012, Ravaja et al., 2017).

5.2 Theoretical contributions

Studies I–IV contributed to Levels 1 to 4 of Ashkanasy's (2003) **five-level model of organizational emotions**. Ashkanasy mentions the short duration of emotions as one of the problems in studying emotions in organizations. As a solution, he suggests the experience sampling method (ESM) with hand-held computers, although he also mentions the intrusiveness of this approach. Experience sampling could also be done using dedicated smartphone applications. One solution to the intrusiveness problem could be the use of mobile psychophysiological measurement devices. For example, social psychophysiological compliance has been utilized to study the effectiveness of teamwork during meetings (Henning, Armstead, & Ferris, 2009).

The studies of the current dissertation provide new insights into the use of **psychophysiological methods** in the study of social interaction, and into how these methods could be used in real organizational environments. This also contributes to

the field of (organizational) social psychophysiology (e.g., Blascovich & Mendes, 2010). When considering the method's viability in the study of organizational psychology, or as a tool for practitioners in the field, it must be emphasized that the psychophysiological response is only one of three components of an emotion (see Section 1.2), and if possible, a multi-method approach should be used for assessing emotions. In the current dissertation, the psychophysiological recordings were accompanied by self-reports of the subjective emotional experience. It is not uncommon that psychophysiological responses and self-reports produce conflicting results. For example, Study II observed no statistically significant correlations between measures of facial activation and self-reported emotional valence. This may be due to the fact that these methods assess the expressive and subjective component of the emotion, respectively, and these different components may not always correlate. It must also be noted that psychophysiological activation is measured continuously during the experience, whereas self-reports have to be collected after the experience or during convenient breaks, which means that they may be affected by memory and social desirability bias (e.g. Ravaja, 2004).

Organizations are a challenging **context** for the study of emotions. Certain emotion-related processes, which are also relevant for organizational behavior, can be studied using strictly controlled laboratory experiments. However, context, which constitutes various aspects (e.g., organizational culture, nationality, field of industry), definitely influences emotional processes in organizational behavior. Thus, it has been suggested that in the study of emotions in organizational behavior, research should move from the laboratories into the field (Gooty, Gavin, & Ashkanasy, 2009). Underlying this concern in the field of organizational behavior is the dichotomy between qualitative researchers, who take into consideration the context, and quantitative researchers, who claim to study generic phenomena (Johns, 2006). This dissertation handled this juxtaposition by employing a quantitative methodology, psychophysiological measurements, in the context of real organizational social interactions.

The finding that emotional contagion occurred within a distributed, technologically connected group has relevance, especially for the field of computer-supported collaborative work (CSCW), in which it is possible to work in a team or group with little or no face-to-face interaction, and the cues of the group's status may be mediated by different technological platforms. In these instances, group

identification may be based on minimal information about the other group members. The **minimal group** paradigm has been used in various study fields (Otten, 2016), and was first presented by Tajfel and colleagues (1970, 1971, 1974) for studying social categorization and in-group favoritism, which may occur even without strong leadership, interaction or group cohesion (Ashforth & Mael, 1989). The findings of Study III highlight the strong effect that mediated emotional information may have on group dynamics.

In Study III, identification with the minimal group may have enabled or enhanced **emotional contagion**, as the participant, possibly unconsciously, may have wanted to experience the same emotions as the group. There was almost no communication between the group members: The aggregated group emotional state, shown as a verbal description, was the only information communicated about the other group members. However, the participants were led to believe that the other group members were conducting the same tasks at the same time, and that at the end there would be a group discussion about each of the participant's responses to the tasks. It is possible that the textual cue of the group's emotional status evoked **appraisal** processes in the participant. Appraisal theories state that it is not the events as such, but the appraisals evoked by them that give rise to different displays of emotion. Cognitive appraisals are conducted with respect to goals, desires, and beliefs (Ellsworth & Scherer, 2003; de Melo et al., 2014). Reverse appraisals, on the other hand, are inferences made from emotional displays about the expresser's goals. The reverse appraisal pathway may be contrasted by the affective pathway, in which emotional expression of the other directly evokes emotion in the observer by, for example, emotional contagion or mimicry (de Melo et al., 2014). This contagious emotion might then affect the decision-making of the observer, for example. Social appraisals can be considered as the third possible pathway (de Melo et al., 2014, Manstead & Fischer, 2001), according to which others' emotional expressions (or emotional information) affect one's appraisals in the situation, and these in turn evoke emotions in the observer. Thus, the text cues of the group's emotional status may have evoked a social appraisal process in the participants, when they inferred the appraisals that the other group members had made, leading to each of the visualized emotional states. The group's negative emotional state may have led the participants to the conclusion that the other group members were encountering difficulties in

conducting the task, and this may have led the participants to experience stress, which was visible as EDA.

Emotional contagion occurred in both Studies III and IV, in which the social setting was mediated by technology. In Study III, the textual cues of the group's emotional status were contagious in both the self-reported and the psychophysiological activity, and in Study IV, the VC's facial expressions evoked congruent facial muscle activity in the participants, thus verifying that at least some of the processes present in face-to-face interaction between humans persist in communication with a computer-controlled agent. Previously, emotional contagion has been studied in face-to-face settings (e.g., Barsade, 2002) and during technology-mediated negotiation (Van Kleef et al., 2004). In the case of email negotiation (e.g., Thompson & Nadler, 2002) the communication media is actually quite rich and offers a wide channel. The main contribution of Study III was that it showed that the group's emotional state was contagious via mere textual cues consisting of one or two words. One could argue that the social nature of the setting had little or no effect on the contagion of the group's emotional state, and that the emotional contagion was caused by only the cue words. However, positive group status also increased perceived confidence in the other group members, thus suggesting possible relations between group emotional state and social processes.

The **Emotions as social information (EASI)** model, with its division into affective and inferential paths in emotional processing, has been used in studies of organizational social interaction, and offers a framework for interpreting the results of the current studies. Van Kleef's EASI model (2009) posits that symmetrical effects of anger and happiness are mediated by affective reactions, and asymmetrical effects are mediated by inferential processing. This suggests that in Study II, similarity in the Extraversion personality dimension may lead to affective rather than inferential emotional processing. In addition, the positive emotional contagion observed in Studies III and IV would be, according to the EASI model, mediated by affective processing. The EASI model also suggests that social power may act as a moderator in determining the relative strength of either the affective or inferential process in the perceiver of emotional expressions. According to the model, the managers in Studies I and II (with higher social power than the subordinates) would have had lower information processing motivation and thus higher motivation for affective processing

of the partner's emotional expressions. However, this would have to be confirmed by future studies.

Study IV found signs that the participants were regulating their emotional expressions towards the VC, and thus acting according to certain display rules of emotion. This kind of **emotion regulation** is not covered in the original EASI model, but is included in the **Cybernetic emotions as social information** model (C-EASI; Johnson, Griffith & Buckley, 2016). The C-EASI model is a combination of the EASI model and the Cybernetic model of impression management (Bozeman & Kacmar, 1997), and aims to explain the relations between the actor's impression management, emotional expressions, and the resulting behavior of the perceiver. The C-EASI models the cyclical process that occurs in interpersonal settings during attempted impression management. During this process, the actor aims to generate desired impressions using both verbal and non-verbal impression management cues. The original EASI model focused on the effects of these cues on the formation of opinions and affective evaluations. One of the central ideas of the C-EASI model is that when attempting to manage impressions, the actor observes the target's behavior, which reveals whether the actor has been successful in these attempts. This amendment to the original EASI model adds the cybernetic nature of feedback loops to the C-EASI model. It remains to be confirmed in future studies whether the participants of Study IV conducted emotion regulation consciously or unconsciously. Whether or not the participants receive direct feedback on the success of the emotion regulation employed could also be manipulated.

5.3 Limitations

Studies I–IV used self-reports in addition to psychophysiological methods. It must be noted that using self-report responses poses obvious problems related to social desirability bias. These issues may be intensified in the organizational context, where one is tempted to give a competent image of oneself. Study I used the 360-degree method in addition to traditional self-reports to assess the leader's EI. It could be beneficial, especially in different development programs, to use both self-reports and 360-degree feedback, and that the person in the development program would particularly benefit from studying the differences between their self-rated qualities and those rated by their peers, colleagues and superiors. Observing the possible

discrepancies between self- and others' ratings would be valuable when considering development goals.

Certain issues may arise when using psychophysiological methods in the study of social interaction. The electrodes used to measure physiological activity are sensitive to movement, which may cause them to become detached, and movement may induce artefacts in the signals. Movement may be a cause of artefacts even in a laboratory environment: In Study III, the participants used a keyboard to complete the tasks, and this probably affected the EDA signal measured from their fingers. However, in Study III, not all the EDA results could be explained by movement artefacts; there were also EDA differences related to the mediated group emotional state.

In addition, when participants have electrodes attached to them, their behavior inevitably changes. The electrodes remind them, during the studied interaction situation, that they are being monitored. During face-to-face social interaction, one is constantly aware of the other's electrodes. The presence of cameras and microphones may also evoke similar reactions. It must also be noted that different participants' reactivity to the electrodes and other data collection apparatus may vary. Future studies of social interaction should control this participant-related variance. It is also possible that the participants did not perceive the performance review discussions as "real" because they were conducted as part of a research and development project. This may have led to the participants not taking the discussions seriously and possibly feeling less personal involvement and emotional arousal. This in turn may have resulted in both decreased self-reported and physiologically measured arousal.

Another problem related to psychophysiological signals is the fact that they are often affected by various psychological processes, as well as other factors. For example, EDA responsivity may be affected by hormonal changes (Gómez-Amor et al., 1990). Although psychophysiological methods are sometimes described as objective, the researcher's interpretation which links the objectively measured physiological response to a certain psychological process is always needed. For example, the frontal asymmetry of the EEG, measured in Studies I, II and IV, does not only index the approach motivation during social interaction; it may also be affected by eye-contact (Hietanen et al., 2008). Another example is corrugator supercilii activation, which was analyzed in Studies I, II and IV. In addition to negative emotional valence, corrugator activation may be related to effortful attention

(Cohen et al., 1992). Thus, more studies are needed to confirm the validity and psychological processing related to the physiological measures in the context of dyadic interaction.

It is possible that in Studies I and II, some sort of selection bias occurred among the participants. The managers may have felt pressure from higher management to take part in the study, and the participating subordinates may also have felt similar pressure to participate. The participating managers may have tried to recruit subordinates with whom they felt that they had good relations. This would lead to positively toned discussions and make the manager look competent. It is also possible that in Study I, the more emotionally intelligent managers were better at selecting a more compliant subordinate for the discussion, and that the more extroverted managers in Study II (with better social skills) may have acted similarly. The managers were requested not to select their “best friend” for the discussion, but preferably someone with whom they felt they had something to develop in their leader-follower relationship. However, this effect cannot be fully ruled out when using this kind of setting for studying existing manager-subordinate pairs. After all, the participants have to volunteer for the study.

In Study III, the lack of an objective measure for the participant’s actual performance is a weakness. There was evidence of positive emotional contagion and increased perceived confidence among group members, which could lead to increases in performance (Barsade, 2002). An objective measure of performance would have benefitted both the theoretical and practical value of the study.

In Study IV, the generalizability of the findings may be limited by the fact that the VC’s facial expressions did not replicate the exact facial action units of the target emotions. Another limitation is related to the possibility that the participants may have learned that there was no actual correlation between the facial expressions and the decisions of the VC. This could have resulted in smaller effects in the outcome variables.

5.4 Future directions

The benefits of EI training for managers has been documented in various studies (e.g., Slaski & Cartwright, 2003; Groves, Pat McEnrue, & Shen, 2008; for a review, see Riggio & Lee, 2007, and Hodzic et al., 2017). The subset of emotional expressivity could be similarly developed in a dedicated program. Promising results

regarding the development of some related constructs already exist. For example, charismatic influence training, including skills such as emotional expressivity, has shown to have positive effects on influencing followers (Towler, 2003). This dissertation contributes to this endeavor by providing a scientific background for the role of EI during organizational social interaction.

In the development of interaction skills, video recordings are an invaluable tool. Observing one's actual behavior in a leadership social interaction may provide insights into how one's personality, EI and related dispositional factors are manifested during social interaction. The video files can be enhanced using visualizations of autonomous nervous system activation during the discussion, to better understand the non-visible emotional physical reactions. Various affordable consumer grade recording devices, designed to be unobtrusive, are already available for this purpose.

Technological developments will offer new ways to measure and mediate emotions. In the area of technology-mediated communication, different technologies for detecting the emotional state of the individual and different formats for presenting emotional information could be studied in various organizational contexts. In addition to psychophysiology, emotions may also be detected automatically by facial and vocal expression analysis (e.g. Pantic and Rothkranz, 2003). The mediation of emotional information would not have to be limited to visual modality; touch, for example, could also be used for conveying emotional information (Mathew, 2005). The advances in 3D virtual reality technologies have enabled the production of almost lifelike avatars. These avatars have various practical uses, ranging from games and entertainment technology to avatar-based communication, and could also be used as training tools for improving social and emotional skills. In basic social psychological research, avatar technology could be utilized for studying dynamic transitional emotional expressions, for example (Filipowicz, Barsade, Melwani, 2011).

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