At The Heart of Digital Collaboration
Navigating Interpersonal Affective Pathways in Digitalized Work Environments

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ABSTRACT

This dissertation delves into the intricate and pluralistic nature of interpersonal affective processes in online collaborative environments. Recognizing affect as a psychophysiological phenomenon that transcends purely cognitive or physiological experiences, this work explores the dynamic interplay between internal mental or biological changes and external social or physical factors. Central to this exploration is the concept that these affective processes, crucial in structuring online collaboration, can only be fully comprehended only through a holistic approach. Accordingly, this research comprises four interrelated studies, each contributing uniquely to the overarching aim: to elucidate how digital media technologies shape affective experiences in digitalized collaborative work settings. The first study introduces Mood Synchronicity Theory, focusing on how media-enabled affective processes influence team problem-solving dynamics. The second study, a theory-generative research synthesis, proposes a model of affective alignment in online collaboration and expands on Media Affectivity theory, exploring the role of digital collaboration tools in mediating affective information exchange. In the third study, a laboratory experiment quantifies different trajectories proposed by mood synchronicity and media affectivity theories, particularly examining affective alignment's moderating role between team colocation and creative outcomes. The final study, focusing on neurodivergent workers, particularly those with autism, investigates how variations in brain functioning can alter typical experiences of digitalized collaborative environments. Findings suggest that technology bridges internal affective, cognitive, and physiological changes to external ones, opening up the social dimension of collaboration. Collectively, these studies offer a path-centric framework for understanding the complex interrelations between digital media, affective processes, problem-solving, creative outcomes, and neurodiverse experiences in digitalized workplaces. This dissertation not only sheds light on the transformative potential of digital tools in organizational practices but also paves the way for future research in the field.

Denne afhandling dykker ned i den komplekse og pluralistiske natur af interpersonelle affektive processer i online samarbejdsmiljøer. Ved at anerkende affekt som et psykofysiologisk fænomen, der går ud over rent kognitive eller fysiologiske oplevelser, udforsker dette arbejde det dynamiske samspil mellem interne mentale eller biologiske ændringer og eksterne sociale eller fysiske faktorer. Central for denne udforskning er konceptet, at disse affektive processer, afgørende for strukturen af online samarbejde, kun kan forstås fuldt ud gennem en holistisk tilgang. Som følge heraf består denne forskning af fire indbyrdes forbundne studier, der hver især bidrager unikt til det overordnede mål: at belyse, hvordan digitale medieteknologier former affektive oplevelser i digitaliserede samarbejdsmiljøer. Det første studie introducerer Mood Synchronicity Theory, der fokuserer på, hvordan medieaktiverede affektive processer påvirker holdproblemløsningens dynamik. Det andet studie, en teorigenererende forskningssyntese, foreslår en model af affektiv alignment i online samarbejde og udvider Media Affectivity-teorien, der udforsker rollen som digitale samarbejdsværktøjer i at formidle affektiv informationsudveksling. I det tredje studie kvantificerer et laboratorieeksperiment forskellige baner foreslået af mood synchronicity og media affectivity teorier, især undersøger den affektive alignments modererende rolle mellem holdplacering og kreative

resultater. Det sidste studie, der fokuserer på neurodivergente arbejdere, især dem med autisme, undersøger, hvordan variationer i hjernefunktion kan ændre typiske oplevelser af digitaliserede samarbejdsmiljøer. Resultaterne tyder på, at teknologi forbinder interne affektive, kognitive og fysiologiske ændringer med eksterne ændringer, der åbner for den sociale dimension af samarbejde. Samlet set tilbyder disse studier en vejcentreret ramme til forståelse af de komplekse relationer mellem digital medie, affektive processer, problemopløsning, kreative resultater og neurodiverse oplevelser i digitaliserede arbejdspladser. Denne afhandling kaster ikke kun lys over de transformative potentialer for digitale værktøjer i organisationspraksis, men baner også vejen for fremtidig forskning på området.

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INTRODUCTION

Displays of emotions are often considered unprofessional, giving rise to a myriad of strategies to hide or modulate one's emotions to match workplace norms and expectations. It is so common for employees to control their emotional displays in their professional roles that this phenomenon, which is particularly emphasized in customer-facing positions, is commonly referred to as "emotional labor" (Diefendorff & Gosserand, 2003). Paradoxically, emotions are also recognized as a core foundation of human experiences, including at the subjective and social levels (Barrett, 2017a; Lieberman, 2013). Despite those assumptions that emotions are ill-fitted to the work environment, this dissertation acknowledges that emotional experiences are not only a key part of our human individuality but also a core feature of social interaction – including in collaborative contexts. Interestingly, human nature lends itself to the involuntary "leak" of emotions, including in professional contexts. Yet, in online environments, those involuntary manifestations and outbursts encounter a variety of buffers that may hamper their visibility and consequences. In other words, a digital work environment may render collaborative experiences devoid of emotion to a much greater extent than traditional workplace norms would. The next few paragraphs introduce a vignette that illustrates how overlooking the importance of emotions can endanger team success and the ability of outside observers to fully grasp the mechanisms underlying visible elements of failures.

As the world grappled with the challenges of remote work amidst the COVID-19 pandemic, a team of scientists and engineers at NASA's Jet Propulsion Laboratory (JPL) in Southern California faced a mission unlike any other. Their goal was to launch the Psyche spacecraft to a unique metal-rich asteroid, believed to be the exposed nickel-iron core of an early planetesimal, a building block of our solar system. The mission was set to provide a window into the violent history of collisions and accretion that created terrestrial planets. Despite the groundbreaking potential of this scientific endeavor, the astronomical budget allocated to the mission, and the infallible dedication of elite engineers and scientists, the space agency was forced to delay the launch. Following the June 2022 announcement, an Independent Review Board (IRB) was chartered to investigate the delay. The committee unveiled surprisingly simple – yet not unfamiliar – issues that contributed to the mission failing to meet its deadlines. As it turned out, NASA had again fallen victim to systemic communication dysfunction. Like a painful reminder of the deadly events of the 1986 Challenger and 2003 Columbia missions, the Board identified key weaknesses in communication across the agency and within the Psyche team. Yet, this time was different. From the onset of COVID-19 sanitary restrictions in March 2020 until late 2022, the Psyche team, like many other teams around the world, had to reinvent their collaboration as they shifted to remote and hybrid work modes. Interestingly, the IRB clearly identified this work setting as a major culprit in the team's productivity decline leading up to the delay. For example, the Board observed "deficiencies in both formal and informal channels of communication, and multiple failures to act decisively upon the

information shared." Based on this assessment, the Board recommended that "remote and hybrid work must be minimized on Psyche to give the team the best opportunity to coalesce in a short time." Arguing that informal "drop-in discussions" and "walking the floor" needed to be re-established, the Board further stated that "prior studies of hybrid and remote work arrangements indicate that trust can fray in remote settings, and working apart discourages integrative activities. Going forward, Psyche team members must reestablish trust and communication pathways, and conduct highly time-intensive, integrative work as a team." These conclusions rattled the entire laboratory, as management went on to implement new policies to restrict remote work arrangements. The new policies enforced three days of onsite work per week, not only for the Psyche team but for the majority of JPL employees. When reviewing the case in May 2023, the IRB expressed satisfaction with the changes implemented, observing that "drop-in meetings, social coffee hours, off-site intensives, and individuals 'walking the floor' have improved team interaction, problem-solving, efficiency, and trust." As the mission successfully launched in October 2023, one could hastily conclude that online collaboration is simply incompatible with high-stake projects requiring high levels of trust and complex problem-solving.

Information Systems (IS) scholars have been interested in such phenomena for a long time. Yet, existing IS literature does not seem sufficient to explain the issues experienced at JPL. According to core media theories (e.g., Daft & Lengel, 1986; Kock, 2004), the use of video-conferencing systems such as Zoom or Webex facilitates experiences of unprecedented richness as users can interact in ways that closely resemble natural face-to-face interaction. Moreover, the plurality of available tools should have made it possible for the team to flexibly select the most appropriate channels to share and discuss information of different levels of complexity. Platforms like Slack or Microsoft Teams give organizations immediate access to a broad range of communication modes, such as instant messaging, collaborative documents, audio-based screen sharing, video calls, etc. (see Dennis et al., 2008). This range of available information-rich features should promote optimal remote collaboration by supporting team members as they share information, negotiate the meaning of this information, and develop shared mental models around the information. Given the sophistication of digital collaboration platforms and the resulting richness of online interaction, the Psyche Team's remoteness did not present obvious risks of becoming such an issue.

In the realm of IS scholarship, the predominant focus has historically gravitated toward the cognitive dimensions of collaboration, examining how various media capabilities facilitate cognitive alignment among team members. The emphasis was often on dissecting how synchronous video conversations, collaborative documents, and instant messaging contribute to a shared understanding and cognitive harmony. However, a crucial facet that has, to a large extent, eluded comprehensive exploration is the profound impact of affective and physiological linkage in remote collaboration. Working together remotely is not merely about the exchange of information – rather, it is about the subtle nuances embedded in the audio channel's capacity to replicate frequencies attuned to our physiological responses, the three-dimensional visual feed that enables the perception

of nuanced gestures like head tilts, and the replication of bodily cues such as the subtle rise and fall of the chest during breathing.

Some research in IS and organization behavior does suggest that different digital media may impact a team's ability to communicate cognitive and affective information differently (e.g., Kahai & Cooper, 2003; Nguyen et al., 2023). Still, such studies often treat affective communication as contextual information that serves cognitive alignment by facilitating the interpretation of shared ideas and the coordination of tasks. This type of affective communication, like cognitive alignment, is instrumental but insufficient to successful teamwork. Affective communication can indeed help people relate at a more foundational level, by creating a "bottom-up" affective connection among them (de Waal & Preston, 2017). This connection develops and evolves through shared emotional experiences and physiological states. These quiet processes often go unnoticed during physical interaction because of their primitive nature. Yet, digital media may not consistently accommodate this distinct layer of affective information, thereby making it challenging for team members to detect and respond to each other's affective states (De Waal, 2012). These insights are rarely present (and never central) in IS theories, which have embraced the cognition-centric view of affective communication. This oversight narrows our understanding of wicked communication issues where a team seemingly has all tools in hand to succeed, yet fails to deliver satisfactorily – as illustrated by the JPL vignette.

In other words, it seems unlikely that being remote inhibited the Psyche team's ability to communicate. In fact, the IRB could not identify specific communication breakdowns. Instead, the committee made loose references to informal chats, social coffee hours, trust, and coalescing. This vocabulary entertains the idea that the underlying issues might not be cognitive after all. The Board unwarily put the finger on the nuanced language encoded in affective processes enabled by subtle cues like a heartbeat or pupil dilation change that remain elusive in the seamless translation within the digital realm. This paradox challenges the assumptions that (i) emotions are unfit for professional behavior and that (ii) the mere richness of communication modes in platforms like Zoom and Slack is a panacea for effective remote collaboration. The landscape we navigate today is characterized by digital media of unprecedented sensitivity. Refined image definition and interconnected sensors redefine our perceptual boundaries, providing an opportunity to unearth and understand the significance of these primitive processes in the digital age. In particular, there are opportunities to examine how organizations may benefit from accepting emotions to be a part of their environment, thereby allowing them to make better decisions when it comes to communication and collaboration processes.

Despite the available literature and the evident surge in digital technology, recent studies have highlighted conflicting trends that existing theories cannot fully explain. For example, there is evidence that idea generation is impaired when teams interact over video conferences, as individuals find it easier to break focus and consider unique personal experiences when collaborating in person (Brucks & Levav, 2022). Yet, there is also evidence that ideas generated

using digital media may be more creative, as the surrounding online environments provide novel means to prime individuals to make different connections before the collaboration starts (Dennis et al., 2013). Research also suggests digital media's limited capabilities for interaction, tie strengthening, and dynamic power shifting make it difficult for team members to share complex information, challenge each other, and synthesize perspectives (e.g., Yang et al., 2022). Meanwhile, cross-functional teams may be more creative when allowed to develop individual perspectives (Riedl & Woolley, 2017). Finally, members of remote teams often feel less connected to their colleagues, more isolated, and struggle for meaning (cf. Sardeshmukh et al., 2012). Yet, large communities are turning to online environments in pursuit of an emotional connection (Hoffner & Bond, 2022), suggesting these environments possess the capabilities to support connectedness and the construction of meaning. These tensions are especially important to address considering that many organizations and employees have embraced hybrid work as a sustainable model going forward (Malhotra, 2021). As a result, there is a growing necessity for research to bridge knowledge about technology-mediated collaboration, creative teamwork, and mental well-being. Moreover, as this hybrid workforce organically becomes more neurodiverse (NCI, 2022), researchers must also understand the implications of diverse ways of processing emotional and social cues within teams. These tensions are especially important in the context of creative team management and collaboration software development.

To resolve inconsistencies in prior research and understand the relationship between affective processes and digital media for remote collaboration, this thesis presents a research program that explores the affective capabilities of digital media, aiming to investigate how digital media technologies shape affective experiences in digitalized collaborative work environments. This overarching goal guides a broad inquiry into the interaction of technology, processes, and people through an affective lens. First, this dissertation lays the theoretical grounds for understanding (i) how digitalized affective processes shape team collaboration during complex problem-solving and (ii) how technology shapes the digitalization of those affective processes. Second, it tests some of the relationships proposed in this theoretical core, examining differences in creative outcomes in different collaborative settings and group affective states. Third, it interrogates the overall depiction of affective processes presented in the dissertation, challenging assumptions of neurotypical affective processing and re-examining those relationships under the assumption of neurodiversity.

Altogether, the four studies contribute to a better understanding of the affective (studies 1, 2, 3, and 4), cognitive (studies 1, 3, and 4), and perceptual (studies 1, 2, and 4) experiences among members of teams that collaborate digitally. More specifically, all four studies explore and define the paths that link affect, cognition, physiology, and technology through an affective lens. This is an important contribution because, despite a long history of research and philosophical reflection on these topics, they are often treated separately. The affective lens facilitates the integration of foundational processes that often occur at the physiological level with other dimensions of collaborative work, such as cognitive alignment and communication media. Studies 1, 3, and 4

incorporate a cognitive layer that facilitates the investigation of output such as team creativity, ability to make decisions, or individual ability to contribute. Studies 1, 2, and 4 contribute to a better understanding of the perceptual processes that structure digital collaboration. They emphasize the important role of perception as one's ability to use their senses to interpret and react to stimuli. Studies 1 and 2 clarify ways in which technology reduces or augments team members' perceptual competencies. Study 4 dives deeper into the implications of asymmetrical or atypical perceptual experiences, explaining how digital media may increase or decrease perceptual stimuli, resulting in different affective and cognitive experiences. Taken together, the four studies therefore integrate foundational knowledge about affective processes, defining pathways that trickle down to cognitive and perceptual experiences through (mostly) physiological mechanisms. The research problem presented in this thesis is theoretically relevant to the IS field, which has always been interested in understanding the implications of the digital transformation of work. As we keep on developing digitalized work practices, IS scholars must set forth a research agenda that helps make sense of paradoxes and poor outcomes. With affect, this dissertation puts forward a new theoretical lens to understand classic IS problems – one that accounts for new developments in information technologies themselves but also in how people use them.

Moreover, the affective lens proposed in this dissertation is of practical relevance because it offers a substantial starting point for the design of information systems. For example, this dissertation calls for the development of "affect-first" capabilities that leverage unique neurophysiological responses to enhance user experience and team collaboration. This approach suggests, among others, integrating biosensor data and adaptive interfaces to create more personalized, emotionally resonant digital interactions, thereby improving well-being and communication within teams. Importantly, this approach has the potential to create more affectively attuned systems, resulting in more affectively attuned work environments, thereby promoting greater inclusivity in increasingly neurodiverse workplaces.

Before diving into the four interrelated studies conducted for this dissertation, the next section reviews emotion theories throughout history, offering a broad perspective on the study of emotions from Ancient Philosophy until today.

A TAPESTRY OF EMOTION: MATERIAL, SOCIAL, AND COGNITIVE PERSPECTIVES THROUGH HISTORY

Written accounts of the human understanding of emotions date back as far as Ancient Philosophy. While the quote "No man ever steps in the same river twice" is often attributed to Heraclitus, the accuracy of this translation and its subsequent interpretations has been subject to debate (Kirk, 1962; Marcovich, 1967). Although different translations lend themselves to different interpretations, Heraclitus' saying may demonstrate an avant-garde idea that the human body only exists by virtue of its constant metabolism (Graham, 2023). Our experiences and behaviors may thus be created in the moment by biological processes within our brain and body (Barrett, 2017a). Yet, the plurality of interpretations of Heraclitus' doctrines reflects the highly fragmented landscape of emotion theories that still prevails today. As we explore these fragments, it is therefore important to consider the unique position of emotions in the scientific landscape. Surgeons can journey through our bodies to identify tumors, infections, and lesions. Neuroscientists can trace chains of neural activation by means of electrical currents and blood flows. Doctors can find bacteria and viruses in samples of our blood. Emotions, like anger, for example, cannot be circled on the map of the human body. It cannot be observed with a microscope. And it certainly cannot be extracted from the body. In other words, emotions can only be described, explained, and imagined. As a result, theorizing about emotion is non-trivial, to say the least. Examining how our understanding of human emotions has evolved is both tedious and highly insightful.

Ancient Philosophy and Early Interpretations

Ancient Greece

Ancient Greeks' concept of emotion was captured by the word πάθος (or pathos, in English). Nevertheless, the term encompassed a range of meanings, from pain to passion, including death, misfortune, and incident. The lack of clarity surrounding the concepts makes it all the more difficult to assign contemporary meaning to ancient reflections (Konstan, 2006). Still, ancient philosophers were highly preoccupied with emotional experiences. Plato and Aristotle provided some of the most influential philosophical perspectives on the matter.

In Book IV of the *Republic*, Plato introduces a model of the soul consisting of three parts: the appetitive part, the spirited part, and the reasoning part (Knuuttila, 2014). The appetitive part is driven by basic desires, the spirited part is associated with emotions like self-assertion and aggression, and the reasoning part is responsible for knowledge and rational judgments. According to Plato, the reasoning part should govern the emotional components by regulating the appetitive

part and conditioning the spirited part to endorse virtuous behavior. He defines emotions as disturbances in the soul that may be caused by internal or external stimuli. Plato distinguishes between rational or irrational, and good or bad emotions. For instance, he considers courage and temperance good emotions, but fear and lust bad ones (Price, 2009). Plato suggests that humans can use reason to control their emotions, thus sticking to moral principles and achieving future goals (Vaida & Calbaza-Ormenişan, 2013). Negative emotions could serve virtuous purposes if kept under control by the reasoning part of the soul (Knuuttila, 2014). For example, anger is generally a bad emotion that can be destructive if uncontrolled. Yet, if it is controlled and channeled adequately, it can be used toward defending oneself or others in the face of injustice. All in all, Plato argued that the soul's harmony, achieved through the governance of reason, is more valuable than any material gain from injustice. Each part of the soul seeks its own goods, and reason is needed to correct the shortsightedness of the appetitive and spirited parts. This harmony fosters just treatment towards others.

Aristotle, on the other hand, criticizes Plato's tripartite division of the soul. Instead, he believes in a more natural and complete view of the soul. He uses his theory of hylomorphism, which states that everything is made up of matter and form, to explain the relationship between the soul and the body (Shields, 2020). According to Aristotle, the soul is what gives life to a living being. Furthermore, he believed that the soul has different abilities or faculties, depending on the type of living being it is associated with. For example, the soul of a human has different faculties than the soul of an animal. He identifies five main faculties: nutrition, perception, imagination, desire, and reason (Price, 2009). He asserts that the soul is inseparable from the body and that emotions are bodily changes that affect the soul. According to Aristotle, emotions are not irrational but involve a kind of practical reasoning that can be correct or incorrect (Schmitter, 2021). Returning to the example of anger, one may feel angry because they feel someone treated them unfairly – which may be true but could also be a misunderstanding. He also argues that emotions are not morally neutral but involve a kind of evaluation that can be virtuous or vicious. In other words, emotions reflect an individual's moral standards. For instance, feeling joy when witnessing others' suffering is vicarious, while feeling empathy is virtuous. Aristotle believes that emotions should be regulated by reason and habit to contribute to the "good" life (Schmitter, 2021).

Stoicism

The Stoic theory of emotion posits that emotions stem from judgments that something beneficial or detrimental to oneself is present or imminent (Gill, 2009). For example, fear at the sight of a snake is derived from the judgment that the snake might harm us. The joy of receiving a gift stems from the judgment that the gift will benefit us in some way. However, the Stoics also consider emotions to be flawed, irrational mental states because they involve misguided or exaggerated evaluations, causing us to excessively care about external objects that do not truly contribute to our happiness. Virtue (or moral excellence and righteousness) is deemed the only true good, and vice (i.e., immoral or wicked behavior) the only true bad. The Stoics aim to eradicate irrational emotions and replace them with rational passions – emotions that are aligned with virtue and wisdom.

Supporting this theory is a unique account of human psychology, physiology, natural functioning, value, and interpersonal relations (Gill, 2009). Adherents to the stoic movement believe that the soul is not an immaterial or abstract entity (many other philosophers argued), but a material substance. This substance is a refined form of "pneuma", or breath. The term "pneuma" in this context doesn't refer to physical breath as we understand it, but rather a life force. This "pneuma" is not just present in living beings, but pervades the entire universe. It is a fundamental element that constitutes both the soul of living beings and the basic principle of life and existence in the universe. According to the Stoics, the soul comprises eight faculties: the five senses, the faculty of reproduction, the faculty of speech, and the ruling faculty, which is the seat of reason and judgment. The ruling faculty is responsible for forming impressions of external objects and events, which are classified as either cognitive or non-cognitive. Cognitive impressions are clear and distinct; they are based on rational understanding and are usually associated with external objects we can perceive directly and understand fully. Non-cognitive impressions, on the other hand, are less clear and distinct. They might be vague, ambiguous, or based on external objects that are harder to understand or perceive. In other words, the way we understand and perceive the world around us comes from the ruling part of our soul.

This philosophy further argues that emotional reactions are often based on these impressions. By understanding and controlling our impressions, we can also control our emotional responses. Wisdom and virtue are therefore especially important because they help us form more cognitive impressions, which tend to result in more balanced and rational emotions.

Emotions are categorized into four generic types: desire, aversion, joy, and distress, each having three specific forms (Schmitter, 2021). Emotions can be present, past, or future-oriented, depending on their trigger. The Stoics posited that the soul is naturally drawn to what benefits its constitution and development, ultimately leading to the formation of virtue as the ultimate goal. Emotions, therefore, arise from errors in judgment, as individuals hold false beliefs about what is truly good or bad.

The Stoics contended that emotions are caused by external objects and contrary to reason (Schmitter, 2021). For instance, the fear of death arises because it is perceived as a bad thing. Correcting these false beliefs and aligning judgments with reality, the Stoics argued, can help avoid or eliminate emotional disturbances. They acknowledged that emotions involve bodily changes, such as the contraction or expansion of pneuma and alterations in the heart's movements. However, these bodily changes alone are insufficient for an emotional experience.

According to the Stoics, emotions are produced by a first movement, an impulsive reaction, followed by a judgment, crucial in Stoic philosophy. They recommended using these judgments to redirect the force from impulses toward more constructive emotions. Notably, the Stoics wouldn't consider an emotion genuine unless the person experiencing it loses control. For example, if Mary perceives a spider, her initial reaction might be a racing heart and sweaty palms. If she judges the

spider as a threat, causing her to run away, she has experienced fear, according to the Stoics (cf. Sellars, 2020).

Epicureanism

Epicureans classify emotions as either natural or empty desires. Natural desires encompass needs that are vital for health and happiness, such as food, shelter, and companionship (Konstan, 2022). Empty desires, on the other hand, are cravings that tend to be rooted in misguided beliefs about what we need, like fame, wealth, or power (Konstan, 2022). For example, when we experience joy as a result of satiating hunger with food, we fulfill a natural desire. Conversely, emotions stemming from the non-realization of empty desires are unnecessary and should be avoided. Tenants of this philosophy study the physical and biological bases of emotions. They believe that the soul is a physical entity made of atoms that spread throughout the body, interact with our senses, and connect with the outside world (Gill, 2009). According to this view, emotions stem from atomic activities in the soul, which are sparked by sensory experiences or mental pictures.

Like the Stoics, the Epicureans support the idea that our thoughts and judgments shape our emotions (Gill, 2009). According to their philosophy, emotions depend on how we perceive and interpret the sensory experiences and mental images that cause them. For example, fear is not just caused by the thought of death, but by the belief that death is evil or harmful. Epicureans support the idea of "ataraxia", a state of calm and happiness that humans can achieve by correcting mistaken beliefs and adopting a rational perspective, which allows us to control our emotions (Gill, 2009). The Epicurean philosophy focuses on how our beliefs can amplify or reduce our emotional reactions, but Epicureans do not necessarily believe that humans always hold wrong beliefs about their experiences. Instead, they prone our ability to use rational thinking to redirect our belief such that we can better control our emotions. For instance, anger does not just come from an insult, but rather from the belief that the insult is unfair or undeserved. This is not necessarily a false belief. However, if we believe that an insult is a reflection of the insulter's character rather than our own worth, we might feel less angry. Using rational thinking to manage emotional responses is therefore helpful in achieving ataraxia (Gill, 2009). The Epicurean philosophy is anchored in ethical naturalism, which claims life's goal to be the attainment of the highest pleasure – or the absence of pain in the body and soul. Epicureans posit that emotions stemming from empty desires are the primary source of mental pain and disturbance, hindering individuals from living in harmony with nature and reason.

Medieval Theories of Emotions

Scholasticism

Augustine drew from Stoic philosophy, incorporating elements of their physical, metaphysical, epistemological, and ethical perspectives on emotions (King, 2009). This included considerations of the cognitive and judgmental aspects of emotions, their moral significance, and their naturalistic and teleological explanations. He, however, criticized the Stoics for condemning emotions as

contrary to reason and disturbing the mind. Augustine found fault with their ideal of apatheia (impassibility), deeming it both impossible and undesirable. Notably, he anticipated the Stoic concept of eupatheia, or good feelings, asserting that the ultimate happiness of the blessed in heaven involves love and joy, excluding fear or sadness (King, 2009)

Augustine went on to present a revised Stoic theory of emotions, aligning it with a Platonic-Peripatetic distinction among various emotions. He accepted both the Stoic fourfold division of emotions (delight, distress, desire, fear) and the Platonic-Aristotelian differentiation between the concupiscible and the irascible powers (King, 2009). Augustine proposed a connection between emotions and the will, suggesting that emotions like desire, delight, fear, and distress express the will's consent or dissent toward desired or rejected things. According to Augustine, the moral assessment of emotions should center on the appropriateness of the will's choice of object rather than simply having an emotion. His extensive discussion of emotions in "City of God" became a pivotal reference for later thinkers in the Latin Christian West (Schmitter, 2021), despite its various interpretive possibilities (King, 2009).

Both Anselm of Canterbury (1033–1109) and Peter Abelard (1079–1142) approached Augustine's teachings in their unique ways, with some convergence in their ideas. They did not focus on reconciling classification systems but homed in on Augustine's proposition that emotions are a form of will. They viewed this as a broad statement about the nature of emotions rather than the relationship between psychological faculties. For Anselm and Abelard, emotions were seen as forms of will or motivation influencing an agent's actions and choices, directed at good or evil objects and possibly involving pleasure, pain, or difficulty. However, their interpretations diverged from there (King, 2009).

Anselm argued for two distinct kinds of motivations for moral agents: one for happiness and one for justice. He conceptualized human emotions as volitional phenomena of two broad types, broadly speaking, moral and non-moral (Knuuttila, 2023). In contrast, Abelard referred to all forms of motivation as "wantings" but posited that emotions have no intrinsic moral value, emphasizing that moral assessment relies on the agent's intentions or actions rather than the emotions themselves (Knuuttila, 2023). According to Abelard, emotions are natural to human beings, and moral value stems from the will, depending on whether the agent consents to the emotions. He rejected Augustine's claim that emotions, like sexual pleasure, result from original sin, arguing that their morality depends on circumstances and the agent's consent (Knuuttila, 2023).

Aristotelian Scholasticism
Jean de la Rochelle (1200 – 1245) stands among the early medieval philosophers who crafted an extensive theory of emotions grounded in Aristotelian psychology (King, 2009). He proposed that emotions constitute the appetitive faculties of the sensitive part of the soul, categorized into the concupiscible and irascible kinds. The former is directed at the pleasurable or painful, while the latter is directed at the difficult. Jean also posited that emotions can be organized into contrary pairs, such as love/hate, desire/aversion, hope/despair, and so forth. To classify emotions and their

subtypes, he drew from diverse sources like medical literature, philosophical traditions, and personal observations (King, 2009). His criteria included physiological effects, such as changes in complexion, pulse, breathing, and body movements. For instance, fear causes paleness, trembling, and flight, while anger induces redness, heat, and aggression. He also correlated emotions with the four humors and their qualities. Jean's contribution extended to linking emotions with the will, asserting that emotions like desire, delight, fear, and distress are expressions of the will's consent or dissent toward desired or rejected things. He considered some emotions natural and innate, like self-love and the desire for happiness, while others are acquired and voluntary, such as the love of God and the desire for virtue. Despite occasional inconsistencies, Jean's work significantly advanced the nuanced understanding of emotions in the medieval period.

Thomas Aquinas (1225 – 1274) embarked on a comprehensive exploration of emotions in his monumental work, the *Summa Theologiae*, earning it recognition as one of the most substantial treatises from the Latin Middle Ages (Perler, 2018). His inquiry into emotions is deeply intertwined with a theory of the soul and seamlessly integrated into a broader theory of action. Aquinas approached emotions through the lens of a theory of faculties, delineating the various functional domains of the soul. In this lucid and concise treatise, he not only refined but also clarified Jean de la Rochelle's earlier theory (King, 2009).

A proponent of a cognitivist perspective, Aquinas asserted that cognition is fundamental to emotions. He contended that emotions, unlike the operations of the intellective faculties of intellect and will, are essentially sensitive and involve physiological changes. Identifying eleven distinct types of emotion, mostly occurring in pairs of contraries and sorted into two kinds, Aquinas modified Jean's perspective on the formal objects of emotions. He argued that concupiscible emotions target basic emotions directing us toward sensibly good things—objects of desire or pleasure like food, rest, or companionship. On the other hand, irascible emotions, also directed toward the sensible good, operate in more complex or challenging situations, triggered by difficulties or obstacles (Murphy, 1999). For instance, courage, an irascible emotion, aids in facing danger to achieve a perceived good.

Aquinas proposed that emotions are products of judgments or perceptions of good and evil (Roberts, 1992). The alignment of emotions with reason and virtue becomes the cornerstone of his moral evaluation of emotions. Emotions guided by right reason and directed toward true good are deemed morally praiseworthy, while those irrational or directed toward false good are morally blameworthy. For instance, courage, aligned with reason and directed toward genuine good, earns moral approval. In contrast, envy, involving resentment towards others' good fortune, is considered morally reprehensible.

Influenced by Aristotelian philosophy, biblical teachings, and the writings of Church Fathers, Aquinas used logical reasoning to scrutinize and interpret these sources. The result was a systematic and coherent theory of emotions that expounded on their causes, effects, and moral dimensions. His

treatise attained authoritative status, surpassing the works of his predecessors and establishing itself as the standard reference for later medieval discussions on emotions (Roberts, 1992).

During the 14th century, the philosophical landscape witnessed significant shifts in the understanding of emotions, courtesy of the influential contributions of John Duns Scotus and William of Ockham (Knuuttila, 2023). Departing from Aquinas's perspective, both philosophers positioned the will at the epicenter of emotions, asserting that emotions entail an active involvement of the will rather than being passive reactions (Cross, 2021).

Scotus also explores the connection between our will, which controls our ability to make choices, and our emotions. He distinguishes the "low" emotions that come from our sensual soul – that is, our basic, instinctual feelings, and the "higher" emotions that come from our rational soul, where our thoughtful, reasoned feelings reside (Perler, 2018). His assigning higher-level emotions to the rational soul links them to the human will. In the context of medieval philosophy, the will is often seen as being the same as rational choice and volition (Perler, 2018). This implies that these higher-level emotions might be more susceptible to our will's control. In other words, we might have more power to manage these emotions through our rational decision-making.

In a parallel departure from Aquinas, William of Ockham develops a voluntarist framework for understanding will and morality, discarding the Aristotelian perspective (Knuuttila, 2011, 2023). He argues that choices and moral judgments are not necessarily the result of a rational process, but could be influenced by other factors such as emotions, desires, or inherent inclinations towards good or evil. This departs from the Aristotelian perspective, which ties these concepts to reason. Ockham sees emotions as acts of the will rather than products of cognition, suggesting that emotions come from the will itself, not from our thoughts or understanding. For example, if we were to encounter a bear in a forest and feel fear – this fear would be driven by our desire to survive and get to safety, instead of resulting from an analysis of the situation involving the recollection of what we know and bears and the danger they represent. Ockham believes that emotions stem from the inherent goodness or badness of the objects of the will, not from our cognitive processes (Knuuttila, 2011, 2023). In the bear example, the will recognizes the bear as inherently bad, generating instant fear. Likewise, if we experience joy from helping someone in need, it is because our will recognizes this act as inherently good. Therefore, he sees emotions as a direct result of our internal drive to do something – not a result of our thought processes or understanding of a situation. They are not derived from our thoughts or understanding of things, but rather from the inherent qualities of the things we desire or will. If we desire something inherently good, it will lead to positive emotions. Conversely, if we desire something inherently bad, it will lead to negative emotions. Ockham further distinguishes between simple and complex affections. Simple affections are instinctive reactions to an object – like fear when seeing a bear or the joy of seeing a friend. Complex affections are the emotions we feel when we act upon those simple affections – for example when we see a friend and feel joy, we then give them a hug and feel warmth. The resulting emotion (warmth) would then be a complex affection. In Ockham's view, emotions are not means

to an end but ends in themselves, reflecting the moral quality of the will's choices. Finally, Ockham simplified the concept of the soul, denying the existence of multiple faculties (Knuuttila, 2011, 2023). He also recognizes a single origin for emotions (i.e., the will). The distinction between simple and complex affection addresses different levels at which the will acts, rather than classifying emotions in types. This is another way in which his views diverged from those of Aristotle (Cross, 2021; King, 2009).

While Aquinas, Scotus, and Ockham acknowledged the will's role in emotions, their perspectives diverged on the nature of this role and the intricate relationship between the will and emotions (Cross, 2021; Knuuttila, 2011; Perler, 2018). Aquinas associated emotions with a cognitive process and physiological changes, whereas Scotus and Ockham conceived emotions as acts of the will, positioning the will at the core of emotional experiences (Cross, 2021).

The intellectual currents set in motion by Scotus and Ockham during the early 14th century played a pivotal role in shaping subsequent medieval and modern theories of emotions. These philosophical trailblazers introduced nuanced concepts and spurred debates on the nature and quantity of cognitive and appetitive faculties, the will's role in emotions, and the intricate relationship between emotions and moral responsibility. Their contributions not only enriched the understanding of emotions in the philosophical realm but also laid the groundwork for ongoing discussions regarding the role of emotions in moral motivation and decision-making (King, 2009).

Early Modern Period

From the Renaissance to the Enlightenment

In the realm of scholastic philosophy, Francisco Suárez (1548–1617), a prominent figure and one of the final major scholastic philosophers, emerged as a devoted follower of the teachings of Aquinas and Scotus on emotions. Despite his allegiance, Suárez boldly challenged fundamental aspects of their arguments, injecting fresh perspectives into the discourse (King, 2009).

A key departure from his predecessors was Suárez's skepticism regarding the relevance of distinguishing between the concupiscible and irascible powers, positing that both types of emotions converge on a common object—the sensible good (King, 2009). In his nuanced view, the pursuit of "goodness" might encounter obstacles or unfold seamlessly, rendering the traditional dichotomy less essential to understanding emotional experiences. Suárez also took on the comprehensive categorization of emotions, particularly challenging the eleven kinds proposed by Aquinas. Labeling them as arbitrary, he proposed an alternative approach based on four criteria: general tendencies, the most fundamental types of acts, distinctive movements involved, and individual merits (King, 2009). By applying these criteria, Suárez generated diverse lists of emotions, emphasizing the contextual and purpose-driven nature of any classification endeavor. His insight resonates with contemporary perspectives on theoretical lenses, suggesting that the categories used to distinguish emotions are context-specific and relevant only within the confines of a particular

analytical framework. Acknowledging the widespread use of Aquinas' scheme as a convenient explanatory tool, Suárez stopped short of dismissing it entirely. While questioning its objective reflection of reality, he recognized its utility and prevalence in explaining emotions within the scholastic tradition (King, 2009; Schmitter, 2021). It's noteworthy that Suárez's contributions, despite originating in the late medieval era, predated the Renaissance and continued to exert influence well into the early modern period, underscoring the enduring impact of his ideas on the evolving discourse surrounding emotions.

In contrast to his contemporaries, particularly the Aristotelians, Michel de Montaigne adopted a distinct approach to the comprehension of emotions in his renowned work, *Essays* (1590). Instead of dissecting the abstract facets of emotions, such as anger, into taxonomies, Montaigne chose to scrutinize individual experiences. His depictions portrayed individuals in the throes of anger, exhibiting a broad spectrum of reactions – from bouts of violence to composed restraint and the internal struggle to maintain composure (Perler, 2018; Schmitter, 2021). Montaigne's portrayals conveyed the notion that anger was not a monolithic entity but rather an amalgamation of diverse responses. The precise nature of Montaigne's stance—whether he deemed it futile or unfeasible to articulate definitive traits of emotions, or posited that these traits failed to demarcate emotions from one another or from other mental phenomena – remains ambiguous (Schmitter, 2021). Montaigne's skepticism regarding the imposition of fixed categories on emotions prompts a contemplation of the purpose underlying the identification of characteristics and its pragmatic utility within the discourse (Guild, 2014).

In deviating from the prevalent perspective positing emotions as cognitive appraisals entwined with the corporeal, Montaigne's emphasis on the myriad expressions of individual emotions compels a reconsideration of the quest for overarching characteristics. Furthermore, his elevation of compassion to a pivotal position contends that it is an indispensable emotion propelling righteous deeds and tempering excessive emotional states. This standpoint challenges the Aristotelian contention linking emotional control to the recognition of general principles (Perler, 2018). However, Montaigne's conceptualization of emotions is not without its conundrums. Firstly, his proposition that inherent capacities guarantee the generation of appropriate emotions raises questions concerning the precise mechanisms by which our nature ensures this outcome. Secondly, his repudiation of internal regulatory mechanisms prompts inquiries into the interplay of our varied abilities and their collective influence on our emotional states. Finally, the foundational premise of the ethical obligation to respect all living beings, coupled with the moral principles underpinning it, remains somewhat opaque in Montaigne's narrative (Perler, 2018).

Notwithstanding these issues, Montaigne's reflections on emotions carry substantial value. His preoccupation with discerning judicious rules through heightened awareness and deliberate contemplation, as evidenced in his exploration of how individuals navigate their emotional landscapes, furnishes a nuanced perspective that transcends conventional categorizations.

The Age of Enlightenment

René Descartes forged a distinctive path in the exploration of emotions, challenging the prevailing Aristotelian scholastic views embraced by thinkers like Aquinas, Scotus, and Ockham (Perler, 2018). His departure from the scholastic faculty psychology, which posited distinct faculties or powers of the soul, was marked by a rejection of a divided soul in favor of a unified one, distinguishing between intellect and will as separate powers within this singular soul.

In his seminal work, *The Passions of the Soul*, Descartes laid out a mechanistic theory of emotions, underscoring the intrinsic connection between the physical and mental facets in the manifestation and expression of emotions. In stark contrast to Montaigne's nuanced exploration, Descartes advocated for an empirically grounded explication of emotions capable of yielding a taxonomy and a more systematic analytical framework (Perler, 2018).

Descartes constructed a classification of passions based on their primary causes, termed 'formal objects,' portraying emotions as intricate cognitive and conative states. These passions, he contended, were essentially evaluative beliefs, varying in clarity, representing perceived present, past, or future good and evil, accompanied by corresponding physiological changes (Alanen, 2014). For Descartes, emotions were representations arising from the interaction between the body and mind, with sense perceptions giving rise to specific emotions marked by distinct physiological changes and behavioral inclinations.

The crux of Descartes' theory lay in identifying the cognitive perceptions of good or evil as the primary cause of emotions. He posited six basic passions—wonder, love, hatred, desire, joy, and sadness—from which all other emotions could be derived (Alanen, 2014). These passions, according to Descartes, served to maintain focus on objects relevant to bodily or mental well-being. Descartes further argued that emotions and sensations can be conjoined to the acquisition of new knowledge. He defined this kind of knowledge in relation to modern epistemology, arguing that emotions may change both our perception of the world and our thoughts about it. The agitation of the mind is not necessarily detrimental to thought; on the contrary, it may enhance or refine it. Because arts produce emotions, Descartes believed arts allow us to experience new sensations that stimulate the mind. Understanding how the theater, fables, and poetry may evoke emotions can thus teach us what emotions are, what they do to us, and how they may serve to produce new knowledge (Sjöholm, 2017).

Notably, Descartes delved into the relationship between emotions, reason, and the brain. His exploration foreshadowed the concept of the adaptive unconscious, a term in modern psychology denoting unconscious processes with adaptive functions crucial for rapid judgments and decision-making (Bargh & Morsella, 2008). While Descartes didn't explicitly use this term, his work hinted at the recognition of unconscious processes shaping emotions and behavior. His insights contribute to the understanding that the adaptive unconscious involves intricate mental processes guiding our perceptions, goal-setting, and actions (Kirkebøen, 2019). Descartes, thus, emerges as a trailblazer in framing models for comprehending the adaptive unconscious. His work has helped shape the view

that the adaptive unconscious is not just a repository of primitive drives and conflict-ridden memories, but a set of pervasive, sophisticated mental processes with which we evaluate our worlds, set goals, and initiate action.

Baruch Spinoza, a prominent Enlightenment philosopher of the 17th century, stands out as a key rationalist whose philosophical contributions reshaped Western thought. Departing from the Renaissance tradition, Spinoza infused philosophy with a personal and moral quest for wisdom, seeking the attainment of human perfection (Marrama, 2018). In his work *Ethics*, he unfolds a distinctive perspective on emotions, referring to them as "affects" (Spinoza, 1883).

Spinoza's philosophy embraces monism, where everything in existence is part of a single substance equated with God (Perler, 2018). This monistic stance leads him to view emotions not as isolated mental or physical entities but as interconnected aspects of this unified substance, in contrast to Descartes' dualism (Brown & Stenner, 2001). Rejecting the Aristotelian and Scholastic notion of the soul's separate faculties, Spinoza sees emotions as integral components of the same substance, arising from the interaction between the body and external stimuli, perceived by the mind (Spinoza, 1883).

Distinguishing between passive and active emotions, Spinoza characterizes passions as the former, representing reactions to external causes beyond individual control, affecting one's power of acting (Spinoza, 1883). Active emotions, on the other hand, result from an adequate understanding of oneself and the world, enhancing autonomy and the power of acting (Sangiacomo, 2019). Central to Spinoza's emotional framework are joy and sadness, fundamental emotions linked to changes in the body's power to act. Joy accompanies an increase in power, signifying a transition to a more perfect state, while sadness corresponds to a decrease in power, tied to a transition to a less perfect or active state (Perler, 2018).

For Spinoza, emotions convey axiological information, indicating the goodness or badness of an individual's power of acting. Notably, he underscores the ethical and psychological inequality between increases and decreases in power, asserting the inherent superiority of the former (Perler, 2018). Spinoza's representationalist theory posits that emotions stem from the mind's interpretation of the body's state, emphasizing that they are not direct responses to external events but rather interpretations of bodily changes in response to these events.

Critiquing what he terms the "intellectualistic and egoistic error," Spinoza challenges the misconception that individuals can be the ultimate cause of their emotions or that emotions can be entirely self-generated. He advocates for understanding the true causes of emotions as a means of gaining control over them (Perler, 2018). Spinoza's rationalistic therapy proposes that by enhancing our comprehension of emotions and their origins, we can transform passive emotions into active ones, fostering greater self-control and freedom from the sway of passions.

Scottish philosopher David Hume (1711-1776) conducted a comprehensive analysis of emotions, delving into their nature, causes, and effects, particularly in his *Treatise of Human Nature* (1739-

40). In his meticulous examination of the mind's perceptions, Hume distinguished between two fundamental categories: impressions and ideas (Schmitter, 2021). Impressions, characterized by their vivid and forceful nature, encompass sensations, passions, and emotions as they initially manifest in our consciousness. Ideas, conversely, represent fainter images of these impressions, emerging during the processes of thinking and reasoning.

Hume further classified impressions into two types: impressions of sense and impressions of reflection (Cohen & Stern, 2017). Impressions of sense encapsulate all our sensations and perceptions of pleasure and pain, stemming from unknown causes. Impressions of reflection, encompassing passions and sentiments, derive from these original impressions or their ideas. Within the realm of impressions of reflection, Hume discerned between calm and violent passions, emphasizing that calm passions are not necessarily weak, nor are violent ones inherently strong. Additionally, he introduced the crucial distinction between direct passions, arising immediately from good or evil, pleasure or pain, and indirect passions, which necessitate the conjunction of other qualities, particularly the interposition of an idea (Schmitter, 2021).

These classifications laid the foundation for Hume's in-depth analysis of human emotions. He expounded on the communication and influence of emotions through mechanisms such as sympathy, allowing individuals to share and understand the feelings of others, and comparison, which produces contrasting emotions by juxtaposing one's situation with others. Hume introduced the concept of the general point of view, serving as a standard for the appropriateness and correction of emotions. This point of view, rooted in adopting a common perspective reflecting the public interest, explains the distinctive sentiments of approbation that underpin moral and aesthetic judgments. Hume employed sympathy to elucidate how this general point of view is constructed, emphasizing the extension and correction of sentiments through various forms of association and comparison (Schmitter, 2021).

In the Enlightenment era, Immanuel Kant (1724 – 1804) emerged as a pivotal figure with profound insights into emotions, even though he did not explicitly label them as such in his writings (Cohen, 2017). Kant employed diverse terms for mental states akin to "emotion," including affects, passions, inclination, desire, and various modes of moral feeling (Lau, 2017; Willaschek & Watkins, 2020). Kant's tripartite division of the mind into cognition, desire, and feeling formed the backdrop for his exploration of emotions (Sorensen & Williamson, 2018). Feeling, in Kant's framework, generates pleasurable and displeasurable representations, although his account of this faculty is dispersed across different texts and exhibits some ambivalence regarding its role in moral cognition (Sorensen & Williamson, 2018).

Kant distinguished between different kinds of feelings, categorizing some as a priori and rational, while others are empirical and animalistic. He asserted the essential role of certain feelings, such as moral respect, in morality, as they unveil our rational nature and moral calling (Cohen, 2017). While acknowledging that some feelings, like sympathy and love, can either support or hinder moral cognition depending on cultivation and regulation, Kant contended that reason is the origin of

emotions. According to him, reason actively shapes our emotions, challenging the notion that emotions are mere instinctual reactions. The concept of "reasoned-caused feeling" in Kant's philosophy implies that emotions play an active role in initiating action, as feelings, shaped by reason, can motivate us toward specific behaviors. Importantly, this reasoned-caused nature of emotions establishes a profound connection between our emotional responses and moral judgments, suggesting that our feelings guide us toward moral actions while our moral understanding shapes our emotional responses (Cohen, 2017).

Late Modern Period

Unique Bodily States for Unique Emotions: Theoretical Perspectives from the 19th Century

In the 19th century, Herbert Spencer, a philosopher-psychologist, articulated an early psychological constructionist perspective on emotions (Gendron & Barrett, 2009). Challenging the notion of a fundamental distinction between emotions and cognition, Spencer contended that both phenomena stem from the same underlying causes (Spencer, 1896). Central to his argument was the idea that emotions and cognition differ primarily in their emphasis on specific mental contents, with feelings not being scientifically divisible from other forms of consciousness. Furthermore, Spencer proposed that distinct emotions might be associated with specific locations in the nervous system, positing that feelings are categorized based on unique bodily states (Spencer, 1896).

Although Spencer's writings encompassed ideas consistent with multiple perspectives on emotion, his predominant classification aligns him most accurately as a psychological constructionist with a leaning towards basic emotion concepts (Gendron & Barrett, 2009). He presaged the concept of emotions as action tendencies, portraying emotions as incipient actions, although he stopped short of entirely reducing emotions to these tendencies. According to Gendron & Barrett (2009), Spencer's perspectives on emotions exerted significant influence during the Golden Years (1855–1899) and played a pivotal role in shaping the psychological constructionist approach to understanding emotions.

Charles Darwin's significant contribution to the understanding of emotions is encapsulated in his seminal work, *The Expression of the Emotions in Man and Animal*s, published in 1872. This groundbreaking book considered a cornerstone in psychology and evolutionary biology, marked the first systematic application of evolutionary theory to the study of emotional expression.

Darwin's central aim was to demonstrate the continuity of emotional expressions across different species, thereby supporting his broader theory of evolution. He asserted that emotions and their expressions were not exclusive to humans but shared with other animals, suggesting a common ancestry (Darwin, 1898). This perspective laid the foundation for the basic emotion approach, emphasizing that emotional states seek behavioral outlets and are intricately woven into behavior, serving as informative displays to others (Gendron & Barrett, 2009).

In his book, Darwin introduced three principles to elucidate the mechanisms of expressive behaviors (Darwin, 1898). The first, the principle of Serviceable Associated Habits, posits that emotional expressions originally evolved as habits with a practical purpose. For instance, a dog baring its teeth when threatened serves as a serviceable habit associated with anger or aggression (de Silva, 2017). Over time, these behaviors became instinctive responses to specific emotional states.

The second principle, the principle of Antithesis, suggests that when an opposite mental state is induced, there is an involuntary tendency to perform movements of a contrasting nature, even though these movements may not be of any use (Hess & Thibault, 2009). This can result in highly expressive movements, such as the widening of eyes in fear or the narrowing of eyes in disgust (D. H. Lee et al., 2014). These opposing facial expressions may have served as an optical trade-off, enhancing either sensitivity or acuity and promoting stimulus localization or discrimination, respectively (D. H. Lee et al., 2014).

The third principle, the Direct Action of the Nervous System, asserts that some emotional expressions are direct results of the nervous system's response to an emotional state. These expressions may not serve any purpose or represent an antithesis but are simply physiological responses to high levels of excitement or stimulation (Abed & John-Smith, 2023). An example is the trembling of muscles in fear or anxiety, which occurs without conscious thought.

Darwin delved into the emotion of disgust, connecting it to both thought and digestion. He viewed disgust as a driver of the "behavioral immune system," protecting individuals from consuming harmful substances. Darwin believed this emotion evolved to prevent our ancestors from eating spoiled food that could be toxic, emphasizing its role in survival (Schaller, 2006).

Despite the anti-essentialist nature of his theory of evolution, Darwin adopted an essentialist approach to emotions in *Expression* (Barrett, 2017a). His emphasis on the functionality of expressions and the encoding of emotional states in behavior influenced the development of the basic emotion perspective. This perspective prescribes specific configurations of facial muscle movements corresponding to different emotion categories.

While Darwin may not have intended to craft a model of emotion, his ideas inspired the basic emotion approach, particularly regarding the role of emotional expressions as vestiges of our evolutionary past and their functionality as displays of information to others (Gendron & Barrett, 2009). Darwin viewed emotions as proactive, motivational states regulating action by allocating bio-psychological energy toward specific goals, emphasizing their functional role in adapting behavior to environmental demands. His work on emotions also anticipated later developments in psychology and psychoanalysis (Abed & John-Smith, 2023).

The adherence to an essentialist approach to emotions persisted and influenced the interpretation of subsequent works. The James-Lange physiological theory of emotions, attributed to William James (1842 – 1910) and Carl Lange (1834 – 1900) by Dewey (1895), diverged significantly from the

common-sense notion that emotions trigger bodily reactions. Instead, it proposed the reverse: bodily reactions trigger emotional experiences. The James-Lange theory of emotions proposed that bodily reactions trigger emotional experiences, suggesting that distinct physiological responses are associated with different emotions, and our awareness of these responses gives rise to our subjective emotional experiences (e.g., Hufendiek, 2016; Zachar, 2022). According to this perspective, emotions emerge as a result of physiological reactions to stimuli. In simpler terms, we do not tremble because we are afraid; rather, we are afraid because we tremble (James, 1922, 2007). The theory posited that bodily activity could both initiate and modulate emotional experiences. For instance, Lange proposed that emotions could arise independently of mental disturbances and be altered through physical methods (Lange, 1922). James similarly argued that intentionally activating bodily expressions associated with a specific emotion should result in experiencing that emotion (James, 1884). He even noted that refusing to express a passion could lead to its demise. A considerable body of research embraced these ideas, suggesting that each emotion is associated with a unique "fingerprint" in the body (see Barrett, 2017a; e.g., Dewey, 1895; Hufendiek, 2016).

However, this interpretation fell victim to the global enthusiasm for the essentialist viewpoint, leading to a profound misunderstanding of James' seminal works (cf. Barbalet, 1999; Ellsworth, 1994). More recently, psychologists have reevaluated James' theory of emotions, viewing it as constructionist rather than essentialist (Barrett, 2011). The constructionist perspective posits that emotions are not universally hardwired responses but are constructed based on cultural, social, and individual factors (Barrett, 2017a; Russell, 2003). Modern interpretations of James' work consider it as anticipating the constructionist viewpoint, as he highlights that instances of emotions (rather than emotions themselves) result from unique bodily markers. In other words, different combinations of bodily markers may all lead to the experience of fear, representing diverse occurrences of fear (Barrett, 2017a). On the contrary, Lange, in line with the essentialist understanding of emotions, claimed the existence of exclusive markers for emotions (Lange, 1922).

Beyond these recent considerations, the initial interpretation of their work (referred to as the James-Lange theory) was one of the most critically examined psychological theories. Skeptics were especially critical of the proposed initiation function (Coles et al., 2019). Many of the most well-known critics of the James-Lange view conceded that bodily states could modulate, but not initiate, emotional experiences (Coles et al., 2019).

Towards Explanations of Emotional Modulation

David Irons was one of the skeptics who were critical of the initiation function proposed by the James-Lange theory. He played a pivotal role in formulating the first comprehensive psychological explanation of an appraisal perspective on emotion (Gendron & Barrett, 2009). Challenging James' belief that emotions stem merely from the perception of reflexive, instinctual responses, Irons introduced his own perspective on the nature of emotion (Irons, 1894). He proposed that the essence of emotion lies in a meaning analysis situated between the object and the ensuing physical changes, determining the specific type of emotion (Irons, 1897b, 1897a). Noting the substantial variability in

physical changes associated with a particular emotion category across different instances, Irons emphasized the common "psychical" element – the meaning analysis of the object – as the consistent factor leading to the same type of emotion each time. Essentially, Irons argued that individuals evaluate an object's meaning in relation to themselves, allowing the same object to elicit different emotions or no emotion at all. Additionally, he provided a detailed account of the appraisals underlying specific emotions, significantly contributing to the development of the appraisal approach to emotion (Gendron & Barrett, 2009).

With the emergence of new research methods, such as animal experiments and brain lesion studies, scientists could explore the neural and physiological mechanisms of emotion. The resulting theories presented new foundations for refuting the James-Lange theory.

Floyd Allport, guided by contemporary experimental studies, proposed that facial feedback guides the categorization of feelings of positivity and negativity. However, he did not believe it could initiate emotional experiences in the absence of these underlying feelings – against the premises of the James-Lange theory (Allport, 1922, 1924; Coles et al., 2019). He also did not believe that nervous system activity or physiology could differentiate between basic emotions. Instead, he contended that the nervous system could only distinguish between pleasant and unpleasant states (which aligns with Cannon's future perspective). Nonetheless, he adopted the Jamesian physiology-first approach and presented one of the earliest versions of the facial efference hypothesis (Allport, 1922, 1924). Four decades before Tomkins formally reintroduced this hypothesis (Tomkins, 1962, 1963), Allport proposed that autonomic activity generates feelings of positivity and negativity based on patterns of facial feedback (Allport, 1922). The facial feedback hypothesis suggests that our facial expressions not only communicate our current emotional state but also have the potential to influence our emotional experience. In essence, smiling can make us feel happier while frowning can evoke a sadder emotional state. Importantly, this implies that emotional expressions serve a functional purpose, contrary to Darwin's earlier suggestion (Darwin, 1898). Allport's theory was among the first to formally introduce the facial feedback idea, establishing the foundation for subsequent theories of emotion, such as the two-factor theory proposed by Schachter and Singer. While not conventionally classified as an appraisal theory, the facial feedback hypothesis aligns with some cognitive appraisal principles. It posits that cognitive appraisal mediates the connection between a bodily change, like a facial expression, and the corresponding affective state (e.g., Myers, 2004; Niedenthal & Ric, 2017; Smith & Kirby, 2004; Wade & Tavris, 2002).

Walter Cannon, who developed the Cannon-Bard theory of emotion, believed that the perception of an emotional stimulus caused the thalamus to discharge a signal that independently produced the experience of emotion and an accompanying set of bodily responses (Cannon, 1927). According to this theory, the experience of emotion in the brain's cortex and the physical arousal in the body occur independently but simultaneously – a departure from the sequential process proposed by the James-Lange theory. The theory recognizes that bodily responses may produce subtle feedback signals, but it downplays their significance in the emotional complex. This critique implies that

while bodily reactions may influence emotional experiences, they aren't the predominant factor, contrary to the James-Lange theory's proposition. Critiquing the James-Lange theory further, the authors emphasize that many emotions elicit similar physiological responses, posing a challenge in distinguishing between different emotions based solely on bodily changes. For instance, the physiological arousal linked to fear and excitement can be quite similar, despite the distinct emotional experiences. Additionally, they note that emotions can be felt even when the body does not exhibit the expected physiological changes associated with those emotions. For example, individuals with spinal cord injuries can still undergo emotional experiences despite diminished bodily sensations. For many psychologists, the Cannon-Bard theory provided a more nuanced understanding of emotions, aligning closely with animal and neuroscience studies (cf. Lang, 1994; Weisfeld & Goetz, 2013).

The debates surrounding the James-Lange theory reflect the historical and theoretical disagreements about whether bodily activity could initiate emotional experiences or only modify ongoing experiences of emotion. The theory itself proposed that bodily activity could do both, but it faced criticism from those who believed that bodily states could modulate, but not initiate emotional experiences. This discussion is essential for understanding the nuances of the James-Lange theory and its implications for the initiation and modulation of emotional experiences.

Making Sense of Our Bodily Sensations: Interpreted Emotions

Schachter and Singer's Two-Factor Theory contends that physiological reactions necessitate cognitive labeling and interpretation to manifest as a specific emotion (Schachter & Singer, 1962). It identifies two essential components of an emotion: physical arousal and a cognitive label. In essence, emotional experience involves first undergoing a physiological response, which is then identified by the mind. According to Schachter-Singer, it is not the specific physical response dictating felt emotions but the cognitive label applied to the physiological arousal. The theory underscores the interplay between physical arousal and how it is cognitively labeled. Merely experiencing arousal is insufficient; we must also identify it to feel the emotion (Schachter & Singer, 1962). This approach allows for a broader spectrum of emotional experiences, as the same physiological response can be labeled differently based on context. In opposition to the James-Lange theory, Schachter-Singer asserts that physiological arousal is necessary but not sufficient for emotion, and the same arousal can lead to different emotions depending on cognitive labeling (Schachter & Singer, 1962). It also challenges the Cannon-Bard theory, which posits simultaneous and independent occurrences of physiological arousal and emotional experience. In contrast, Schachter and Singer argue that physiological arousal must be interpreted in context to generate the emotional experience. Physiological arousal not only precedes emotion but significantly influences it through cognitive appraisal labeling (Schachter & Singer, 1962). Despite these contrasts, the two-factor theory shares common ground with the constructionist perspective, emphasizing the similarities between constructionist and appraisal viewpoints (Gendron & Barrett, 2009). It is widely recognized for its alignment with cognitive appraisal theories (Schachter & Singer, 1962).

Similar to Schachter-Singer's two-factor theory, Richard Lazarus emphasizes the role of cognition in emotion (Lazarus, 1966). Lazarus, however, introduces more complexity to the appraisal process. His Theory of Emotion proposes a two-step cognitive process, where emotions result from evaluating a situation in terms of its relevance to well-being, goals, or values (primary appraisal) and assessing resources and potential coping strategies (secondary appraisal). The outcome of this cognitive appraisal directly shapes the type and intensity of the experienced emotion (Lazarus, 1966). Unlike earlier theories suggesting that emotions can occur independently of cognitive processes, Lazarus contends that cognitive appraisal is not just a component but a necessary condition for emotion. His theory represents a departure from the notion that emotions can occur in isolation from cognitive processes, a stance some earlier theorists hold (e.g., James-Lange, Cannon-Bard, Robert Zajonc).

Neural Integrations of Emotion and Cognition

More recently, researchers have increasingly been interested in understanding how our body senses and processes internal signals to produce and maintain our emotions, motivations, and internal organs. Interoception involves the transmission of neural signals from the body's tissues to the brain and is essential for maintaining homeostasis – or internal balance. These signals contribute to the processes that help us understand our own experiences and the experiences of others. Interoception influences how we feel and what we are motivated to do. It also affects the way our internal organs work and how we experience emotions (Cameron, 2001).

Even though the role of interoception in emotion theory only recently started receiving attention, some of the underlying ideas about interoception have influenced theories and debates on emotions since ancient times. The philosophical ideas and psychological theories discussed up until now make for a heteroclite account of our historical understanding of emotion. Yet, most of the debates have focused on the tension between emotion and cognition, as the greatest thinkers argued over the structure of the soul, the nature of emotions, how they influenced the mind, and how the mind influenced them. The concept of interoception plays a crucial role in integrating cognition and emotion and may help us finally understand how emotion works.

In his seminal work *Descartes' Error*, neuroscientist Antonio Damasio introduces the somatic marker hypothesis, suggesting that emotions play a crucial role in evaluating and selecting among different options, particularly in complex and uncertain situations (Damasio, 2005).

He argues that interoception and the generation of homeostatic feelings are crucial to understanding how conscious states emerge (Damasio & Damasio, 2022). He also proposes that interoception is fundamental to our experience of emotions, as it shapes our thoughts and decisions based on our bodily signals. Damasio's theory of consciousness is based on the idea that the brain creates dynamic maps of the body's internal and external milieux. According to him, consciousness, or our awareness of ourselves and our surroundings, arises when our brain recognizes these maps as belonging to us, the individual organism. In essence, Damasio argues that interoception serves as a vital link between our mind (our thoughts and emotions), our brain (the organ that processes these

thoughts and emotions), and our body (the source of the internal signals that influence our thoughts and emotions). It's through this interconnected system that we gain self-awareness, understanding both our physical presence in the world and our internal emotional states. This is the foundation of Damasio's explanation for the origin and nature of self-awareness.

To illustrate his somatic marker hypothesis, Damasio references the case of Phineas Gage, a railroad worker whose frontal lobe damage, caused by an iron rod driven through his head, led to profound changes in personality and behavior. Post-accident, Gage exhibited increased impulsivity, irresponsibility, and aggression, along with difficulties in planning and executing tasks. Damasio contends that Gage's injury disrupted his capacity to use emotions as guides for decision-making. Emotions, according to Damasio, function as "somatic markers" that aid in the assessment of various options and potential outcomes. Gage's loss of these somatic markers, Damasio argues, resulted in a decline in rationality and social skills (Damasio, 2005). He further conceptualizes emotions as intricate reactions to stimuli that induce observable external changes in the organism, defining feelings as the awareness of these changes resulting from external or internal stimuli (Damasio, 1999). These emotions, he argues, serve as subjective expressions of our physiological states, reflecting our dynamic relationship with the environment.

Contrary to René Descartes' dualist perspective, which separated mind from body and reason from emotion, Damasio rejects the notion that emotions are irrational and obstructive to reason (Damasio, 1999). Instead, he demonstrates that emotions are indispensable for rationality and social behavior, providing the values and preferences that inform our decision-making processes. In alignment with the James-Lange theory, Damasio sees emotions not as isolated from bodily responses but as the perception of those responses, indicating the existence of corresponding "somatic markers" (Damasio, 2005). However, he advances the argument that emotions involve higher cognitive processes beyond mere bodily sensations. Damasio's ground-breaking work has significantly reshaped the neuroscience community's understanding of emotion, challenging the traditional separation of emotion from cognition and consciousness (Damasio, 2005).

Lisa Feldman Barrett's theory of emotion, known as the theory of constructed emotion, challenges the classical view of emotions as universal, hardwired responses (Barrett, 2011, 2017a). Instead, Barrett proposes that emotions are constructed by our brains and are not the same for everyone. While her ideas also build upon interoception, they oppose those of Damasio's somatic marker hypothesis. Instead, Barrett argues that emotions are actively constructed by the brain based on a combination of sensory input, past experiences, and cultural context (Barrett, 2017b). This process involves interoception, the brain's perception of sensations from inside the body, and the brain's predictions based on past experiences. As it perceives internal, bodily sensations, the brain interprets these sensations and makes predictions to construct an emotional experience. This explains how an individual's unique experiences and cultural context can result in unique emotional experiences – which Barrett calls "instances of emotion" (Barrett, 2017a). Barrett uses the term "emotion" to refer to a general category, such as fear, anger, or happiness, which encompasses a

diverse range of instances. An "instance of emotion," on the other hand, designates a specific, individual experience of feeling happy, sad, or any other emotion. Because emotions are actively and continuously constructed by the brain, each instance of emotion is unique and can vary greatly between individuals and across different situations. For example, the way one person experiences and expresses happiness may be quite different from another person's experience of the same emotion, as it is based on their unique brain wiring, past experiences, and cultural context. Therefore, according to Barrett, the concept of "instance of emotion" highlights the variability and individuality of emotional experiences.

Barrett uses the concept of "body budget" to illustrate the brain's regulation of the body's energy budget to maintain physiological stability. This concept suggests that the brain constructs emotions as a means to predict and adjust our bodily needs to maintain a healthy balance or homeostasis. This involves regulating resources like glucose and water, as well as modulating body temperature and heart rate. These predictions and adjustments are influenced by our past experiences, current context, and future expectations. When the "body budget" is out of balance, it can lead to intense emotional experiences. For example, when the brain predicts that the body's energy resources are running low, it may construct the experience of hunger or fatigue. This highlights the dynamic and adaptive nature of emotions, as they are closely tied to the brain's predictions about the body's energy budget.

A New Era of Digitalized Emotions

In an editorial for the MIS Quarterly, Burton-Jones & Stein (2021) made a compelling statement: while the importance of emotions in the workplace is largely recognized in many academic disciplines and broadly experienced individually, Information Systems journals have tackled the topic relatively sparsely. It is a natural feature of IS research that it does not investigate the nature of emotions, but rather their role in relation to organizational and technological issues. In particular, IS scholars have been most interested in the role of emotions in IT adoption and use (e.g., Beaudry & Pinsonneault, 2010; De Guinea & Markus, 2009; Stein et al., 2015; Venkatesh, 2000), the diffusion of information on social networking sites (e.g., Chang, 2019; Stieglitz & Dang-Xuan, 2013a), and mental health (including topics like technostress, burnout, etc.) (e.g., Koch et al., 2012; Rutner et al., 2008; Srivastava et al., 2015). The next few paragraphs provide a brief overview of the main contributions of the IS field to emotion research, as well as the contribution of emotion literature to IS research.

Emotions In IT Adoption And Use

The Technology Acceptance Model (TAM) is a foundational framework to predict user acceptance (F. Davis, 1989). In essence, the model proposes perceived usefulness and perceived ease of use as major determinants of acceptance. TAM has been extensively validated and challenged since its initial development (e.g., Bagozzi, 2007; Bhattacherjee & Sanford, 2006; Dishaw & Strong, 1999; Y. Lee et al., 2003; Legris et al., 2003; Venkatesh, 2000). Despite the broad scope of research

conducted based on TAM, including in the healthcare sector (e.g., Mishra et al., 2012) or learning management systems (e.g., Saadé & Bahli, 2005), few studies have considered the emotional realm (cf. Bagozzi, 2007; Stein et al., 2015).

Venkatesh (2000) was one of the first to conceptualize and investigate the role of emotions in how users perceive a system's ease of use. Specifically, the author conceptualizes emotion as computer anxiety and explains that "an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers" (Venkatesh, 2000, p. 349) will negatively affect a user's cognitive responses by triggering negative expectancies, and emotions by generating negative physiological changes (Morris et al., 1981). This is particularly interesting against the historical background of emotion conceptualization and research. In agreement with Tobias (1979), Venkatesh (2000) proposes that while anxiety is an affective state, it influences the cognitive processes that ultimately determine behavior and performance. As such, it has both an affective and cognitive component and affective reactions can be considered attitudinal instances (Venkatesh, 2000).

Yet, Bagozzi (2007) argues that "treatments of affect with respect to technology acceptance have not been grounded in theories most appropriate to the decision processes people go through" (p.249). While most IS scholars have examined TAM as it relates to emotions with a strong empirical focus, Bagozzi expresses the need to rely on theories specifically tailored to the effects of emotion on technology acceptance. Whereas attitudes are traditionally considered to be evaluative judgments that affect behavior when activated, Bagozzi (2007) suggests that affect results in prefactual attitudes that are "dynamic constructions of how a decision maker feels about anticipated effort and outcomes related to a personal goal" (p.249). This approach shares similarities with the theory of constructed emotions discussed in the previous section, which posits that the human brain continuously makes predictions about real-time events (cf. Barrett, 2017a). However, according to Barrett, emotions are the result of those predictions, whereas Bagozzi assumes the opposite – with affect leading to predictive attitudes. His approach is therefore closer to that of Lazarus (1991) and the concept of appraisal – also discussed in previous sections (Bagozzi, 2007; Bagozzi et al., 1999).

Beaudry & Pinsonneault (2005, 2010) further built on this appraisal tradition to develop a coping model of user adaptation to information technology (2005) and a framework that classifies early-stage emotions and how they influence future IT use (2010). In their coping model, the authors emphasize the foundational processes that determine their ongoing behaviors toward a newly introduced technology. They propose IT events as affective events that are appraised similarly to other types of affective events (cf. Weiss & Cropanzano, 1996). A key contribution of their model is the extension of appraisal theory to tangible artifacts (i.e., an information system) as opposed to non-material objects, such as a merger, a job loss, a promotion, etc. Their work demonstrates that IS research has a strong potential for bringing value to other traditional disciplines, like psychology (Beaudry & Pinsonneault, 2005). In their later work, the authors further develop the appraisal element of their model with a classification of emotions that occur at the primary and secondary levels of appraisal (Beaudry & Pinsonneault, 2010). Their work shows that taking an emotional

perspective can improve our understanding of user acceptance and resistance, which has important implications for technology implementation (Beaudry & Pinsonneault, 2010). Their classification also furthers previous efforts to define groups of emotion, showing the practical relevance of the achievement–challenge–loss–deterrence classification.

Stein et al. (2015) develop yet another layer to those models of emotion-driven IT use. In a field study, the authors propose and investigate an extension to the work by Beaudry & Pinsonneault (2010) by examining what happens when users experience ambivalent emotions (Pratt & Doucet, 2000) – that is, when they simultaneously experience mixed (and sometimes even opposite) affective responses. By acknowledging and theorizing the effects of mixed affective responses to IT events, Stein et al. (2015) identified new adaptation strategies that differed from those triggered by uniform affective responses. Despite those encouraging findings, further efforts to investigate situations of mixed or ambivalent emotions are still missing from major IS journals, even as those topics are largely explored in psychology journals (e.g., Hui et al., 2009; Kreibig & Gross, 2017; Larsen & McGraw, 2011, 2014).

Affective Frameworks for IS Research

Most IS communication research examines the influence of digital media on communication effectiveness. In his seminal review paper, Te'eni (2001) examines and integrates literature on communication, aiming to develop a new model of organizational communication. He presents his review as a "conceptual inventory", emphasizing the unique contributions of his work: (i) bringing together perspectives from different sources and disciplines, (ii) providing directions for a future research agenda in the form of propositions, and most importantly, (iii) revealing new insights on communication processes that can challenge and stimulate past and future research (Te'eni, 2001).

Based on his review of the literature, Te'eni (2001) establishes a model of organizational communication that factors in the inputs to the communication process (i.e., attributes of the task, distance between communicative parties, and the relevant values/norms of communication), the cognitive-affective process of communication – which guides choices about the communication strategies, form, and medium – and the impact of the communication (i.e., mutual understanding, post-communication relationship). In his proposed model, the author unfolds three perspectives. First, he considers organizations to be collections of communicative acts, where all communication is a form of taking action. Second, he argues that organizations are deeply engaged in social exchange, implying that relationship-oriented goals always accompany action-oriented goals. Third, he emphasizes the role of choice and explains that organization agents use a combination of social (relationship-oriented) and utilitarian (task-oriented) frames to guide their uses of communication technology.

Central to the model is the concept of communication complexity, which results from increases in cognitive, dynamic, and affective complexity (Te'eni, 2001). Cognitive complexity stems from high interdependence between communicators, the compared variability in their respective views, and the need for information to be represented before it can be used – which increases risks of

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misinterpretation. Dynamic complexity describes aspects of a communication situation that require dynamic adaptation – for example when unpredicted changes or events have ripple effects that dynamically change needs or requirements in related tasks (Diehl & Sterman, 1995). Finally, Te'eni (2001) discusses the role of affective complexity in communication as the extent to which the communication is sensitive to affective variables like attitudes or attitudinal changes. He posits that affective complexity plays an important role in communication because it inhibits the development of trust and an appropriate normative context. Importantly, he acknowledges the potential of affectivity to motivate and inform, which can be used as a strategy to achieve communication goals in the face of challenges caused by affective complexity (Te'eni, 2001).

Similar to Carlson & Zmud (1999) and Kock (2005), Te'eni (2001) recognizes a progression between initial communication patterns and mature communicative behavior. He argues that mature communicators are more likely able to use affectivity even through channels that are not traditionally compatible with this strategy (e.g., emails). Moreover, the author distinguishes between a channel's capacity to transmit affective versus cognitive cues. He uses the example of perspective taking, which requires affective cues like voice tone and non-verbal gestures, and the capability to carry "cognitive references to the receiver's world" (Te'eni, 2001, p. 274). In general, his model posits that reduced channel capacity results in higher affective complexity – which may increase or decrease users' propensity to use affectivity as a strategy (this propensity will depend on the level of interactivity). Like others, this model highlights the importance of considering both cognitive and affective aspects in communication to ensure comprehensibility and engagement while aligning with effective communication principles.

Other scholars have extensively covered the cognitive aspects of ICT interaction (Zhang, 2013). Instead, Zhang (2013) therefore focuses exclusively on affect and develops the Affective Response Model (ARM), a theoretically bound conceptual framework that systematically classifies affective concepts along five dimensions. This model establishes a nomological network to illustrate causal or co-occurring relationships among different types of affective concepts during ICT-based interaction episodes. Zhang (2013) thus defines and integrates fundamental concepts from the literature on affect, including terms like *core affect*, *affective cue*, or *mood*. The five dimensions of the resulting taxonomy include residing, temporal, particular/general stimulus, object/behavior stimulus, and process/outcome dimensions (Zhang, 2013).

The residing dimension assesses whether the affective concept resides within a person (e.g., mood), stimulus (e.g., affective cue), or in-between (e.g., emotion). The temporal dimension classifies affective concepts based on whether they are constrained by the duration of the affective condition (i.e., time-constrained state versus time-unconstrained disposition). The author further discusses stimulus conditions along two dimensions – that is, whether the affective concept is directed toward an object versus a behavior and is specific versus general. For example, an attitude can be directed at a computer or at the behavior of using the computer. This is also consistent with design-based studies of affective experience in human-computer interaction, which found empirical support for

the thesis that users experience affect toward an object or the experience of said object (Hassenzahl et al., 2015). The distinction between specific and general refers to whether the attitude is directed at a specific object or rather a class of objects, like the latest released iPhone (specific) or Apple products (general). Finally, affective concepts can arguably be classified based on whether they help evaluate an outcome versus a process. In other words, when interacting with an ICT, the user can make a quick, substantive (Hassenzahl, 2004) evaluation of the interaction with an ICT, which means that they engage in a low-level processing of the experience. Conversely, they can also engage in high-level processing of the experience, and make verdictive judgments about the outcome of the experience – for example, after having had a positive interaction with an ICT, the user might conclude that the system is good (Hassenzahl, 2004; Zhang, 2013).

The taxonomy and nomological net developed by Zhang (2013) is foundational to the study of affect in the IS discipline. Yet, it focuses on the interaction between users and ICTs and does not examine the intricacies of user-to-user interaction on ICTs.

Synthesis and Reflection

This section offered a detailed – although non-exhaustive – overview of the evolution of emotion theory, spanning from ancient Greece to today, including the medieval, early and late modern, and digital periods. This rich tapestry of philosophical insights, debates, and paradigm shifts has shaped our understanding of human emotions. By delving into the perspectives of influential philosophical schools and thinkers, this section sheds light on the intricate relationship between reason, will, and emotions, and our species' enduring fascination with the nature and impact of emotions on human lives.

The exploration began in ancient Greece, where the concept of emotion, encapsulated by the word "pathos," encompassed a diverse array of meanings, from pain to passion. Philosophers such as Plato and Aristotle laid the groundwork for understanding emotions, emphasizing the role of reason in governing and regulating them. The Stoic and Epicurean schools of thought offered contrasting perspectives, with Stoicism advocating for the replacement of irrational emotions with rational passions aligned with virtue, while Epicureanism emphasized the role of cognitive judgments in shaping emotions and the pursuit of tranquility and happiness.

The medieval period witnessed a rich unfolding of philosophical discourse on emotions, with prominent figures such as Augustine, Anselm, Abelard, Jean de la Rochelle, and Thomas Aquinas contributing to the understanding of emotions. Augustine drew from Stoic philosophy, incorporating elements of their perspectives on emotions while critiquing the ideal of apatheia. He proposed a connection between emotions and the will, suggesting that they express the will's consent or dissent toward desired or rejected things. Anselm and Abelard offered unique interpretations of emotions, focusing on the moral and volitional aspects of emotional experiences. Philosophers like Jean de la Rochelle and Thomas Aquinas contributed to Aristotelian

Scholasticism by offering nuanced theories of emotions grounded in Aristotelian psychology. The intellectual currents set in motion by John Duns Scotus and William of Ockham during the early 14th century played a pivotal role in shaping subsequent medieval and modern theories of emotions. Their contributions enriched the understanding of emotions and laid the groundwork for ongoing discussions regarding the role of emotions in moral motivation and decision-making.

The early modern period, from the Renaissance to the Enlightenment, witnessed the emergence of thinkers such as René Descartes and Baruch Spinoza, who offered distinctive perspectives on emotions. Descartes laid out a mechanistic theory of emotions, emphasizing the intrinsic connection between the physical and mental facets in the manifestation and expression of emotions. He classified passions based on their primary causes, portraying emotions as intricate cognitive and conative states. Spinoza, on the other hand, referred to emotions as "affects" and infused philosophy with a personal and moral quest for wisdom, seeking the attainment of human perfection.

The late modern period, from the 19th century until today, witnessed significant contributions to the understanding of emotions. Herbert Spencer, a philosopher-psychologist, challenged the fundamental distinction between emotions and cognition, proposing that both phenomena stem from the same underlying causes. He suggested that distinct emotions might be associated with specific locations in the nervous system, categorizing feelings based on unique bodily states. Charles Darwin's seminal work, "The Expression of the Emotions in Man and Animals," applied evolutionary theory to the study of emotional expression, emphasizing the continuity of emotional expressions across different species. Darwin's work laid the foundation for the basic emotion approach, highlighting the functionality of emotional expressions and their role in behavior. Additionally, the James-Lange theory, the Cannon-Bard theory, and Schachter and Singer's Two-Factor Theory presented contrasting perspectives on the relationship between physiological responses and emotional experiences, contributing to the ongoing debate about the initiation and modulation of emotions. These historical perspectives offer valuable insights into the diverse theoretical frameworks that have shaped our understanding of emotions, laying the groundwork for contemporary research and theories, such as Lisa Feldman Barrett's theory of constructed emotion, which challenges the classical view of emotions as universal, hardwired responses, and proposes that emotions are actively constructed by the brain based on a combination of sensory input, past experiences, and cultural context.

Most recently, the field of Information Systems also contributed to the creation of knowledge around affective phenomena. The key contribution of the IS discipline to the emotion and affect literature is a strong stream of empirical studies assessing different aspects of human affect in relation to other variables such as technology use or mental health. A few frameworks also emerged within the field, as attempts to streamline the scattered literature on affect to support future research in this domain. A key element that seems to be missing from IS research is the recognition of the most recent neurological advancements led by Barrett (2017a) as well as the examination of

the social dimension of emotions – including phenomena like emotion contagion, complementarity, and how technology may influence socio-collective affective processes in general.

This thorough look into the evolution of emotion theory takes us on a fascinating journey from ancient Greece to the present day. We explore different viewpoints from influential philosophers, revealing a complex interplay between reason, will, and emotions. While there is no definitive explanation for how emotions work, the variety of perspectives shows just how much they shape our lives. From the Stoics valuing rational passions to Spinoza's search for wisdom, and from Descartes' mechanical theories to Darwin's evolutionary insights, each idea adds a unique layer to our understanding. As we navigate the realm of Lisa Feldman Barrett's constructed emotion theory and other contemporary perspectives, it becomes evident that the exploration of emotions remains a dynamic and evolving endeavor. There may be no final answer, but the unsettledness of this domain encourages us to keep exploring, recognizing the profound impact emotions have on us.

Historically, researchers and philosophers have observed emotions and affect as exogenous shocks that humans must deal with – by suppressing them, interpreting them, etc. Moving away from this dedication to understand the nature of the affective process, IS scholars have often considered affect and emotions as behavioral antecedents to predict or explain IT use. Incidentally, these studies tend to "black-box" affect. The long, historical evolution of emotion research and philosophy laid out substantial foundations for thinking about affect. Many IS scholars adhere to one of the descending schools of thought that were shaped throughout time. Yet, Barrett's renewed perspective on affective experiences shows the complexity and ambivalence of those affective processes. As a result, IS studies of affect tend to be overly set in stone and detached from the dynamic reality of human affective experience. This thesis acknowledges and embraces the complexity, dynamism, and individuality of those dynamic affective experiences and offers frameworks that can handle the richness of the issue.

Emotions and affect are complex, but vital parts of the human experience – urging us to dive deeper into the world of affect to keep developing new knowledge about humanity. As a contribution to this quest, this dissertation builds on the plurality of perspectives offered by esteemed scholars to advance our understanding of the dynamic and social aspects of affective processes in technology-enabled collaborative interaction (see Figure 1). Importantly, the concepts and relationships presented in this work are robust to multiple assumptions and paradigms, focusing on the interactional layer rather than holding forth on stating truths about the inner workings of affective and emotional experiences.
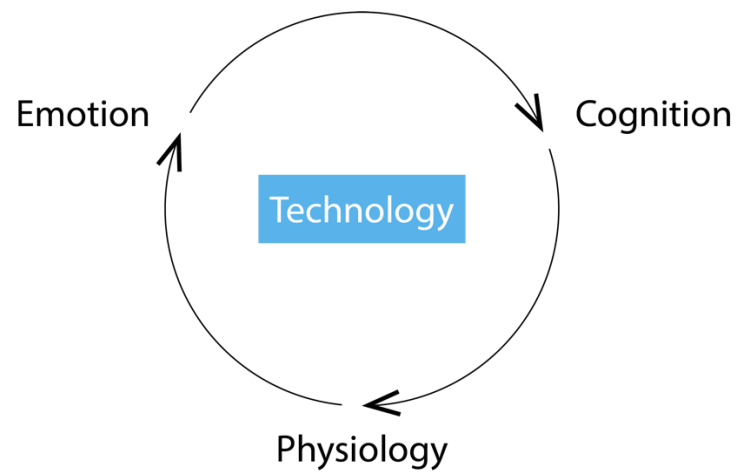
Figure 1: A historical interplay between emotion, cognition, and physiology with the added technological layer

RESEARCH APPROACH

Research Philosophy

It has become evident through history that emotions are closely linked with physiology. Because physiological changes can be observed directly, many thinkers have considered emotions separately from other social and cognitive constructs. Yet, recent developments in emotion theory explain that these approaches have ignored the psychological and latent social underpinnings of emotion. Hence, this thesis is not a perfect fit with the empiricism that often characterizes neuroscientific research, nor the subjective ontologies that tend to underlie organizational behavior research. Critical realism was developed by Roy Bhaskar and other scholars in response to the problems of empiricism, positivism, and conventionalism in the philosophy of natural and social science (Archer et al., 2013). Empiricism emphasizes the role of experience and evidence, especially sensory perception, in the formation of ideas (Hyslop-Margison & Naseem, 2007). However, it has been criticized for disregarding social contexts and human individuality, as it can make it hard to interpret data without context or reasoning behind social facts. Moreover, it is often critiqued for its inability to answer questions based on intangible subjects such as the mind or theoretical mathematics (Dijk, 2018; Hyslop-Margison & Naseem, 2007). Positivism asserts that only knowledge gained through empirical observation (sensory experience) and logical analysis is valid (Bechtel, 2013; Park et al., 2020). However, it has been criticized for encouraging a misleading emphasis on superficial facts without any attention to underlying mechanisms that cannot be observed. It is also critiqued for disregarding social contexts and human individuality (Hyslop-Margison & Naseem, 2007). Furthermore, it is inflexible and cannot change in the middle of the study as it will invalidate the study. Conventionalism is the philosophical attitude that fundamental principles of a certain kind are grounded on (explicit or implicit) agreements in society, rather than on external reality (Boland, 2016). It suggests that certain principles are considered true because they are widely accepted within a particular society or culture, rather than being inherently true in and of themselves. Conventionalism faces challenges in demonstrating that alternative, equally workable conventions could have been adopted, and it also struggles to establish a correspondence between reality and theory without rational proof or empirical evidence (Ben-Menahem, 2006).

Critical realism aims to understand the underlying structures and mechanisms that generate observable events and phenomena (Archer et al., 2013; Bhaskar et al., 1998). It distinguishes between the real, the actual, and the empirical domains of reality, and argues that causal laws are not reducible to empirical regularities or human perceptions. Critical realism also recognizes the complexity and diversity of the social world and the role of human agency and interpretation in shaping social structures and practices. Given the context and focus of this dissertation, critical realism presents significant advantages (Mingers, 2004).

First, it can help to explain how emotion is not just a subjective experience, but a real and causal force that influences human behavior and social outcomes (Luongo, 2021). Critical realism can also account for the different ways that emotion is expressed, experienced, and regulated in different contexts and cultures, and how digital communication mediates these processes. Second, it can help explore how digital communication is not just a neutral tool, but a complex and dynamic phenomenon that involves multiple levels of structures and mechanisms – like technological features, social norms, discursive practices, and power relations, among others (Mingers, 2004). Critical realism can also examine how digital and affective communication enables or constrains collaborative work, and how it shapes how participants interact. Finally, critical realism can help us understand how collaborative work is not just a collection of individual actions, but a social practice that is influenced by various factors, such as organizational structures, institutional rules, cultural values, and ethical principles (Botha, 2021). Critical realism can also analyze how collaborative work produces or transforms social structures and outcomes, and how it relates to the broader issues of development, justice, and emancipation (e.g., Luongo, 2021; Samsonsen & Heggdalsvik, 2023).

Critical realism asserts that reality exists independently of our perceptions, theories, and constructions. This is often referred to as ontological realism (Akram, 2023). The 'real' cannot be observed and exists independently from human perceptions, theories, and constructions. Thus, according to critical realists, unobservable structures cause observable events (Archer et al., 1999).

The epistemology of critical realism acknowledges that while reality exists independently of our perception, our understanding of it is constructed from our perspectives and experiences. This is often referred to as epistemological relativism (Akram, 2023; Archer et al., 1999). The scientist's understanding is through epistemological constructivism and relativism. This is where the phrase Critical Realism originates from – the 'epistemic fallacy' that reduces what we say is 'real' or exists (ontological statements) to what we can know or understand about the 'real' (epistemological statements) (Akram, 2023).

The research philosophy of this thesis is thus grounded in the belief that reality exists independently of human perceptions, but our understanding of it is always mediated by our sensory and cognitive processes, combining ontological realism with epistemological relativism. As a result, this dissertation adopts a retroductive approach, moving from observed phenomena to hypothetical explanations of the underlying mechanisms that generate them (Mukumbang, 2023). The proposed explanations are then subjected to further scrutiny and refinement, using a variety of research methods and sources of evidence. Through this critical realism approach, this dissertation recognizes that our knowledge of reality is fallible and theory-laden, while also supporting that rigorous and critical investigation can help get closer to understanding the structures and mechanisms that produce observable phenomena.

This approach is particularly useful in this research as it makes it possible to explore the underlying mechanisms that might explain the conflicting trends observed in the use of digital media for remote collaboration. As depicted in Figure 2, the phenomenon of interest is what observers can see

– for example outcomes in terms of productivity, communication effectiveness, or job satisfaction, but also visible communication processes of information transmission and processing, among others. The critical realist approach facilitates the examination of underlying mechanisms that form the fundamental structures of those visible layers. For example, the mood synchronicity study examines teams' ability to solve complex problems. In doing so, it investigates the deep-level structures of teams' interactive affective processes, dissecting the different paths through which social affective processes can impact a team's ability to engage in convergent and divergent thinking. The media affectivity study breaks down the technological structures that facilitate or hinder the development and maintenance of affective alignment. While it focuses on the technological object, this study gives new depth to our understanding of technology because it uncovers the different pathways through which technology communicates affect, positioning it against the development of affective alignment (i.e., affective channels, affective environment, and affective character). The third study dives into how different combinations of communication media and affective states lead to different types of creativity, creative performance, and levels of satisfaction. The final study unearths several paths through which neurodivergent workers can leverage technology to mitigate stressors from their collaborative environments. This study lies at a deep level of analysis, unfolding the structures that pre-exist the affective, cognitive, and perceptual processes of interest.

Observable layer

Team phenomena

Affective, physiological, and cognitive processes

Underlying structures
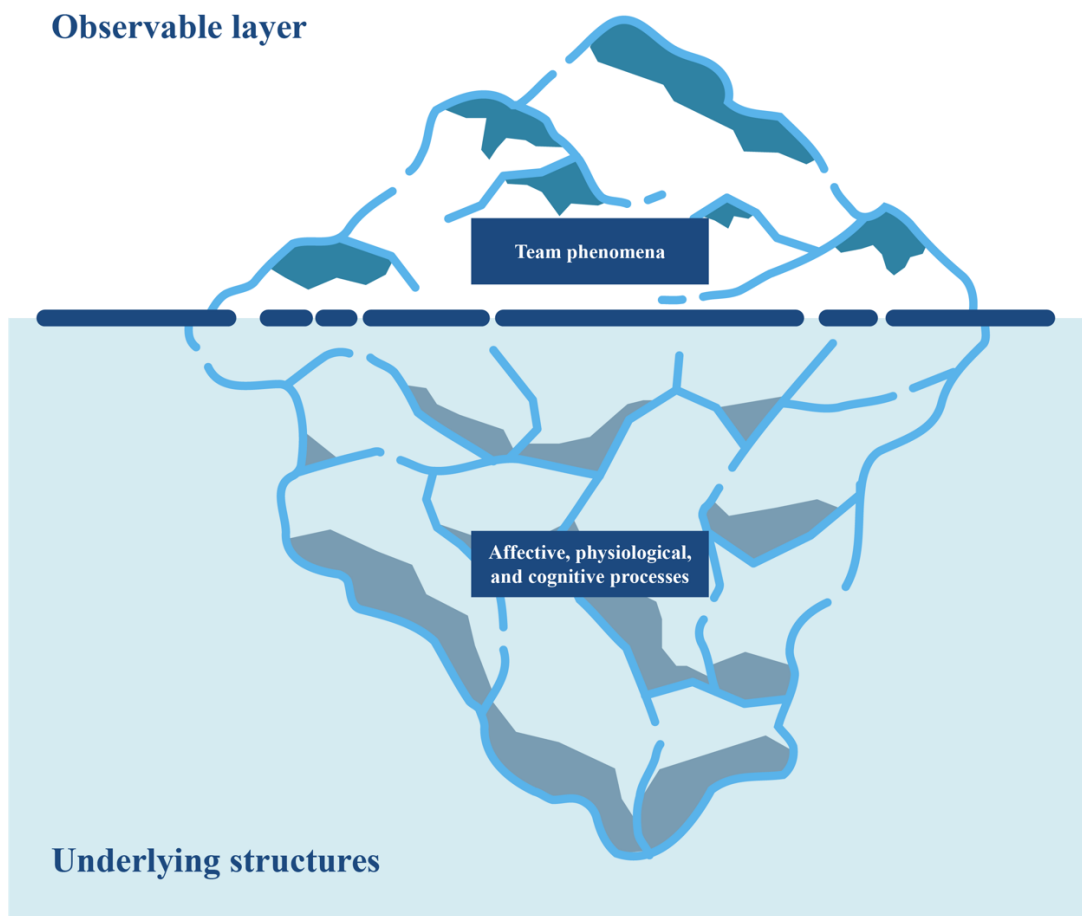
Figure 2: A critical realist approach to the interpersonal affective process of online collaboration

This work is also consistent with post-positivism as it reflects a commitment to empirical and logical scrutiny. Post-positivism, as a successor to classical positivism, maintains the emphasis on empirical observation and logical analysis but acknowledges that our understanding of reality is inevitably theory-laden and that our pre-existing knowledge and theories influence our observation (Karupiah, 2022; Sinead Ryan, 2019). My research methodology, which includes a laboratory experiment and a qualitative study using interviews, aligns with this perspective.

In my research, I use these philosophical perspectives to navigate the complex interplay between technology-mediated collaboration, creative teamwork, and mental well-being. My critical realist lens allows me to explore the underlying mechanisms and structures that might explain the observed phenomena, while my contemporary positivist stance ensures that my findings are grounded in empirical evidence and logical analysis. This combination of philosophical perspectives provides a robust framework for investigating my research questions and contributes to the development of a comprehensive understanding of the affective capabilities of digital media in remote collaboration.

Overview of Studies

Unpacking the interpersonal affective processes at play during online collaboration is non-trivial. As described in the previous section, the processes are plural, multilevel, and described across several academic disciplines. This dissertation focuses on the complex, plural, and continuously evolving interpersonal affective processes that take place during digitally mediated collaboration. Importantly, we posit that affect is a psychophysiological process that goes beyond the conceptual interpretation of a physiological experience. Instead, affective processes capture the dynamic interaction between internal mental or biological changes and external social or physical changes. In other words, the affective processes that structure online collaboration can only be fully understood when studied holistically. Let's imagine that Laura is a Risk Assessment Expert who contributes remotely to NASA's Psyche Mission. She occasionally meets online with her colleagues to discuss the mission. On a Sunday evening, Laura received a reproachful text message from her sister who was upset because Laura was going to miss their upcoming family gathering. That night, Laura felt guilty and slept badly. On Monday, Laura had a morning meeting with her team to plan out the rest of the week. She was tired because she had slept poorly, and was still in a bad mood after the argument. She logged into the meeting and kept her camera off, as she was not in the mood to show her face. The meeting started, and Laura was not very enthusiastic about the ideas put forward. Her colleagues could not see her facial expressions, but her monotonous voice and camera obstinately turned off suggested that she was not in the mood. While she is usually positive and outwardly, her apathy became contagious, and the meeting unfolded automatically, strictly following the agenda and not engaging in the chitchatting that usually kickstarts the week. What happened? What would the consequences of this interaction be? Instead of focusing on the bad mood, the camera off, or the goal of the meeting, the study of organizational processes invites us to consider objects and processes as co-existing. Such a process-first approach lets us visualize how emotions emerge from within to the outside physiologically and digitally. The process includes the interaction of several objects such as physiological sensations (e.g., accelerated heart rate), conceptualized emotions (e.g., anger), and digital features to express them intentionally (e.g., emoji reactions) or unintentionally (e.g., audio/video channels). Laura's hypothetical story helps illustrate both the value and complexity of studying organizational processes in this way.

This dissertation proposes a collection of four interrelated studies, including two conceptual papers, a laboratory experiment, and a qualitative study using semi-structured interviews. Each study zooms in on a particular path through which technology may shape, facilitate, and constrain the unfolding of affective processes in collaborative environments, and combined they contribute to addressing a main research objective: *how do digital media technologies shape affective experiences in digitalized collaborative work environments?* Path-centric theory focuses on the patterns of actions enabled by technology and their role in shaping transformative effects. It emphasizes the interplay between performing and patterning as mechanisms that influence the emergence of new paths and the transformation of established patterns of action. This theory

provides a framework for analyzing the complex interaction between digital media, affective processes, problem-solving, creative outcomes, and the experiences of neurodivergent workers in remote collaboration, offering insights into the transformative potential of digital tools in organizational practices. Path-centric thus offers a useful framework to reflect on this thesis' research approach and unpack the complexity of this work in examining the interpersonal affective process of online collaboration through a set of four interrelated studies (Pentland et al., 2022). Figure 3 illustrates how each study zooms in on a particular aspect of the interpersonal affective process of online collaboration. Figure 4 illustrates the overarching framework developed through this dissertation. The core of the thesis is essentially theoretical, with the rigorous development of theories and models at the interplay of technology, people, and the collaborative process. The two empirical studies add methodological rigor to the theorizing process by (i) testing and (ii) interrogating the theories proposed. The upbringing and role of the studies will be explained in greater detail in the next paragraphs.
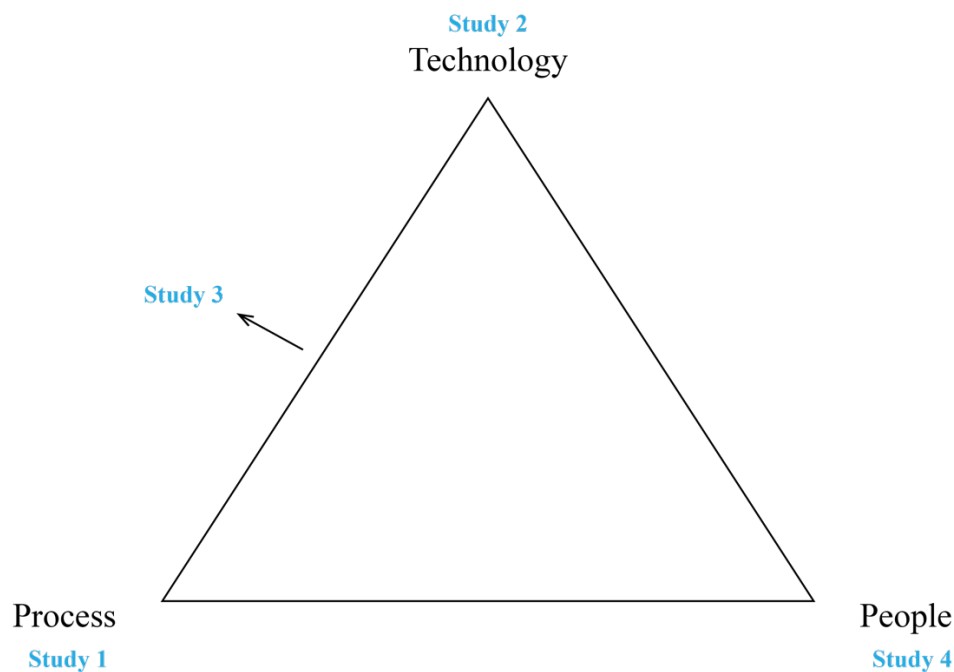
Figure 3: Zooming in and out on technology, process, and people

Study 1 – Affective Processes And Team Performance In The Digital Workplace: Towards A Theory Of Mood Synchronicity

The first study lays the ground for the remaining studies in this dissertation. The goal of the study was to dissect the interplay between affective processes and cognitive processes in the context of complex problem-solving. By diving into the cognitive structures of creative thinking, the study then conceptually examined how team-level affective processes may interact with creative and problem-solving outcomes. In essence, this study approaches team performance as the outcome of intersecting affective and cognitive pathways. It therefore builds on literature about problem-

solving and affective communication in teams to propose a theory of mood synchronicity that explains the process by which a team adapts its collective mood in response to affective cues and performance feedback. Specifically, the study asks: *How do media-enabled affective processes contribute to a team's approach and response to solving problems?* Depending on the (in)consistency of affective reactions across team members, a team may alternate between different forms of problem-solving: either divergent modes, in which they explore new solutions, or convergent modes, in which they elaborate upon a preferred solution. These processes both contribute to a team's ability to perform, which results in external feedback that corrects or corroborates their progress. At the heart of this mechanism are the media that teams use to communicate, as a team's ability to signal various affective reactions to one another impacts their collective ability to react to feedback, and to switch between divergent and convergent thinking. Different media may subtly highlight or obfuscate these affective reactions, influencing how the team approaches problem-solving and subsequently strengthening or amending the extent to which team members feel they are in similar or dissimilar moods. The study focused on the interpersonal affective processes leading up to a creative outcome through the lens of Mood Synchronicity Theory. The emphasis is on the process through which individual psychophysiological experiences transform into team-level experiences, resulting in different team outcomes. To facilitate this task, the study intentionally black-boxed the technology and individual characteristics of the people. While the model acknowledges that different technological features and different individual dispositions will affect the process, the details of these specific characteristics are not discussed. In other words, the central path in focus was the theory of mood synchronicity, which explains how teams shift between different collaborative styles based on external performance feedback and affective cues. The constructs of affective transitioning and affective harmonizing were the secondary arguments in the study, as they both contributed to the understanding and support of the central path in different ways (affective transitioning → divergent thinking → team performance; affective harmonizing → convergent thinking → team performance). Starting by establishing the importance of affective communication in team problem-solving, the study then introduced the new constructs of affective transitioning and harmonizing as mediators of the relationship. This also allowed the consideration of the essential role of technology, as affective transitioning and harmonizing are heavily reliant on the communication of affective cues between team members. Mood Synchronicity Theory considers the role of collaborative digital media as a core emerging technology influencing the generation and refinement of ideas. Altogether, these paths establish trajectories towards different outcomes such as collective moods, creativity, productivity, team cohesiveness, etc. This study journeys through the space of ideas, with mood synchronicity being the central path, and affective transitioning and affective harmonizing offering different sub-paths and trajectories, with technology setting the argument in motion.

Study 2 – Media Affectivity Theory: A New Perspective On Media Capabilities And The Communication Of Affect In Teams

The purpose of the second study was to examine the technological component of those emerging ideas. Conducted in parallel to the development of Mood Synchronicity Theory, this work delved into the details of the psychophysiological processes that occur individually and in interaction with others. It then considered the different ways in which digital media may be instrumental in conveying these psychophysiological processes. This work is a theory-generative research synthesis. Based on an extensive review of the literature on affective alignment and media capabilities, the study proposes a synthesis model of affective alignment in online collaboration. The model outlines the mechanisms that enable and constrain the emergence of aligned affective states during online collaboration. The model describes how digitally mediated cycles of affective display and internalization shape coworkers' core affect, resulting in affective alignment. Understanding the iterative nature of the affective alignment process and the mediating role of digital media capabilities are important steps toward explaining how online collaboration leads to experiences that are often different from in-person. The study further builds on the review of the literature to expand a Media Affectivity theory, which helps (i) identify the specific role of different components of a digital collaboration tool in mediating the exchange of affective information, and (ii) describe how these elements relate to one another in determining the level of affectivity of a medium. This study addresses the following question: *How do different media capabilities enable and constrain affective processes during online collaboration?* Taken together, the model of affective alignment in online collaboration and the theory of media affectivity can be used by researchers interested in understanding the unfolding of communicative and/or community failure in organizations. Moreover, the new theory of media affectivity has implications for important related areas of research and practice, such as workers' social and mental well-being. In the context of this new theory, actions taken by individuals as they communicate and collaborate using digital media constitute the enactment of paths or performing. As individuals chip in and out of affective alignment, they form and dissolve paths, which can be seen as patterns. This study strongly emphasizes technology (white box), and more specifically how different affective capabilities make it possible or impossible for individuals to achieve affective alignment as they interact using these capabilities. Affective capabilities are growing in number and scope, as technology becomes increasingly sophisticated, going beyond the idea of naturalness and toward augmentation. In doing so, they afford new actions that could not be performed using older media (e.g., it would not have made sense to have a virtual coffee break using emails, but video conference software makes it possible and arguably, desirable), and new ways of recombining actions (e.g., leveraging biofeedback to enhance future interactions with others). These new affordances expand the space of possible paths in online collaboration. Media affectivity theory explains how different media capabilities enable and constrain affective processes, which can influence patterns of action. Different affective channels, environments, and characters may shape affective displays differently,

resulting in a variety of affective outcomes. This work regards affective alignment as the outcome enabled by the media capabilities laid out in the theory.

Study 3 – In or Out of Sync? A Psychophysiological Approach to Understanding Creative Collaboration in Online and In-Person Teams

The third study aimed to empirically examine some of the relationships proposed by Mood Synchronicity and Media Affectivity theories. In a lab environment, it leveraged a fraction of the media capabilities examined by Media Affectivity to hypothesize about the role of those capabilities in the unfolding of mood synchronicity. The study considers the creative performance of teams as the main outcome variable, thus examining how the interplay of technology and affect may result in different levels and types of creativity. The study asked: *how do online collaboration's creative outcomes differ from in-person collaborations when team members are in similar or different affective states?* Participants were grouped into dyads, assigned to an in-person or online condition, and asked to collaboratively find creative alternative uses for several objects. This study used a laboratory version of the Pac-man game to place dyads either in similar or different moods. Merging ideas about media-related paths and affect-related paths, the experimental design presented manipulations to examine different trajectories unfold as participants engaged in different frames of performing and patterning. Instruments included self-reported measures of affective states and creativity was assessed using measures of originality, fluency, flexibility, and elaboration. Analyses showed that (i) online teams produced fewer ideas than in-person, (ii) teams in convergent moods elaborated on their ideas more than their divergent counterparts, and (iii) online teams with convergent moods produced ideas with the least originality. These findings have important implications for the management of creative teams, as they highlight how different team configurations have different creative outcomes. Moreover, biosensor data was also collected as part of the experiment, including measures of cardiac activity, galvanic skin response, facial expressions, and eye gaze. Preliminary analysis of this data shows encouraging signs that co-smiling behaviors may play an important role in mediating the relationships between creativity, collaboration medium, and the participants' starting affective state. Future research will aim to confirm these emerging findings and further leverage measures of physiological synchrony to enrich our understanding of the effects of interactive affective processes on team creativity.

Study 4 – Unveiling Technorelief: Enhancing Neurodiverse Collaboration with Media Capabilities

The first three studies presented in this dissertation examined the mechanisms underlying the interplay of affect, digital media, and team performance. To facilitate the emergence of interpretable patterns, individual variations that may change the relationships of interests were purposefully left out. Yet, one important concern lies in the fundamental assumption that processes of affective alignment constitute a species-level experience. In other words, the models were developed upon the assumptions of typical processing of socio-affective cues. Yet, an estimated 15-20% of the world population exhibits some form of neurodivergence, meaning that their brain functions in atypical ways, resulting in affective, sensory, and cognitive experiences that

significantly diverge from what is considered typical (NCI, 2022). Neurodivergence is therefore a non-medical term that encompasses conditions such as autism and attention deficit hyperactivity disorder (ADHD). Given these unique experiences, researchers need to explore the equally unique ways in which technology can shape the collaborative experience of neurodivergent team members. Neurodivergence is often characterized by its plurality and fuzzy boundaries, which can make it hard to study as a single phenomenon. Instead, this study focuses on one type of neurodivergence known to be particularly prone to impacting interactive affective processes. Autism is a lifelong neurodevelopmental condition that often manifests through differences in social communication and interaction, as well as repetitive patterns of behavior, interests, or activities (National Institute of Mental Health, 2024). The intention behind this study was initially to develop design guidelines for collaboration software to help foster interactive affective processes that support productive and enjoyable collaborative processes in neurodiverse teams. However, in the early stages of data collection, it appeared evident that the study needed to pivot. Clearly, participants experienced a range of social, affective, and perceptual challenges that rendered the initial research question essentially irrelevant. Rather than focusing on media capabilities to enhance social experiences of affect, these early-stage interviews showed the participants' unique experiences of their own bodies, their collaborative experiences, and their social desires. The focus of the study therefore naturally shifted away from finding technology-driven solutions to foster desirable affective processes. Instead, the main purpose became focused on the unique challenges and opportunities underlying digitalized collaborative experience, and on how participants navigate some of the challenges of collaborative work by leveraging technology-driven strategies. The fourth study of this collection thus asks: *how do digital technologies alleviate autistic workers' experiences of their collaborative work environment?* This project treats performance and well-being as the outcomes that employees strive to achieve, with affective, cognitive, and perceptual processes serving an explanatory role. It was designed as an inductive qualitative study, which afforded the flexibility of non-standardized data collection techniques that lend themselves to alterations and iterations throughout the research process. So far, 34 semi-structured interviews have been conducted with participants who routinely engage in online collaboration with their work team and identify or were diagnosed as autistic. Data collection is ongoing and will continue until it reaches data saturation. A preliminary analysis revealed significant findings through the identification of three main themes. First, media capabilities act as *digital filters* that help manage overwhelming sensory inputs. Second, they aid in navigating the challenges of masking, allowing more agency in how individuals present themselves in the *digital stage*. Third, they enable a *digital timeout*, offering a temporal buffer for self-care and reflection. Importantly, these findings indicate the potential emergence of a new phenomenon that we call technorelief, which describes the psychological relief achieved through the use of technology to cope with stressors from the work environment. The study identifies several media capabilities that drive technorelief through a network of sensory, cognitive, and affective mechanisms. This last piece of work zoomed in on the human aspect of the organizational processes of affect and collaboration by examining how individual characteristics may result in individual

experiences of affect and collaboration. The digital filters, time out, and filters represent trajectories that different workers might experience based on the unique ways in which they will interact with the emerging technology. Different capabilities (e.g., turning off the camera, enabling closed-captioning, using emojis, etc.) produce different acts of performing and patterning as neurodiverse individuals engage in collaborative practices. The study describes in detail some of the possible paths that shape the relationship between technology, collaborative outcomes, and socio-affective experiences. In doing so, the paper captures the concept of "technorelief", which represents a trajectory toward a "drift" outcome, where users take advantage of emerging technology to alleviate stress factors in their work environment. The concept of technorelief complements technostress, highlighting technology's positive role in managing collaboration stress for neurodivergent workers. Our findings have implications for information-processing researchers. While there are extensive empirical studies of media richness, synchronicity, and naturalness theories, this work suggests that new analytical frameworks might be needed to include media capabilities that moderate sensory stimuli and affective cues. Positioning technorelief within the theories of mood synchronicity and media affectivity is a promising avenue and I plan to further develop this concept beyond this dissertation. Future work may include broadening the concept of technorelief to study its implications for different neurotypes and circumstances, including ADHD, anxiety disorder, occupational stress, etc.
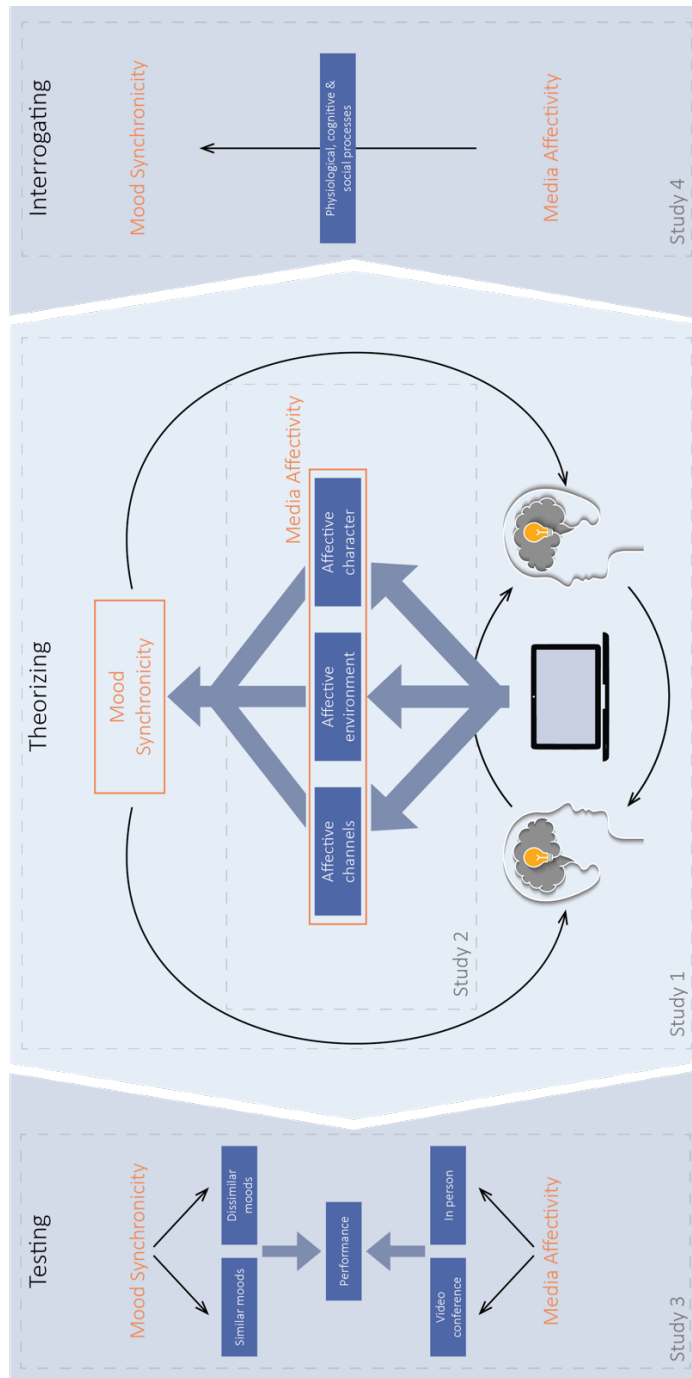
Figure 4: Overarching Framework of the Dissertation

CONTRIBUTIONS

Bringing the Foundational Affective Layer of Human Interaction from Reference Disciplines to Information Systems

This dissertation makes sense and integrates knowledge about foundational affective mechanisms in human social interaction that is often difficult to access due to being siloed or overly complex. The first and main contribution to the field of Information Systems is therefore a comprehensive collection of models, departing from the core affective display–internalization mechanism (DIM), which moderates the development of affective alignment, thus structuring social interaction and ultimately conditioning team performance (see Figure 5).
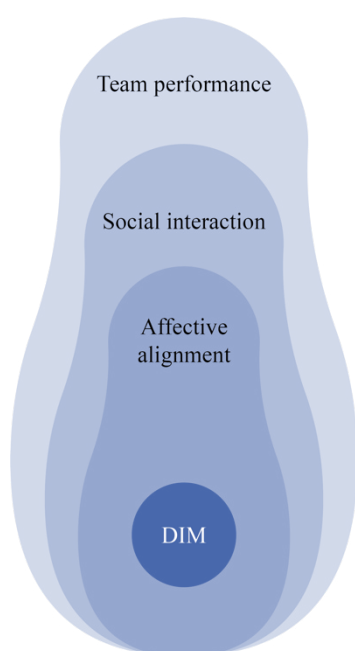
Figure 5: Illustration of the pervasiveness of the display—internalization mechanism (DIM) through the imbrication of layers that shape team collaboration.

The first study closely examines the interplay between affect and cognition at the interactional level, and the second one unpacks the different paths affect can take on digital media platforms. This theoretical core dives into foundational affective processes at levels of detail rarely explored in the field of IS. Only two studies made affective concepts the core of their analysis (Te'eni, 2001; Zhang, 2013). Te'eni (2001) focuses on ways that ICTs can render communication more effective by breaking down the cognitive foundations of the communication process, including aspects of affective complexity and affectivity as a communication strategy. Zhang (2013) examines affective processes more closely by creating a nomological net of affective concepts, defining and integrating

key concepts into an overarching framework of user affective experiences when interacting with ICTs. Despite the intrinsic value of each of these works, the truly foundational mechanisms underlying those affective processes remain either out of their scope (i.e., Te'eni, 2001), or are not discussed in the context of human-to-human interaction (i.e., Zhang, 2013).

Making sense of and integrating knowledge about foundational affective mechanisms in human social interaction required surveying the disciplines that primarily study the human body and mind. Therefore, this dissertation was less concerned with finding depictions of the affective phenomena in familiar outlets than finding relevant theoretical and empirical discussions directly in the field where these concepts were born (Thatcher et al., 2018). Using distal models can be an effective way to engage in innovative theorizing (Grover & Lyytinen, 2023), so long as the resulting constructs are IS-borne – that is, authors should develop constructs that are fully embedded within the digitalized context. This dissertation builds on such distal models with, for instance, mother-infant synchrony (Feldman, 2006), the mirror neuron system (Iacoboni, 2009), facial efference (Adelmann & Zajonc, 1989), frequency effect (Harrison, 1977), or empathy (De Waal, 2012).

Rigorously building on reference disciplines to understand the biology of social interaction helps uncover underlying mechanisms that are often overlooked in IS theories (see Kock (2009) for an exception). For example, Media Affectivity examines the process of affective alignment closely by attentively reviewing literature from journals that are not commonly cited in IS publications, such as the Annual Review of Psychology, Trends in Cognitive Science, Development Psychology, the Proceedings of the National Academy of Sciences, Emotion, Science, and more (e.g., Adelmann & Zajonc, 1989; J. Davis et al., 2010; de Waal, 2008; Feldman, 2006; Goldenberg & Gross, 2020; Shamay-Tsoory et al., 2019). The theories and methods used in those outlets are often unappealing to IS scholars, making it challenging to integrate them into our theorizing process. For instance, the process of emotional contagion is well-known among IS scholars and readily used as an explanatory or outcome variable in many empirical studies (e.g., Han et al., 2023; Mirbabaie et al., 2020; Naskar et al., 2020; Stieglitz & Dang-Xuan, 2013b; Weismueller et al., 2023). However, these studies pay little attention to the core mechanisms driving those effects, disregarding the foundational layer of human interaction. In doing so, IS researchers are at risk of missing out on patterns and structures that could potentially take on new, valuable meanings when applied to different contexts (Grover & Lyytinen, 2023). Yet, there is considerable value in studying affective phenomena from the perspective of their reference disciplines, because it unlocks unobstructed access to the details and layers of otherwise commonly known mechanisms.

This thesis strives to get a deep understanding of those structures to identify elements likely to impact social interaction due to how they interact with the digital capabilities of the communication tools used. The building blocks of this thesis are thus rooted in a thorough evaluation of materials from reference disciplines like neuroscience, psychology, or organizational behavior. Uncovering the building blocks of affective alignment, from neurological, psychological, and physiological perspectives helped create a model that does not focus on antecedents or outcomes, but instead

breaks down the foundational, underlying mechanisms of the process. This allows other scholars to use the resulting model without having to subscribe to any specific school of thought, and instead center their attention on the phenomenon of interest. Uncovering the nuts and bolts of affective alignment makes it possible to study affective phenomena regardless of whether one adheres to any emotional theory in particular, such as the construction of emotions, appraisal theory, or universal emotions (see Barrett, 2017a; Damasio, 2005; Darwin, 1898; Lazarus, 1991).

A major strength of this work is therefore its bottom-up approach to understanding social interaction – by examining the very foundational processes that structure how humans communicate and relate to one another. In this sense, the approach adopted in this dissertation adheres to the principles of entrepreneurial scholarship, pushing the field of IS forward by embracing unfamiliarity (Thatcher et al., 2018). This entrepreneurial approach facilitates the prioritization of research questions before research methodologies – in other words, it does not call for a single method but instead provides a framework that can be equally valuable for qualitative and quantitative researchers.

Defining Affective Pathways from the Individual to the Interactional Level

This dissertation extends the scope of prior research on the affective phenomena by capturing the underlying structures and effects of affective processes at the interactional level – moving from the individual to the collective. Key theories in IS and HCI have examined how systems and the interaction with systems may influence how users feel emotionally and about the target object. One of the most influential theories in the realm is that of the Technology Acceptance Model, which captures how affective experiences using systems shape users' attitudes about those systems and their subsequent behavior concerning those systems (F. Davis, 1989). Departing from this tradition, the present work is concerned with human-to-human interaction using digital media. This shift in focus is theoretically and methodologically challenging and requires conceptual flexibility. Establishing a deep understanding of how affect works at the individual level was a key first step toward analyzing its impact on how we interact with others and our environment.

The impact of individual affect on how we interact with colleagues and our work environment was extensively studied in psychology and organizational behavior (see Barsade et al., 2018; Bartel & Saavedra, 2000; Weiss & Cropanzano, 1996), but has been limited in IS research. In contexts where the psychophysiological structures of social interaction fundamentally depart from natural evolution, these exogenous theories offer valuable insight to theorize on digitally-mediated team interaction from an IS perspective. Departing from classical IS on affect and ICT use (e.g., Beaudry & Pinsonneault, 2010; F. Davis, 1989; Stein et al., 2015), this thesis leverages the understanding of the foundational layer of social interaction to theorize on the interpersonal affective processes that structure digital team collaboration. Mood Synchronicity Theory offers unparalleled insight into the interplay between affect and cognition from the micro level and moving toward the meso level in teams that use multiple modes of collaboration. This dissertation takes a holistic approach to the affective underpinnings of digitally mediated social interaction. Once the affective display –

internalization mechanism was established (through Media Affectivity Theory), it became possible to analyze how these dynamics impact how teams react interpersonally and think collectively (through Mood Synchronicity Theory).

This collection of studies unpacks the social dimensions of interpersonal affective processes, which have been overlooked in past research. Much of the scholarly focus has been on issues related to cognitive alignment and collective sense-making (e.g., Dunbar & Garud, 2009; Mathieu et al., 2000; Rafaeli et al., 2012; Tao & Tombros, 2017; Wrzesniewski et al., 2003). Instead, this dissertation describes possible pathways leading groups of individuals and their micro experiences to turn into teams with different configurations of cohesiveness and performance. Although examining how interpersonal affective processes shape cognitive dynamics in teams is an important first step, the digital context complicates the analysis. How do interpersonal affective processes unfold and impact team performance in a situation that lends itself to more ambiguous affective cues? How does communicating more or less affect impact a team's ability to process feedback? How do digital media change how team members perceive the affective dynamics in the team? How do these perceptions and variations shape a team's creative thinking? The dissertation addresses these questions by reviewing and integrating existing literature (i.e., Barsade et al., 2018; Elfenbein, 2014; Goldenberg & Gross, 2020; Hatfield et al., 1993; Jarvenpaa & Standaert, 2018, etc.) to establish a knowledge base on the affective underpinning of collaboration and later theorize relationships between digital media, dynamic affect, and team performance.

More specifically, the Mood Synchronicity study zooms out from foundational affective processes, taking them for granted, and instead focuses on understanding how those digitally-mediated processes are likely to impact team performance. While Te'eni (2001) also examines performance as an outcome, his main focus is on communication effectiveness and his model thus proposes relationships between communication inputs, obstacles, and strategies – and how all these dimensions interact with the characteristics of different ICT media. Instead, this dissertation probes the foundational affective underpinnings of digital collaboration. In other words, it models the standard ways in which affective processes structure social interaction and collaboration, and further investigates how digital mediation influences these processes, in turn rippling into how people feel and think – individually and in their relations to others. The theoretical and empirical studies presented in this collection offer practical guidance on how teams can manage collaborative problem-solving. Using these insights, organizations can make better decisions on whether to prioritize different types of collaboration (e.g., video call, in-person meeting, asynchronous documents) given the team's ongoing affective processes and the goals of the task. For example, let's imagine a team has been working together in the office all day. A brainstorming session is scheduled at the end of the day. At this point, the team is likely to experience high affective convergence and low affective variation. Yet, affective variation may be more desirable since brainstorming usually benefits from divergent thinking. In these circumstances, it could be helpful to let teams break communication and go home – joining the brainstorming sessions remotely

instead to foster affective variation and thus more creative fluency (Saigot, Gleasure, Constantiou, et al., 2023).

The new theories proposed in this dissertation can also serve as useful frameworks for researchers and practitioners to study specific cases. Companies and government agencies alike rely heavily on dispersed teams to solve complex and critical problems. As these organizations experiment with different work models (e.g., hybrid, flexible, traditional) and technologies (e.g., Slack, Zoom, Google Workspace), mood synchronicity and media affectivity theories can provide unparalleled insights into the planning and evaluation of different combinations. For example, NASA recently reconsidered its remote work policy in light of important delays in the launch of its Psyche Mission. As an internal investigation suggested that the communication tools used on the Mission prohibited the coalescence of the team, NASA focused on getting people back in the office – instead of considering whether digital media with different sets of capabilities might be a more effective solution. Applying the theories developed as part of this dissertation may unlock greater clarity on poorly understood outcomes and experiences in organizations. In the past, psychologists and management scholars have recognized the importance of variables such as burnout or loneliness. Yet, little to no research has established direct links between those outcomes with the material qualities of digital media. In a context where employees increasingly spend time using these technologies daily, this thesis provides the first steps toward the rigorous inclusion of affect when studying these topics.

Calling for the Design and Study of Embodied Media Toward "Affect-First" Capabilities

This dissertation pushes forward the concept of embedded media as an opportunity for future digital media to create new affective experiences instead of aiming to replicate physical world experiences. Building on the valuable potential of embodied media, the collection of studies in this corpus suggests that the individual nature of the human species creates ripple effects of inter-influence that can be hard to predict.

In this collection of studies, this aspect is particularly enhanced by the fourth one, where neurodivergent workers developed narratives around their own social, affective, cognitive, and sensory experiences within different technological and collaborative contexts. These narratives show that atypical ways to process information do not only shape the protagonist's experience but also that of all the other team members involved in the project. This study therefore crystallizes the importance of affect-first capabilities by outlining how unique neurophysiological functioning can impact how employees experience using digital media as well as team collaboration. Let's return to our fictitious NASA employee, Laura. If her brain functioned atypically, her resulting experience might be different from those described in the introduction – which would have impacted the entire team's communication.

Although prior research has been interested in implementing affective capabilities in ICTs – for instance by using individual biofeedback for emotion regulation (e.g., Astor et al., 2013; Peake et al., 2018) or integrating biosignals into interactive communication platforms (e.g., Hassib et al.,

2017; Liu et al., 2019), developing built-in computer support for affectivity is notoriously challenging due to the often intuitive, undocumented, and non-verbal nature of affective communication (Te'eni, 2001). Yet, when truly understanding the underlying mechanisms of interpersonal affective processes, implementing "affect-first" capabilities becomes more accessible. The fourth study further demonstrates that different sensibilities to stimuli and different affective experiences impact workers' well-being and ability to contribute to collaborative tasks. These findings emphasize the potential of embedded media to naturally espouse individual physiologies to support more humane affective and sensory experiences.

Kock (2004) suggests that media vary between natural and unnatural, with face-to-face interaction being in the middle of the spectrum. New technologies make it possible to achieve unprecedented affective experiences by augmenting the range of physical possibilities from what face-to-face communication can afford (e.g., Dennis et al., 2008; Derks et al., 2008; Kock, 2005b). Technologies like virtual and augmented realities are examples of how digital environments can replicate some aspects of the physical world while adding new layers of information and interactivity that would be unrealistic in the real world.

However, instead of considering features that can replicate real-life affective experiences, returning to the core of those experiences (i.e., the affective display – internalization mechanism, or DIM) can help design systems that are entirely built on the promise of the foundational layer. One example of replicating real-life experiences might be to design new emojis that can represent with increasing granularity the richness of human facial expressions. An affect-first capability could instead be an adaptive font color based on biosensor data – for example, when two users become very excited during a brainstorm, the font color of their chat messages could increase in saturation. As another example, two colleagues might get online in a virtual environment to evaluate a 3D version of a car engine they are working on (e.g., Hololight Space). An affect-first virtual environment may not only contain more cognitive information about the product and past communication, but it could also embed and visualize data that is directly collected from biological data or unprocessed affective behaviors for the purpose of enriching the interaction between users – which seems to be missing from current empirical studies.

Embracing this type of technology would not only offer unique opportunities for researchers to better refine their understanding of media affectivity and its impact on mood synchronicity, but also potentially improve team coalescence, user experience, and work-related well-being. These design opportunities are a key contribution to the existing IS literature, which currently lacks design approaches to affect-driven digital technologies. Moreover, these approaches complement recent advances in neuroscience as they make way for the development of embodied media – putting the human body as a stepping stone into digitalized interaction.

Building a Case Against "Unaffective" Professionalism
As this work examined the mechanisms underlying collaborative efforts, it unfolded the many ways that affect, cognition and perceptions influence individual and social experiences. It did so without

acknowledging that affective displays are often considered unprofessional – instead focusing on the implications of those displays. Instead of evaluating the hedonic range of affective displays and their effects in the workplace, this thesis focused on the interactional dynamics of naturally occurring and digitally-mediated affective processes. This non-normative approach helped define different affective pathways that may shape team collaboration in digital settings. Taken together, the collection of studies presented in this dissertation helped uncover new nuances in our understanding of the interplay between affect, digital media, and team collaboration.

For one, the findings suggest not only that affective displays are indissociable from human-to-human interaction – regardless of the interaction mode. The way they present, as much as their absence, carries an affective load that will infallibly influence ongoing and subsequent interactions. Second, the models and data presented indicate that these unavoidable affective displays may trigger a myriad of effects at the affective, cognitive, and physiological levels. For example, affective displays can shape the affective states of the members of a team as they interact – immediately or over time. Likewise, these displays are likely to shape how teams think, and how creative they are in approaching problems collectively. Specifically, a team characterized by affective convergence or variation may more easily engage in convergent or divergent thinking, facilitating different aspects of creative tasks. The double diamond model, an innovation framework widely used in the design world, suggests that divergent thinking and convergent thinking consist of the two main processes at play during a creative project (British Design Council, 2015). Another recognized conceptualization of creativity break it down into four qualities, including fluency, elaboration, originality, and flexibility. This dissertation proposes dynamic, interpersonal affective processes as a potential bridge between these two conceptualizations, proposing that different affective conditions in a team may support different creative qualities, thus contributing to different aspects of divergent and convergent thinking. These findings unlock a more nuanced understanding of creativity and the related role of affect. These new understandings may guide managerial decisions regarding which team members, digital medium, or meeting goals should be prioritized for a specific creative task at a certain time of the day.

Taken together, these considerations build on the fundamental assumption that affective displays are an integral layer of workplace dynamics that should be acknowledged, given credit, and managed to similar extents as cognitive and social dynamics. In agreement with the call by Burton-Jones & Stein (2021) to open up about affect and emotions in the workplace, this dissertation recognizes the same need at a more global level. The collection of studies presented here also illustrates their statement that effacing the affective dimensions of work does not make it un-affective – instead it, it may engender negative externalities. Burton-Jones & Stein (2021) suggest that effacing emotions may result in emotional labor and burnout. This dissertation further emphasizes that voluntarily attempting to remove affectivity – or removing affectivity as a limitation resulting from the availability of the communication channels – may also result in

communication breakdowns and team failures. This is exemplified by the NASA vignette presented in the introduction and further developed in the first study.

This dissertation therefore shows through conceptual and empirical studies that affective mechanisms are deeply rooted in perceptual and physiological experience, and influence cognitive processes in important and tangible ways. Using NASA as a vignette demonstrated that even in this highly hierarchical organization that focuses on complex problem-solving, leaving emotions at the door may not always be desirable. Mood synchronicity suggests that displays of affective states contribute to influencing the cognitive thinking that helps people resolve complex problems. Affect is also particularly influential in the communication of feedback. In essence, affect is an integral part of professionalism.

In recent years, there has been a growing interest in the concept of emotional intelligence, which is increasingly considered a key driver of academic and professional success (e.g., Brackett et al., 2011; Emmadi, 2017; Romanelli et al., 2006). Emotional intelligence describes the set of skills that allow people to perceive, accurately interpret, and appropriately respond to others' and their own emotional signals (Mayer & Salovey, 1993; Salovey & Mayer, 1990). As organizations and scholars come to value this competence, assumptions that affect should be kept separate from professional settings lose credibility. This dissertation supports this trend, carefully describing how affective processes are (i) unavoidable and (ii) instrumental. Emotional intelligence is one of the many assets that can contribute to a thriving organizational environment. Establishing and adequately managing a digital architecture that follows this model is another one – and arguably will only become more important as we continue to transition to digitalized workplaces. Overall, this dissertation suggest that emotional intelligence may not be a human-only competence – instead, it could become a way to characterize and design IT systems, too. Emotionally intelligent IT systems may be those systems that have intentionally built-in affective capabilities, including affective channels, an affective environment, and an affective character as captured by the Media Affectivity Theory presented in the second study in this collection (Saigot, Gleasure, & Constantiou, 2023).

RESEARCH OUTLOOK

This research invites future works to further advance the theories of mood synchronicity and media affectivity by seeking empirical validation. For example, online experiments to capture affective content across various media capabilities could help establish a quantified typology of affective features commonly present in contemporary tools such as Slack or Microsoft Teams. Collaborations with industry partners like Microsoft in a design-driven study may further enhance the development of these theories and add new boundary conditions. Such a study could, for example, see the implementation of affective features in experimental-grade artifacts for laboratory testing using sensors. Furthermore, the concept of technorelief presents significant potential for impact. Field experiments using experience sampling and mobile sensors such as fitness bands may provide valuable insight and validation of the concept. Moreover, there is also potential for expanding the boundaries of the concept, to examine how the phenomenon may arise in other populations. Scholars interested in these themes may also wish to explore in more detail artificial intelligence's potential to enhance communication and facilitate social, affective, and cognitive processes.

Our minds and bodies are in constant search for emotional cues. When we interact using applications like Zoom, Slack, or Miro, those cues can take many different forms. The research purpose behind this dissertation was to explore how technology helps people foster emotional connection, engage in fulfilling collaboration, and achieve greater productivity at work. To this end, this work pioneered theories on the interplay between technology, collaboration, and affect, and conducted empirical studies to capture resulting collaborative affective phenomena. As work practices continue to evolve with the continuous development of technology, the affective layer of communication will become increasingly influential in organizations. Moreover, emotions are slowly being regarded as a feature of professionalism and competence. By laying out the foundations to capture and understand the complex relationship between affective processes, digital technology, and collaborative practices, this dissertation extends the scope of the digitalization of work. It proposes new ways of thinking and analyzing work practices as a new era of affect-first digitalized workplaces emerges.

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(1) THE ROLE OF EMOTIONAL CONNECTION IN ONLINE COLLABORATION: TOWARDS A THEORY OF MOOD SYNCHRONICITY

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Abstract

Digital media are widespread in modern workplaces, but their impact on various aspects of teamwork is often ambiguous. Prior research shows contradictory suggestions that digital media both enable and constrain teams' ability to engage in creative thinking, while also somehow making individuals feel both more and less emotionally connected. Building on literature about problem-solving and affective communication in teams, we propose a theory of mood synchronicity to explain the process by which collective moods emerged and evolve within teams in response to affective cues and performance feedback. The (in)consistency of affective reactions across team members may nudge them to intuitively lean toward different forms of problem-solving: either divergent modes, in which they explore new solutions, or convergent modes, in which they elaborate upon a preferred solution. At the heart of this process are the media that teams use to communicate. The extent to which those media enable the communication of affective cues determines a team's awareness of mismatched affective reactions. The perceived affective tone of the team, in turn, impacts their ability to collectively react to feedback, and to switch between divergent and convergent thinking. Collaborative media tend to highlight or obfuscate these affective reactions, influencing how the team approaches problem-solving. Thus, implications of mood synchronicity include a broadened understanding of how digital media affects team outcomes such as creative thinking, information exchange, and emotional connection.

Keywords: future of work, digital workplace, emotional contagion, teamwork, media richness.

Introduction

Many organizations have integrated digital media into their daily work practices in recent years, finding new ways to build and maintain teams across borders and time zones. This growing reliance on digital media coincides with a changing understanding of modern workplaces, including an increased focus on the social and emotional aspects of work (e.g., Schinoff et al., 2020; Waytz & Gray, 2018), and an increased focus on creative problem-solving from multidisciplinary teams with

diverse backgrounds and skills . These changes highlight important tensions in how we understand the relationship between media capabilities, affective processes, and creative problem-solving.

First, prior literature is inconclusive on the relationship between the use of digital media and creative performance and highlights a tension between digital media's ability to inhibit or foster variety in perspectives among team members. For example, there is evidence that idea generation is impaired when teams interact over video conferences, as individuals find it easier to break focus and consider unique personal experiences when collaborating in person (Brucks & Levav, 2022). Yet, there is also evidence that ideas generated using digital media may be more creative, as the surrounding online environments provide novel means to prime individuals to make different connections before collaboration (Dennis et al., 2013).

Second, the way digital media changes the quality of information exchange within teams remains unclear in past studies. Prior works unreliably indicate that digital media both inhibits and fosters the formation of novel connections between concepts and experiences. For instance, research suggests digital media's limited capabilities for interaction, tie strengthening, and dynamic power shifting make it difficult for team members to share complex information, challenge each other, and synthesize perspectives (e.g., Yang et al., 2022). At the same time, research also shows that cross-functional teams – and especially multi-lingual teams – may be more creative when they are allowed to develop their own perspectives with fewer interruptions, such as when those teams rely on digital media to collaborate instead of shared physical offices (Riedl & Woolley, 2017).

Third, it is ambiguous from prior studies whether digital media facilitate or inhibit the formation of emotional bonds, making it unclear how their use affects social connectedness. On one hand, members of remote teams often feel less connected to their colleagues, more isolated, and struggle for meaning (cf. Sardeshmukh et al., 2012). On the other hand, large numbers of individuals are turning to online environments in pursuit of an emotional connection (Hoffner & Bond, 2022), suggesting these environments possess the capabilities to support connectedness and the construction of meaning. Moreover, an overwhelming majority of workers whose work can be performed from home wish to maintain flexible work arrangements in a post-Covid-19-pandemic world (cf. Parker et al., 2022).

The purpose of this paper is to clarify some of the processes responsible for such contradictions. Specifically, we ask: *how do media-enabled affective processes contribute to a team's approach and response to solving problems?* Building on existing literature that describes problem-solving and affective communication in teams, we propose a new theory of *mood synchronicity*, which we define as the process by which a team adapts its collective mood in response to affective cues and performance feedback. A core feature of this theory is that it helps unpack the complex relationship in a team context between digital media, affective processes, and creative problem-solving. As a result, mood synchronicity helps to understand why teams that rely on different media capabilities may perform better or worse at specific elements of problem-solving. Our findings make important contributions to research on creative thinking, online teamwork, and remote work. These new

perspectives have implications for a range of areas, including the design of digital workspaces, the management of positive and negative efficiency spirals, and the construction of diverse workforces.

Problem-solving in teams

Organizations often rely on teams to perform complex tasks. This is partly because many complex tasks require a wide range of specialized skills, which no single individual is likely to possess (Van der Vegt & Bunderson, 2005). Organizations' reliance on teams is also because cognitively diverse individuals can offer a variety of perspectives and experiences, which can frame problems in different ways, challenge assumptions, and identify new possibilities (Horwitz & Horwitz, 2007). The resulting complexity usually requires that teams engage in multiple problem-solving iterations, moving backward and forward through several phases, including information gathering, goal setting, ideation, and production or execution (McGrath, 1991).

Problem-solving iterations can be characterized by two main modes of dialectic exchange within teams: *divergent thinking* and *convergent thinking* (cf. Coursey et al., 2019). Divergent thinking occurs when teams find alternative ways to frame the problem so they can generate multiple possible solutions. For this reason, divergent thinking generally requires that teams can "mentally wander", so they are free to make new associations and they do not become prematurely fixated on specific ideas (Baird et al., 2012). Convergent thinking occurs when teams identify what they believe to be the best solution, and then elaborate and refine that solution to resolve emerging tensions. This allows teams to apply existing knowledge, explore the variability within a narrower solution space, recognize the familiar, and establish the requisite levels of simplicity and orthodoxy to make an idea work (Cropley, 2006).

These two modes of problem-solving are complementary, meaning successful problem-solving usually includes both divergent and convergent thinking (Berg, 2016). However, each represents a distinct mindset, meaning it can be difficult to switch from convergent thinking to divergent thinking, and vice-versa (Moreau & Engeset, 2016). Hence, as part of problem-solving iterations, teams rely on continuous evaluation of positive and negative outcomes to determine their progress toward a possible solution (Eisenhardt & Bingham, 2017). These outcomes can be material or social in nature, as teams may not only have to resolve task-related conflict but also tensions that arise from divergences in values, power distribution, role definition, etc. (Maruping & Agarwal, 2004; McGrath, 1991). Some of these social outcomes may be individualistic. For example, team members may seek to achieve outcomes related to status, inclusion, commitment, loyalty, contribution, and expectations (McGrath, 1991). Other outcomes may be collective, such as paying attention to the group's identity and reinforcing the team's collective belief in their ability to perform (Maruping & Agarwal, 2004).

Affective Communication in Teams

A long tradition of research has studied shared cognition in teams (e.g., Ensley & Pearce, 2001). While cognitive processes integrate affective outputs, and vice-versa (Barrett, 2017), affective processes also operate at a more "basic" level that builds on common, evolutionarily "built-in" mechanisms (Panksepp & Watt, 2011). Affective processes, therefore, provide a foundational layer for social interaction, distinct from shared cognition, though each is important in different ways (cf. De Waal, 2012). It is this foundational layer of affective processes that this study theorizes.

In the fields of psychology and organizational behavior, substantial research has focused on affective processes. Within this research, "affect", "emotion", and "mood" are sometimes used interchangeably, although each can be distinguished. George (1996) explains that "affect is a broad, generic term that covers both the intense feelings and reactions people have, which are commonly referred to as emotions, and the less intense, but no less important, feelings often called moods" (p.145). In contrast to long-lasting moods, which can be difficult to link to any one specific event, emotions are defined as intense, short-lived feelings that occur in response to some specific stimuli (Frijda, 1993). Emotions manifest themselves through physiological changes, they are directed at a specific person or event and are cognitively demanding, meaning that they interrupt ongoing cognitive processes and behaviors as they demand attention (George, 1996). Emotions serve as signals of environmental events and command a reaction – as such, they are a foundational driver of survival (LeDoux, 2012). Emotions are sometimes divided into discrete categories, such as joy, sadness, anger, fear, surprise, and disgust (Panksepp & Watt, 2011). These categories can be hard to disentangle from context-specific psychological processes (Barrett, 2017), and so many studies of team affect adopt Russell's (1980) two-dimensional model of emotion, which distinguishes emotions by the extent to which they are positive or negative, and the extent to which they are exciting/agitating or calming/soothing (e.g., Jeong & Korsgaard, 2022; Knight, 2015).

Social interaction and interpersonal relationships rely heavily on the primitive, unintentional behavior of mood contagion, whereby individuals "catch" other people's emotions (Hatfield et al., 1992). This affective process facilitates the development of trust and makes communication more efficient (Ashforth & Humphrey, 1995; Barsade et al., 2018). Mood contagion further enables the formation of a "group affective tone" (George, 1990) or shared affect – that is, a prolonged affective state that transcends any one specific event or stimulus (Zhang, 2013). Although *affective convergence* often emerges naturally in groups due to mood contagion (Barsade & Knight, 2015; Hatfield et al., 1992), past research indicates that this process can be counteracted by a range of factors, resulting in members feeling differently from one another (cf. Barsade & Knight, 2015; Jeong & Korsgaard, 2022). For example, the shared environment of a physical office space can stimulate affective convergence by increasing mutual understanding, shared norms, and coordination (Hinds & Mortensen, 2005) and by creating a shared vantage point (Elfenbein, 2014). This shared context acts as a natural stimulus that induces affective convergence even when people

do not interact (Barsade & Knight, 2015). At the other end of the spectrum, groups may also be in a state of *affective variation*[1] – or the "configuration of different affective states across team members" (Barsade & Knight, 2015, p. 4). This can occur when individuals have different affective reactions to common stimuli, such as events that trigger nostalgia in some people but not others (Derbaix & Pham, 1991). It can also occur because individuals are exposed to different stimuli from one another. Notably, when working from remote locations they are anchored in separate spaces. This reduces the presence of shared affective influences and provides more scope for individual factors such as trait affect, vivid ephemeral emotions, and residual mood from foregoing events and experiences (Frijda, 1993).

When a group is characterized by affective convergence, they are more adept at empathy and perspective-taking, meaning they tend to form closer bonds and become more mutually supportive (De Waal, 2012). This is one reason that teams who share affective states are often more committed to those teams (Bartel & Saavedra, 2000) and more willing to follow leaders who match those affective states (Sy & Choi, 2013). Similarly, in online networks, communities appear to cluster together around affective states, either as a common resting state (Bollen et al., 2011) or in response to particular events and triggers (Farny et al., 2019). Yet, affective convergence can also become problematic, especially in instances where it causes organizational groupthink (Neck & Manz, 1994). Conversely, *affective variation* tends to increase the risk of miscommunication and conflict escalation and can inhibit cooperative behavior (Barsade et al., 2000).

In order to perceive and react to affective convergence or affective variation, team members must be capable of communicating affective information (Jeong & Korsgaard, 2022). Face-to-face interaction has traditionally offered the most natural medium for team members to share such information (DeRosa et al., 2004). However, other communication media can also transmit affective information in various ways. Obvious examples include loaded and valenced words that explicitly communicate emotions (Cheshin et al., 2011; Goldenberg & Gross, 2020). Less obvious examples include message length, conversational cadence, and affective connotation (Cheshin et al., 2011), as well as the textualization of prosodic features using punctuation, repeated characters, and verbosity (Park, 2007). Additionally, non-verbal cues enable users to communicate affective states without using words, such as emoticons (or emojis) (Goldenberg & Gross, 2020; Park, 2007). More recent studies suggest that digital systems also introduce new dynamics for the communication of affective information. For example, they extend team members' reach when they are seeking emotional support or companionship (Waytz & Gray, 2018). The resulting size and structure of digital networks may serve to either amplify mood contagion due to the tendency towards homogeneity or reduce it over time due to habituation (Goldenberg & Gross, 2020). These new sets of media capabilities and online social behaviors suggest that digital systems are reaching unprecedented levels of maturity that allow them to not only maintain but also extend the range of social interaction and collaborative work (e.g., Waytz & Gray, 2018). In this context, it becomes especially important to explain how media capabilities mediate affective processes because this

understanding can help establish sustainable remote collaboration and flexible work arrangements that foster high levels of productivity and social well-being.

A Theory of Mood Synchronicity

Bringing together significant concepts from the literature on team problem-solving and affective communication, we define mood synchronicity as the process by which a team's collective mood shifts and evolves in response to affective cues and performance feedback, concomitantly shaping the team's engagement with different creative thinking styles. The unit of analysis for the theory of mood synchronicity is the team level. This means we must translate individual-level affective responses and externalizations into collective affective processes if we are to link these processes with team-level problem-solving. We thus introduce two new constructs to explain how teams switch between different modes of problem-solving (convergent thinking vs. divergent thinking). Each of these new constructs builds on the individual-level mechanism of emotional contagion in ways that are explained in the following sections. The first new construct is *affective transitioning*, which refers to a team's dynamic exploration of its affective space in search of a more suitable collective mood. The second new construct is *affective harmonizing*, which refers to the homogenization of team members' core affect as a team settles into an emerging shared mood. We propose that affective transitioning and affective harmonizing mediate the relationships between a team's affective reaction to performance feedback and that team's ability to adapt their approach to problem-solving. This is illustrated in Figure 6.
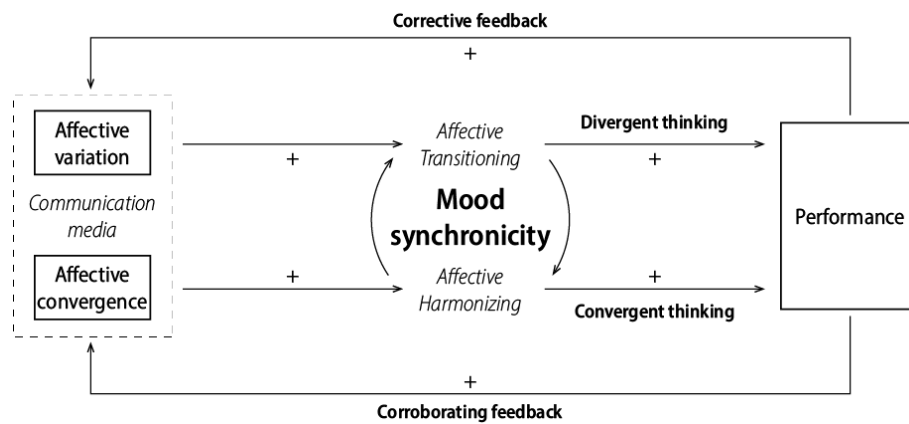
Figure 6. A model of mood synchronicity

Affective Variation and Affective Transitioning

Human beings continuously send emotional cues and displays – whether consciously or non-consciously, overtly or subtly (Elfenbein, 2014), and different media capabilities enable different kinds of signals (Dennis et al., 2008). Expressing one's emotions and being able to perceive others' emotional cues is a central element of social interaction in teams, as suppressing those natural processes can result in emotional exhaustion, decreased performance, and negative attributions

about others (Chiang et al., 2021; Jeong & Korsgaard, 2022). Evolutionary explanations of emotion further suggest that the human species evolved to notice unexpected signals because these act as alarm systems that attract our attention to potential dangers (LeDoux, 2012). As a result, unexpected affective signals capture our attentional resources, compelling us to appraise these signals and determine how to respond (Curci et al., 2013; Jeong & Korsgaard, 2022). When signals increase in number or intensity, people tend to develop hypersensitivity to environmental triggers, which often results in overreactions and can feed affective chaos (Maslach & Leiter, 2008). These mismatched responses may further lead to miscommunication and complicate consensus-building or amenability (Priem et al., 1995).

Affective variation, therefore, creates a strain that can push team members to disengage from the collaboration (Jeong & Korsgaard, 2022). This can further cause them to avoid one another, and result in the group's polarization around, for example, different strategies, values, and affective extremes (e.g., Weisbuch & Ambady, 2008). The resulting range of affective states leads the team to dynamically explore its affective space and make sense of mixed signals, all while engaging in ongoing collaborative work (Fong, 2006; Jarvenpaa & Standaert, 2018). It is worth emphasizing that while the team engages in explicit collaboration, much of the affective processes unfold in the background and at an intuitive and non-conscious level.

We refer to this process as affective transitioning – that is, a team's dynamic exploration of its affective space in search of a more suitable collective mood. An important distinction between affective variation and affective transitioning is that the former is a static state of dissimilar individual affective states, while the latter is a group-level effort to make sense of affective variation. Further, we propose that the degree of affective transitioning relies on media capabilities that can transmit the affective information needed to indicate affective variation. For example, this could be an unexpected facial expression or change in posture in a face-to-face meeting or video call, or a surprising affective tone in an email or text communication. Media that provide more opportunities to communicate these reactions provide more affective signals, and so, more opportunities to observe unexpected signals.

> *Proposition 1: The visibility of affective variation through the available media capabilities*
>
> *leads to affective transitioning, as it makes team members more likely to explore the affective*
>
> *space in search of an alternative collective mood.*

Affective Transitioning, Divergent thinking, and Team Performance

Divergent thinking has historically been linked with positive affect (e.g., Amabile et al., 2005). This is because positive affect is associated with reduced functional fixity and broader perceptual attention (Fredrickson & Branigan, 2005). Positive affect, therefore, stimulates an explorative mindset that leads teams to consider novel ideas (Friedman & Förster, 2010). In contrast, negative

affect appears to constrict the scope of attention (Fredrickson & Branigan, 2005). However, this historical view may be an oversimplification. Other studies found that under some circumstances, negative affect might be a stronger predictor of creative performance (e.g., George & Zhou, 2002). This appears to be because positive and negative affect play complementary roles, even in divergent thinking (Fong, 2006; Tiedens et al., 2004). For example, negative affect can help team members notice problems and encourage them to branch off from specific ideas to find novel and useful solutions (George & Zhou, 2002).

To benefit from a variety of different but complementary affective states, teams require media capabilities that allow them the flexibility to alternate between cognitive "deep dives" when experiencing negative affect, and "exploratory thoughts and actions" when they begin to experience more positive affect (Bledow et al., 2013). In other words, if an emerging alternative affective state is linked with an emerging idea or possibility, then the team must possess the media capabilities to communicate both the affective state and the related idea/possibility if the team is to respond effectively. Teams also require the media capabilities to communicate when affective reactions are complex and uncertain, as these ambivalent affective states may signal that certain elements or associations are unusual or important (Fong, 2006). Jarvenpaa et al. (2018) explain that the experience of multiple affective reactions simultaneously results in exploratory behavior that is generative, as new possibilities and compromises act as "probes" that force individuals to confront their differences and reconsider what is essential. This is reinforced by findings from Barsade & Knight (2015) and Fong (2006), which provide further evidence that the co-experience of dissimilar affective states is likely to increase a team's willingness to explore new possibilities and depart from normalized behaviors The resulting breakdown in routine frees individuals to reconsider past decisions and new possibilities in light of new information and uncertainty (Fleming, 2001).

The ability to dynamically explore the affective space in search of alternative collective moods (i.e., affective transitioning) is therefore key for teams to engage in divergent thinking, and so improve their performance. This once again puts pressure on a team's media capabilities to not only communicate distinct ideas and affective states but to enable team members to experience multiple ideas and affective states simultaneously. These capabilities may differ from those that enable the communication of affective variation. For example, a face-to-face meeting may combine a slideshow and a roundtable setting. That setting allows a team to focus on similar items while simultaneously observing each other's affective reactions. An online meeting may appear similar if it begins with a slideshow and then progresses to a videoconferencing discussion. However, the lack of simultaneity limits the visibility of each team member's item-specific affective reaction, and this could inhibit that team's ability to affectively transition.

Proposition 2. Affective transitioning has a positive impact on performance, as it makes it

more likely that teams engage in divergent thinking to make new connections and discover

new possibilities.

Corrective Feedback and Affective Transitioning

The purpose of feedback is to encourage certain behaviors while discouraging others (London & Smither, 2002). In the context of longitudinal performance management, teams frequently receive external feedback through various communication channels, but the nature of the feedback and how team members respond to it can vary (London & Smither, 2002; Twemlow et al., 2023). This variation in the way team members react to feedback is higher when feedback does not match what those team members had anticipated – that is when the feedback challenges their expectations and attitudes toward the topic at hand (Côté, 2005). In response to this discrepancy, individuals within teams exhibit diverse reactions: some are willing to accept the feedback and adjust their expectations, while others prefer to interpret the information in a way that supports their pre-existing beliefs (DeNisi & Kluger, 2000). These reactions may reflect a different pre-existing set of expectations, or varying levels of personal investment in the elements receiving feedback (Coutifaris & Grant, 2022). For example, if two team members disagreed about a specific decision, and that decision subsequently received negative feedback, some may view this as ongoing close-mindedness while others may view it as validation of earlier concerns (cf. Brennecke, 2020).

We refer to this as *corrective feedback*, as it inhibits the team from progressing with their existing expectations of the problem and/or possible solutions. Media capabilities play an important role in both receiving and processing this feedback. Some of the most common ways feedback is received include behavioral cues, such as a change in body language from a customer or manager, and explicit communication, such as verbal feedback or data from performance measures (Dennis & Kinney, 1998). This feedback is then internalized by team members via physiological experiences. For example, when team members observe an outcome that they did not expect or desire, those team members may experience a sinking feeling in their stomach, or their faces may change in expression to reflect sadness, fear, or anger (Heaphy & Dutton, 2008). That individual may become aware of these changes through the process of interoception – that is, the perception of physiological changes in one's own body, and this could lead them to reflect on the specific outcomes that have caused them to have this undesirable reaction (Barrett, 2017).

Corrective feedback will therefore contribute to affective variation, as each individual struggles to reconcile unexpected outcomes in reference to their individual expectations, expertise, physiologies, and relative participation. Individuals may also make negative attributions about others as they seek to allocate blame, particularly when collaborating remotely over digital media (Cramton et al., 2007). The ability of team members to observe one another's affective reactions may have an impact on how they collectively adjust to corrective feedback (Jeong & Korsgaard, 2022). For example, if affective reactions are clearly visible across the team, this can prompt team members to respond to affective cues more strategically and with less mirroring, as they strive to increase their affective influence on the group and reduce the affective influence of others (Chiang et al., 2021).

The visibility of those affective reactions is contingent upon the capacity of the digital media employed to convey those cues. In remote collaboration settings mediated by digital platforms, the

ability to observe and interpret these physiological cues heavily depends on the constraints imposed by the medium. For instance, in text-based communication, where visual and auditory cues are absent, team members may rely solely on verbal communication, which may hinder the detection of subtle physiological changes. On the other hand, videoconferencing platforms enable the transmission of facial expressions, body language, and tone of voice, providing access to a more comprehensive set of perceivable affective reactions. The extent to which affective reactions are visible, and thus their impact on the team's collective adjustment to corrective feedback, is therefore highly contingent on the capabilities and limitations of the digital medium used for communication.

Proposition 3. The communication of corrective feedback via the available media capabilities leads to affective variation, as team members are more likely to identify differences among their individual understandings and expectations.

Affective Convergence and Affective Harmonizing

Team members experience affective convergence when they experience similar affective states (Barsade & Knight, 2015). This process is often cumulative, meaning the ability of individuals to communicate and mirror each other's affective state relies upon their finding some preliminary similarities on which to build in the first place (De Waal, 2012). This means the team must have the media capabilities to signal their affective states to "get the ball rolling". Once members of a team develop some sort of shared affective states and signals, they have a greater capacity to empathize with one another further (Ashforth & Humphrey, 1995). Thus, affective convergence often snowballs around a shared affective "vantage point" which occurs "when we share the same vantage point in appraising an emotionally evocative stimulus, we experience convergent or divergent contagion – convergent when we interpret the stimulus in the same way and divergent when our idiosyncratic interpretations differ" (Elfenbein, 2014, p. 355).

Media capabilities play an important role in developing this shared vantage point, as team members need to communicate their individual reactions if they are to recognize similarities. As teams become more aware that they are affectively aligned, team members' interpersonal bonds also grow stronger, as the added coordination increases social closeness (Wiltermuth & Heath, 2009). Since the relationship between social closeness and mood contagion is reciprocal, the closer team members feel to one another, the more affective convergence they experience (Lakin et al., 2003). The result is a collective pattern of affect which allows team members to rely less on factors such as similar trait affect or shared stimuli because they now share an affective reaction to a common experience.

We describe this process in which teams experience increasingly similar levels of positive and negative affect as *affective harmonizing* – that is, the homogenization of team members' core affect as part of an emerging shared mood.

Proposition 4: The communication of affective convergence via the available media capabilities leads to affective harmonizing, as team members are more likely to experience shared affective vantage points.

Affective Harmonizing, Convergent Thinking, and Team Performance

The impact of affective harmonizing is to reinforce specific emotions within a team and reduce ambivalence across the team. This social reinforcement of affective states tends to amplify those states among the individuals involved (Hadley, 2014). This also appears to happen when individuals communicate using digital media capabilities, even over large distances (Iyengar et al., 2019). Given the connection between attention and emotional arousal, this also means that individuals are more likely to be focused on specific objects and concerns, as their common affective vantage point causes them to fixate on similar perceived threats and opportunities (Vuori & Huy, 2016). For face-to-face interactions, this shared fixation is often communicated in ways such as gaze following, which acts as an unconscious signal that individuals have a common object of focus (Bayliss et al., 2006). This type of shared focus allows a team to limit the potential distraction of exploring new possibilities, and spend more time on convergent thinking to refine a preferred solution. When teams lack the media capabilities to recognize objects of shared focus, this may give rise to confusion and doubt (Chiang et al., 2021).

Affective harmonizing may also impact team members' attitudes toward one another, due to the types of unconscious social mimicry that are typically associated with mood contagion (see Barsade et al., 2018). Such mimicry helps to signal affiliation and rapport among team members (Lakin et al., 2003). This is because mimicry leads individuals to assume they are part of an in-group, leading them to become more cooperative (Maddux et al., 2008). Ashton-James & Chartrand (2009) demonstrated the power of simple mimicry in enabling convergent thinking, even when team members actually perform tasks in isolation, without collaborating. They observed that individuals performed better in their individual convergent thinking tasks when an experimenter mimicked that individual's movements before beginning a given task, such as face, hair, and body touching, posture shifting, and limb movements. They attribute this to a changing mindset when mimicry is present, in which individuals are more likely to perceive familiarity and similarity in the task at hand.

Specific affective states stimulate specific actions (Zhang, 2013), and so coordinated affect tends to facilitate coordinated action (Bartel & Saavedra, 2000; Sy & Choi, 2013). The ability to move towards a shared affective state (i.e., affective harmonizing) is therefore key for teams to engage in convergent thinking, and so to improve their performance, as are the media capabilities to enable mimicry and other conscious or unconscious social cues required for affective harmonizing. Teams become more likely to consider the same elements of a problem and solution to be important, to feel similarly about those particular elements of a problem and solution, and to follow one another's

lead in the collaborative process. This allows them to iterate on a selected idea, resolve issues, and expand on capabilities.

> *Proposition 5. Affective harmonizing has a positive impact on performance, as it makes it more likely that teams engage in convergent thinking to prioritize problems and agree on preferred solutions.*

Corroborating Feedback and Affective Harmonizing

Feedback is not only about discouraging ineffective or undesirable behaviors. Feedback also plays an important role in encouraging behaviors and building enthusiasm (DeNisi & Kluger, 2000). When individuals receive feedback that aligns with their expectations, it increases their sense of self-efficacy and control (Eccles & Wigfield, 2002). As individuals start to feel confident in their decision-making and progress, they may become more likely to seek, through the available channels, *corroborating feedback* that allows them to progress with preferred ideas and dismiss alternatives (De Stobbeleir et al., 2020). This creates a sense of momentum that allows informationally diverse teams to elaborate on ideas and share additional, domain-specific insights, building on a common affective reaction to their existing progress (Jeong & Korsgaard, 2022). As teams develop an increasingly sophisticated shared understanding of the problem and solution, they also develop more sophisticated shared expectations, and this can help the team spiral towards more corroborating feedback and more closely aligned affective experiences and expectations (Lindsley et al., 1995).

Corroborating feedback can thus be viewed as a force that pulls teams towards affective convergence, provided they have the media capabilities to receive this feedback. This can become problematic if the feedback is misleading or not properly calibrated. This means there must be a means to communicate feedback in ways that allow the affective tone to be evaluated and adjusted, depending on how it is received (London & Smither, 2002). For example, where corroborating feedback is insufficiently critical, it can mean that groups can have insufficient conflict, or address conflict too quickly, and this contributes to groupthink (Riccobono et al., 2016) and reluctance to adapt and change (Schulman, 1993). Such pitfalls are historically exemplified by NASA and their fatal disasters in 1986 (Challenger Mission) and 2003 (Columbia Mission), where a climate of overconfidence reinforced by past successes and under-critical feedback might have played a major role in the engineering and management teams overlooking critical safety concerns (Feldman, 2004). This inability to express balanced affectively-calibrated feedback is common when relying on media with limited affective capabilities, such as emails and written reports (e.g., Patient & Skarlicki, 2010). In other words, without suitable media capabilities, corroborating feedback may not stimulate suitable levels of affective convergence, or it may stimulate excessive affective convergence even when a team's performance does not warrant it.

Proposition 6. The communication of performance feedback via available media capabilities leads to affective convergence, as team members are more likely to identify similarities among their individual understandings and expectations.

Discussion

The main contribution of this article is the theory of mood synchronicity. The theory helps to understand how teams shift between different collaborative styles, based on external performance feedback. Affective convergence or affective variation is communicated via the chosen collaborative media, and the resulting affective harmonizing or affective transitioning gives rise to the convergent thinking or divergent thinking needed to address complex and dynamic problems. Specifically, mood synchronicity helps shed light on some of the tensions highlighted at the opening of this article.

First, we noted contrasting claims that team members inconsistently produce better and worse creative outcomes in digital environments (e.g., Brucks & Levav, 2022; Dennis et al., 2013). Mood synchronicity helps to address this tension by describing the mechanisms through which media communicate corrective and corroborating feedback as well as the team's affective response to that feedback. This feedback indicates to a team when to disengage in search of alternative new creative expectations (i.e., use divergent thinking) and when to engage more thoroughly with one another and establish common expectations (i.e., convergent thinking). While during in-person interaction, variance in intercepting and interpreting such feedback is mostly induced by factors such as different personalities and social norms, technological mediation introduces even greater variance through differences in media capabilities. For example, while many may assume that a Zoom meeting is close enough to in-person interaction to symmetrically replicate the social and affective cues of in-person collaboration, features of the app such as screen sharing, collaborative whiteboards, and different video layouts may impact the perceptibility of these cues. As a result, online collaboration introduces added variance and complexity to the communication of and reaction to feedback. This is especially important when considering complex problem-solving, which requires strategic uses of divergent and convergent thinking. Teams need media capabilities that can effectively communicate corrective and corroborating feedback, such that it dynamically stimulates divergent and convergent thinking at relevant stages of the collaborative process. Prior literature suggests that teams often perform better when they can switch between creative modes quickly and often, rather than treating divergent thinking and convergent thinking as separate processes (Fong, 2006; Tiedens et al., 2004). We extend this line of research by explicating that the media capabilities available to a team support the communication of feedback to different extents, which either stimulate divergent or convergent thinking and to different levels of accuracy, which

affects the appropriateness of each thinking style. The team's ability to switch between divergent and convergent thinking at key stages of the collaborative process directly affects its performance.

Second, we noted contrasting evidence suggesting that team members are better and worse at exchanging ideas in digital environments (e.g., Riedl & Woolley, 2017; Yang et al., 2022). Mood synchronicity helps explain these conflicting findings by explaining that digital media capabilities play a central role in communicating affective states in a team (i.e., affective variation and affective convergence). These capabilities help teams to recognize the degree of uncertainty among team members, with higher levels of affective variation prompting team members to focus on the generation of different ideas, or higher levels of affective convergence prompting them to focus on refining existing ideas. Collaborating using media that communicate affective variation prompts affective transitioning. Assuming a team is anchored in an environment of psychological safety, affective transitioning triggers generative mechanisms that are likely to motivate dynamic communication and idea generation. Likewise, if the media communicate affective convergence, team members will engage in affective harmonizing and naturally focus on the existing pool of ideas – possibly withholding or overlooking insight or pieces of information that may deviate from the emerging collective mood. Much of the existing literature focuses on binary views of the impact of affective states on idea exchange and creative insight (e.g., George & Zhou, 2002), although some studies identify emotional ambivalence (Fong, 2006; Jarvenpaa & Standaert, 2018) as the affective drivers of generativity. We extend those findings by mapping the mechanisms through which affective convergence and variation are likely to trigger different thinking styles (i.e., convergent and divergent). Most importantly, we explain how media capabilities can accurately, exaggeratedly, or prohibitively depict those affective processes during online collaboration, thereby shaping a team's collaborative processes and performance.

Third, we noted contrasting claims that team members find it easier and harder to form emotional connections in digital environments (e.g., Hoffner & Bond, 2022; Mihalache & Mihalache, 2021; Sardeshmukh et al., 2012). While there is a widespread view that digital media change the nature of work relationships in some way, mood synchronicity sheds light on these contradicting trends by describing how media capabilities shape the affective nature of digital interaction. Digital media change the set of affective signals that individuals can transmit, replacing some of the primitive mechanisms of face-to-face interaction with more effortful and conscious emotional communications and perspective-taking (Kock, 2011). In such cases, motivation for engaging in affective communication and nurturing relationships becomes more important (Schinoff et al., 2020). This is possibly a reason why some people experience strong emotional bonds over digital media, while others cannot seem to connect. Another reason is that digital media that reduce perceived affective variation may lead co-workers to feel more similar to one another, which fosters processes such as self-disclosure, thereby increasing the team's closeness and maturity (Pillemer & Rothbard, 2018). On the other hand, the pervasiveness of digital tools can make it difficult to escape work environments, especially where there are overlaps between work relationships and other

relationships (Schinoff et al., 2020). A continuous abundance of affective signals may have other negative impacts, such as distraction from organizational goals, groupthink, and the formation of exclusive identity-based cliques that inhibit knowledge sharing (Pillemer & Rothbard, 2018). Biological studies on early life already the relational benefits of disengaging from social relationships, and then subsequently repairing them (Provenzi & Tronick, 2020; Tronick, 2008). Other studies showed that digital media that enable communication bursts rather than ongoing communication may foster team performance during online projects (Riedl & Woolley, 2017). Our findings build on the biological mechanisms by making sense of them in the context of digital and hybrid workplaces, in adult relationships. Moreover, we unpack some of the affective mechanisms that explain the success of communication bursts by bringing nuance into the role of media capabilities and the exchange of affective cues during remote teamwork.

The findings from this study do not prescribe the specific media capabilities that should be used to produce better team outcomes. Nonetheless, we believe that by laying out the role played by digital media in various affective processes, and the relationship of those affective processes to creative outcomes, management research is better placed to analyse emerging digital workspaces.

Future research directions

An important outcome of this study is to create a foundation for future empirical research on mood synchronicity. Recent studies have highlighted the need for management research to focus more attention on emotions (Matta & Van Dyne, 2020), team cadence (Schinoff et al., 2020), and digital collaboration media (Jarvenpaa & Välikangas, 2020). There has also been a growing interest in "emotional intelligence", and the corresponding "competencies of perception, understanding, utilizing and managing emotions effectively in the self and others" (Schutte et al., 2013, p. 56), which have already been linked with creativity and performance outcomes (e.g., Côté & Miners, 2006). Mood synchronicity brings together this wider set of affect-related literature under a cohesive collaborative logic, and so helps to unpack some of the mystery of digital collaboration media. It provides a coherent theoretical frame with which to connect physiological processes with the material qualities of specific media. This framing allows theories to consider new affective capabilities in digital media that go beyond what is possible in face-to-face communication. For example, studies have introduced biosignal-enabled systems that communicate physiological data between people to help them understand each other's physiological states. There have also been suggestions that technologies measuring physiological changes could provide alternative approaches to management in the future, as new tools make it easier to detect and remedy harmful affective changes in teams and functions (Whelan et al., 2018). The theory of mood synchronicity helps future organizational research to make sense of new affect-related capabilities, synthesize results across studies, and relate these new capabilities to other organizational changes.

Mood synchronicity offers a means to understand why people feel disconnected from others in their online work environment. For example, if team members cannot observe each other's affective

variation or affective convergence in response to external feedback, they may infer a sense of apathy among other team members (Cramton et al., 2007). One widely discussed instance of this is the concept of "Zoom fatigue", in which team members struggle for motivation or a sense of progression (Fauville et al., 2021). Just as a team's affect drives them to take action, mood synchronicity suggests a lack of communicated affect inhibits the generation of possibilities. This may be because a team lacks the feedback needed to elicit affective variation or affective convergence among team members, or a lack of media capabilities to communicate the affective variation or affective convergence that is elicited.

Mood synchronicity also helps to make sense of the role of media in enabling and constraining "efficacy-performance spirals". When self-evaluation and performance begin a mutually-amplifying loop, teams that receive positive feedback become increasingly confident, and thus more likely to perform well and receive further positive feedback (Lindsley et al., 1995). However, these reinforcement spirals are not always useful, as teams can become insufficiently self-critical and insensitive to corrective feedback (Whyte, 1998). Teams may further become stuck in "downward spirals", meaning those teams that receive corrective feedback can become increasingly self-critical, and thus more likely to receive further corrective feedback (Shea & Howell, 2000). Viewed in terms of mood synchronicity, these spirals can be attributed to a team's inability to communicate affective variation and affective convergence, respectively. The use of alternative media capabilities may therefore provide a means of nurturing desirable spirals and inhibiting negative spirals, by introducing features intended to communicate affective variation or affective convergence.

Mood synchronicity further suggests that for teams to process corrective feedback and adjust their subsequent behaviors, they must be able to collectively communicate affective variation. When this does not occur, corrective feedback may not be effective in stimulating a response. One example of this is the tendency for online environments to create "echo chambers", characterized by extreme opinions and heightened affective states (Del Vicario et al., 2016). These echo chambers lack diverse viewpoints, and individuals may be unwilling to speak out against misinformation. Under these conditions, media capabilities to communicate affective variation become especially important, as they highlight an unspoken sensitivity to corrective feedback. For example, labeling a piece of information as factually incorrect may not impact people's likelihood of believing it (Moravec et al., 2019), if those people cannot see the affective variation that results. Thus, part of the solution to online echo chambers may be to capture and communicate affective variation that is otherwise not shared. In terms of system design, this requires a shift in media capabilities that provide external feedback, to media capabilities that provide peer visibility of users' affective responses to feedback.

More fundamentally, mood synchronicity encourages managers to reconsider the concept of "affective conflict". Organization and management literature has long discussed the existence of affective conflict as distinct from cognitive conflict, where cognitive conflict describes task-

oriented differences in perspective and affective conflict describes the negative feelings that team members may develop towards one another when they disagree, such as distrust, suspicion, or hostility (Amason & Sapienza, 1997; Jehn, 1995). By focusing on affective variation, mood synchronicity places the emphasis on a different way to think about affective conflict; the existence of alternative affective states. The affective variation and affective conflict in a team may be related. After all, shared affective states enable empathy (De Waal, 2012) and commitment to the team (Bartel & Saavedra, 2000; Sy & Choi, 2013). However, the ability to distinguish affective variation may help to explain why some forms of cognitive conflict are associated with more positive relationships (cf. Jehn, 1995).

Recent findings illustrate that team members produce more creative ideas when they are free to disengage from one another, and then re-establish their connection once they have had a chance to explore different ideas (Brucks & Levav, 2022). Building on research during the COVID-19 lockdowns as well as from mother-infant studies, it also appears that continuous affective state-matching is not always positive for social relationships (Provenzi & Tronick, 2020). Instead, it appears that the ability to affectively "disconnect", followed by periods of "reparation", actually results in more positive affect in the relationship between individuals (Tronick, 2008). Mood synchronicity adds to existing research by elaborating on why individuals need the media capabilities to both deviate from shared affective states (i.e., affective transitioning) and subsequently communicate the affective information needed to re-establish those shared states (i.e., affective harmonizing).

Mood synchronicity also raises considerations for future research, most notably for the design of diverse hybrid or digital workplaces. There is compelling evidence that diverse teams tend to be more innovative, provided the organizational climate supports the integration of multiple perspectives and thinking styles (Shin et al., 2012). Such diversity may present different dispositional traits and norms, and those traits and norms may impact how similarly people display and perceive affective cues, thereby making them more or less susceptible to forming shared affective states (Bond & Raleigh, 1999). For example, there is evidence that women are generally more empathetic than men and more susceptible to mood contagion (cf. Doherty et al., 1995). There is also evidence that different cultures express (and therefore experience) emotions differently (Immordino-Yang et al., 2016). Other studies found that similarity in personality attributes such as extroversion and neuroticism increases the degree of mood contagion among team members (Barsade et al., 2018; Sy & Choi, 2013) and that, once a mood starts spreading, affective spirals are fuelled by mutual attraction and individual susceptibility to mood contagion (Hareli & Rafaeli, 2008; Sy & Choi, 2013). Meanwhile, people who process and respond to affective cues in non-typical ways (i.e., neurodivergent individuals) have been historically excluded from workplaces – partly due to non-typical processing of affective cues (Dreaver et al., 2020). Yet, Austin & Pisano (2017) describe multiple instances when the ability of autistic team members to avoid mood contagion led to significant innovation. The growing sophistication and widespread use of digital

work systems present a unique opportunity to unleash the potential of neurologically atypical workers (Walkowiak, 2021). All of this suggests that the effective management of diverse teams may require careful design and selection of collaboration media, built on an understanding of mood synchronicity and how it can be nurtured.

Conclusion

Digital media present teams with different capabilities to communicate affective changes across the team, and these affective changes provide important cues for how the team approaches problem-solving, and how it responds to feedback. Mood synchronicity explains this process. It also illustrates how affect-related media capabilities determine teams' ability to develop and adapt the shared affective "vantage point" that is required for them to collectively switch between convergent and divergent thinking modes. Understanding this process is increasingly important due to the expansion of digital media, not only terms of in popularity but also in terms of affect-related capabilities. As these capabilities continue to develop in the future, managers and team leaders will be required to make informed decisions about the communication channels they promote and make available to their teams. Increased awareness of the affective consequences of choosing one channel over another will help organizations set up adaptive communication structures that contribute to setting teams up for success.

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(2) MEDIA AFFECTIVITY THEORY: A NEW PERSPECTIVE ON MEDIA CAPABILITIES AND THE COMMUNICATION OF AFFECT IN TEAMS

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Abstract

The recent shift toward hybrid workplaces and online collaboration highlighted the important, yet often overlooked, implications of affective processes among digitally connected team members. To empathize and understand one another, team members must often find a way to improve their "affective alignment" – that is, the degree to which each team member's affective state is responsive to the affective states of others in the team. In this article, we review the literature on affective alignment and media capabilities. Synthesizing our findings, we propose a theory of media affectivity, which posits that a medium's affective channels, affective environment, and affective character enable and constrain the emergence of affective alignment in teams. This theory helps to understand why teams may feel more or less connected when using different media, and how new technologies may be used to augment affective alignment. By focusing on the affective layer of communication, media affectivity highlights the role of digital "locations", the challenges of asynchronously communicating fleeting emotions, and the need to distinguish between "natural" media and "embodied" media, thus challenging some of the assumptions of existing theories.

Keywords: Media naturalness, emotional contagion, virtual teams.

Introduction

In 2022, The National Aeronautics and Space Administration (NASA) embarked on the pioneering Psyche mission, aimed at unveiling the secrets of a metal-rich asteroid nestled between Mars and Jupiter (NASA, 2022b). As the planned launch date approached, unforeseen delays triggered an inquiry by an Independent Review Board (IRB) (Potter, 2022). The

investigation uncovered issues relating to the array of advanced digital tools which the team used to collaborate. Within this high-stakes mission, the communication of emotional reactions such as stress, surprise, and fear was crucial. However, the team's reliance on digital media inadvertently hindered the nuanced transmission of these affective states (NASA, 2022a). The issue did not seem to be the speed or veracity of the information; NASA applied a combination of cutting-edge digital media for formal and informal communication and team members did not appear to misunderstand one another. Instead, the IRB report suggests that the digital media that NASA used failed to adequately communicate the affective states of the people involved. Team members needed to know what other team members were feeling, not only to help interpret their communications but because those feelings were themselves valuable information.

Like NASA, many modern workplaces have come to rely on digital media and online collaboration. Also, like NASA, the discussion of these digital media has focused on the cognitive elements of communication, such as the development of shared mental models and the reduction of uncertainty or equivocality (e.g., Daft et al., 1987; Daft & Lengel, 1986; Dennis et al., 2008; Kahai & Cooper, 2003; Kock, 2009; Rafaeli et al., 2012; Rice, 1992). Yet, as the NASA example demonstrates, communication is not only about shared mental models and cognitive alignment; communication also includes a distinct layer of affective information that allows individuals to detect and respond to each other's affective states (De Waal, 2012). Much of this response is involuntary, as individuals tend to naturally converge on shared affective states over the course of their interaction, creating a sense of togetherness and empathy as each individual comes to experience similar physiological influences (Hatfield, Carpenter, et al., 2014). Once these individuals have become affectively aligned, they become more sensitive to changes in each other's affective states and they can begin to make more conscious emotional communications when they detect an unexpected or undesirable state (Tee, 2015).

Affective information is notoriously difficult to communicate using digital media (Brady et al., 2023; Byron, 2008; Kramer et al., 2014). This problem has become relevant for many organizations that have shifted to flexible work as a sustainable model, under the assumption that this allows workers to avoid stressful commutes and find a better work/life balance (Diab-Bahman & Al-Enzi, 2020; Malhotra, 2021). Despite the gains in efficiency, multiple studies suggest that, since this shift, workers have felt less connected to their colleagues (Mihalache & Mihalache, 2021; Yuan et al., 2020), and more lonely in general (Fonner & Roloff, 2010; Sardeshmukh et al., 2012; Weinert et al., 2015).

Existing theories of digital media do not differentiate between the communication of intentional and often symbolized information, such as words, affirmations, and gestures, and basic affective information, which is often involuntary and interpreted subconsciously (Hatfield et al., 1993). This study addresses this need to understand and analyze the affective capabilities presented by different digital media. Specifically, we ask: *how do different media capabilities enable and constrain affective communication among team members?* Note that we do not

attempt to integrate the types of foundational affective processes described by De Waal (2012) into the types of cognitive processes commonly described in existing work on digital media, such as Dennis et al. (2008). That approach would put us at risk of contributing to the growing incommensurability of existing models, thus rendering valuable concepts difficult to use (Grover & Lyytinen, 2015). Instead, we develop a dedicated theory to focus on this distinct affective layer of communication. This requires that we differentiate and relate foundational affective processes and foundational media capabilities that will later serve as the building blocks of our theory development (Grover & Lyytinen, 2023). The next section performs an in-depth literature review of existing research on *media capabilities* and *affective processes* in a work-team context. We then synthesize our findings from the literature into a model of *alignment in online communication* and propose the new theory of *media affectivity*. Finally, we discuss how this theory contributes to existing research on digital media and online collaboration.

Theoretical Background

Background Literature on Digital Media

Much of the existing literature on media capabilities has focused on the elements of face-to-face communication that are lost when individuals use different media (Raghuram et al., 2019), and the subsequent threat of misinterpretation. This characteristic is often referred to as "media richness" (Treviño et al., 1987). Media richness refers to "the ability of information to change understanding within a time interval" (Daft & Lengel, 1986, p. 560). The richness of a given medium is determined by that medium's ability to provide immediate feedback, transmit multiple cues, use natural language, and provide personal focus (Daft & Lengel, 1986). This measure of media richness means media that resemble face-to-face communication are considered rich media, while media that rely on limited symbol sets or asynchronous communication, such as written memos, are considered lean media. Media richness theory argues that rich media are perceived as more effective for communication tasks that involve high levels of uncertainty and equivocality, as they allow for immediate feedback, the transmission of multiple cues, and the use of natural language. In contrast, lean media are deemed more suitable for communication tasks that involve low levels of uncertainty and equivocality, as those media are more efficient and less prone to information overload (Treviño et al., 1987). Several studies have examined the applicability of media richness theory in different contexts. While some of these studies found empirical support for media richness theory (e.g., Daft et al., 1987; Rice, 1993; Walther, 1996), other studies highlighted limitations in the theory, such as the unreliable predictions it affords about which media teams actually prefer (e.g., Dennis & Kinney, 1998; El-Shinnawy & Markus, 1997; Suh, 1999).

Media richness theory was later reformulated to develop a "media synchronicity theory" (Dennis & Valacich, 1999). Media synchronicity theory focuses on the synchronicity between communication media and the different types of communication processes (Dennis et al., 2008).

One type of process is "conveyance", which refers to the process of transmitting information from one person to another. Conveyance involves the sharing of information, ideas, and messages between individuals. Another type is "convergence", which involves the process of reaching a shared understanding and agreement among individuals. Convergence is the process of adjusting perspectives, resolving differences, and achieving consensus. These communication needs vary throughout a project, as teams go through different modes of operation that emphasize different interpersonal and cognitive aspects.

According to media synchronicity theory, different communication media have varying capabilities to support these two communication processes. Some media may be more effective in facilitating the conveyance process, while others may be more effective in supporting the convergence process. For example, media with high synchronicity, such as face-to-face communication, are considered more suitable for tasks that require high levels of convergence, as they allow for immediate feedback, the use of multiple cues, and natural language (Thomas et al., 2023). In contrast, asynchronous media, such as email, may be more suitable for tasks that primarily involve conveyance, as they allow for the transmission of information without the need for immediate interaction (Parlamis & Dibble, 2019).

Other streams of research have focused on less conscious or task-specific communication. The concept of *social presence*, for example, designates a medium's quality to enable a "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" (Short et al., 1976, p. 65). A useful analogy is that of social presence being the "illusion of non-mediation" (Lombard & Ditton, 1997). The concept captures the subjective perception of a medium's quality – even though it is anchored in objective qualities. Social presence is therefore measured using scales such as impersonal to personal, cold to warm, unsociable to sociable, insensitive to sensitive (Short et al., 1976). Social presence can be discussed within a range of different scopes, including social richness, realism, transportation, immersion, social actor within a medium, and medium as a social actor (see Lombard & Ditton, 1997). Theoretically, social presence might emerge from media attributes such as the availability of sensory output on a given medium (i.e., human senses for which a medium provides stimulation), interactivity, obtrusiveness, etc. Unlike perceived communication effectiveness (Carlson & Zmud, 1999), social presence seems to remain constant over repeated interaction using a given medium (Burke & Chidambaram, 1999).

Across these different streams of research on media capabilities, affective communication has received little attention, though some studies highlight the impact of empathy and emotion on cognitive and relational processes (e.g., Kahai & Cooper, 2003; Nguyen et al., 2023). For example, Torro et al. (2022) suggest that higher synchronicity media facilitate cognitive trust-building more effectively due to shared focus, faster transmission, and increased social cues. Te'eni (2001) argues that affective communication can be used to motivate other group members or to provide others with a general sense of how one feels about an object or situation. Byron

(2008) examines the communication and miscommunication of affect in emails, proposing negative and neutrality effects that distort the reception of emotionally-loaded communications. Despite those affective breakthroughs, many of these studies either entangle cognitive and affective processes (e.g., Te'eni, 2001; Torro et al., 2022), focus on a specific communication channel (e.g., Byron, 2008), or ignore the social dynamics of emotional contagion (e.g., Burke & Chidambaram, 1999; Rice, 1993).

The relationship between team members' media capabilities and their affective states has come further into focus in recent years. Researchers increasingly study the effects of different media on variables like well-being, self-efficacy, and self-care management (e.g., Kashian & Mirzaei, 2019; Kumar & Alok, 2022; Torro et al., 2022). To explain why many people report more positive affective states when using face-to-face-like communications, Kock (2004, 2005) proposed a "media naturalness hypothesis". Based on evolutionary psychology, media naturalness suggests humans prefer communication that resembles face-to-face communication because our biological apparatus has evolved to prime us with the symbolic tools and heightened physiological alertness for this mode of communication. "Media naturalness" is defined according to the similarity with face-to-face interaction and is characterized by (i) a high degree of co-location and synchronicity, (ii) the ability to convey and observe facial expressions and body language, and most importantly, (iii) the ability to convey and listen to speech (Kock, 2010). Less natural media force individuals to expend more cognitive effort as they work to resolve ambiguities and overcome a lower level of physiological arousal. Learning and training can help to overcome some of these evolutionary preferences, as prolonged exposure allows individuals to adapt their behaviors to offset some of the challenges of unnatural media (Kock, 2009, 2010). This idea of adaptation is consistent with channel expansion theory, which offers a dynamic view of media perception. The theory suggests that users overcome the communication challenges of lean media as they practice using them (Carlson & Zmud, 1999; Kock, 2009)

Collectively, these streams of research highlight that the choice of digital media impacts a team's ability to communicate both cognitive and affective information. However, each of these theories focuses on the cognitive side of collaboration, and so each positions affective communication as contextual information that is necessary to interpret shared ideas and coordinate tasks. While this type of affective communication is important, there are also more foundational forms that create a "bottom-up" affective connection among individuals (de Waal & Preston, 2017). This connection often manifests through shared physiological states and emotional experiences, even when individuals are not exchanging ideas or interacting toward some shared goal (De Waal, 2012). This helps to explain why team members may feel disconnected and lonely when their digital media lack the capabilities for these foundational affective communication, even if their teams are coordinating and performing tasks satisfactorily. It also explains why it is difficult to explain these feelings using existing IS theories of digital media, which have embraced the cognition-centric view of affective communication.

The Communication of Affect

One of the challenges when understanding affect and affective communication is that many terms are often used interchangeably, such as "affect", "emotion", and "mood". George (1996) explains that "affect is a broad, generic term that covers both the intense feelings and reactions people have, which are commonly referred to as emotions, and the less intense, but no less important, feelings often called moods" (p.145). Individuals also present "trait affect", which is the result of disposition and personality (George, 1996). This means that affect can be thought of as a continuously changing physiological state, influenced simultaneously by an individual's response to specific events and stimuli (emotions), their social environment and previous affective states (mood), and their individual affective tendencies (trait affect). Core affect, in this case, captures well this entanglement as it refers to "the most elementary consciously accessible affective feelings (and their neurophysiological counterparts)", which can encompass "a sense of pleasure or displeasure, tension or relaxation, and depression or elation" (Russell & Barrett, 1999, p. 806). Importantly, core affect designates affective feelings that can be free-floating or become directed and are experienced as very intense or neutral (such that it is not experienced consciously) (Russell & Barrett, 1999).

When it comes to socially communicating affect, De Waal (2012) explains that there appear to be at least three layers by which affective information becomes integrated into social interaction. At the foundational layer, individuals who interact with one another communicate and imitate each other's affective states via (often unconscious and unintentional) "contagion" processes, whereby individuals "catch" other people's emotions (Hatfield et al., 1992). This process of contagion enables a prolonged and shared affective state across individuals that transcends any one specific event or stimulus (Zhang, 2013), creating the team's "affective tone" (George, 1990).

At the middle layer, individuals use their understanding of others' affective states to engage in "sympathetic concern", whereby they may attempt to create more desirable affective states in others. In an organizational context, this often occurs when team members use their understanding of others' affective states as a sign they need to adjust their attitude or behavior (Manstead & Fischer, 2001). For example, team member A may recognize that team member B appears stressed when they are asked to come into their office. Team member A may choose to smile at team member B, thus prompting team member B to also smile and become less stressed.

The third layer is most conscious and intentional, and it occurs when individuals engage in "perspective-taking" by interpreting the affective information they receive from others, such that they can imagine how others are likely to interpret situations and interactions. This type of communication adds complexity to communication, as it requires that affective information is integrated with cognitive information (Te'eni, 2001). Yet, this combination of cognitive and affective information is important to understand how others make judgments (Weiss et al., 1999; Weiss & Cropanzano, 1996), as well as to coordinate behaviors (Barsade et al., 2000; Bartel &

Saavedra, 2000; Spoor & Kelly, 2004), and to develop meaningful interpersonal relationships (Barsade & Knight, 2015; O'Leary et al., 2014; Schinoff et al., 2020).

This study focuses on the first, foundational layer of affective communication for three reasons. First, this foundational layer provides necessary preconditions for the remaining layers. If teams are to interact via digital media, those teams' success relies on those media having the capabilities to support the formulation and perception of subtle affective communications (Kelly & Barsade, 2001; McGrath & Hollingshead, 1993). Second, many of the practical problems that motivated this study, such as widespread feelings of being lonely and disconnected, are most intuitively linked to this foundational layer.

This study also consolidates the various terms "emotional contagion", "mood contagion", and "affective state-matching" into one single term, *affective alignment*, which we define as the degree to which each team member's core affect is responsive to the affective states of others in the team. We further prefer this term because affective alignment does not always mean that team members experience the same core affect.

Methodology

The main purpose of this systematic literature review is two-fold. First, we develop a transdisciplinary synthesis model of affective alignment in online communication. Second, we make recommendations for future research based on this new model. Because many of the concepts relevant to this model are scattered across multiple literature streams, this study requires a broad, multidisciplinary search for literature. To increase coverage and facilitate access to siloed concepts (Raghuram et al., 2019), we thus adopted a three-step strategy, as per the review protocol outlined in Table 1.

For the first step, we conducted a systematic search to find existing research at the intersection of communication media and emotion/affect, following a process adapted from Okoli & Schabram (2010) and vom Brocke et al. (2015). We defined two areas to start our search: affective alignment and media capabilities for affect communication. We created two search strings that captured these terms. We ran the search on Scopus and iteratively excluded keywords and subject areas until the results seemed optimal. For instance, in our search for affective alignment literature, we restricted the subject areas to the key areas that study emotional processes (psychology, neuroscience, etc.). We further excluded terms related to "viruses" due to the conflicting meaning of "contagion" and terms related to animal research to focus our search on human studies due to the pervasive use of animal studies in the fields of psychology and neuroscience. In the affective alignment search, we were looking for established models and studies explaining the mechanisms underlying emotional contagion. Because this topic has been extensively studied, we restricted document types to book chapters and peer-reviewed journal articles that had either received at least 10 citations or were published in 2022 and after. On the other hand, in our media capabilities search, we wanted to capture emerging

studies exploring opportunities for affect communication in new technology, so we also included conference papers and removed the citation cap. To further increase the focus of our search and eliminate noise in the affective alignment search, we restricted it to title only, whereas we also included abstract and keywords for the media capabilities search. The searches returned 460 (affective alignment) and 467 (media capabilities for affect communication) documents. Next, we manually screened the titles and abstracts, and removed 297 (affective alignment) and 223 (media capabilities) documents that were either out of scope, editorials, retracted, or not publicly accessible (conference abstracts). Within each corpus, we then proceeded to rank the documents' topics according to a star system, with one star being a poor fit, two stars being a medium fit and three stars being an ideal fit (see Table 2 for criteria). At this point, we were left with 52 3-star documents for affective alignment and 111 3-star documents for media capabilities, though we retained others for ongoing reflection during later theorizing. Among those articles, we identified 17 key documents that best captured the mechanisms and capabilities we were interested in.

As the second step of our search strategy, we proceeded to use a snowballing technique to identify articles similar to these 17 key documents that might not have been captured by during our initial search. We performed backward and forward searches (Webster & Watson, 2002), as

Table 1: Review protocol	
Protocol steps	Activities
1. Establish a project timeline	12 weeks (to first iteration of the initial manuscript)`
2. Identify keywords that result in articles that could answer the research question[1]	Affective alignment: TITLE ((emotion* OR {affect} OR affective OR mood OR physiolog*) AND (align* OR contagion OR linkage OR entrain* OR collective OR group OR diffusion OR synchrony))
	Media capabilities for affective communication: (TITLE ((physiological OR affective OR emotion* OR heartbeat OR "heart rate" OR "socio-affective" OR biosignal) W/5 (computing OR communication OR technolog* OR capabilit* OR chat OR messaging OR smartwatch OR application)) AND TITLE-ABS-KEY ((virtual OR online OR remote OR digital OR comput* OR distributed OR technolog* OR textual) W/5 (team OR collaborat* OR interact* OR chat* OR conversation OR communicat* OR chat OR messaging)))
3. Define search databases and scope of the review	Database: Scopus
	Affective alignment: search in title only, peer-reviewed articles published in academic journals and book chapters with min. 10 citations or published 2022 or later; subject area limited to psychology, neuroscience, economy, and arts; excluding keywords (see Appendix X for full string).
	Media capabilities: search in title, abstract and keywords, peer-reviewed articles published in academic journals or conference proceedings and book chapters; excluding subject area and keywords (see Appendix X for full string).
4. Run the search and remove duplicates	Affective alignment: 460 results
	Media capabilities: 467 results
5. Screen and categorize results based on titles/abstracts according to inclusion/exclusion criteria (no fit, poor fit; medium fit; ideal fit)	Affective alignment: ideal fit (52), medium fit (69), poor fit (42), no fit (297)
	Media capabilities: ideal fit (111), medium fit (49), poor fit (83), no fit (223)
6. Thoroughly read the resulting articles and conduct primary thematic analysis	Two emerging themes in affective alignment: display of affective cues, mechanisms for internalizing affective cues
	Three emerging themes in media capabilities: users' expressions of affective states, environment-level information contextualizing users' affective expressions, platform-level design features influencing users' affective states
7. Expand each theme with additional literature	Identification of 17 key documents at the nexus of those themes; backward, forward, and similarity search on 17 chosen documents; resulting in an additional 95 documents (affective alignment = 57 ; media capabilities = 38) and overall corpus of 258 "ideal fit" documents.
8. Discuss and revise themes and sub-themes until a satisfactory consensus is reached	Two confirmed themes with supporting literature, and additional literature of contextual relevance: affective processes for alignment (109) and media capabilities for affective alignment (149); construction of conceptual tables with aggregated constructs.
9. Write the analysis	Dimensions and constructs are described according to sampled literature.

well as a similarity search using connectedpapers.com[2]. These three methods added another 95 articles that were selected because they brought clarity to (i) media capabilities that are likely to impact the exchange of affective information or (ii) the underlying mechanisms that explain and drive emotional contagion.

Third, we coded the sampled literature to identify key concepts. We iteratively developed first-order concepts and second-order themes, as well as aggregate dimensions (Gioia et al., 2013). We used these themes and dimensions to characterize and integrate findings from a range of study domains, and to define media affectivity in the context of online collaboration. We continuously revisited articles until we reached saturation (i.e., we could not find new components that did not overlap with our existing themes), focusing mostly on our set of 258 documents, but also drawing from our reserved documents whenever needed. A few examples can help illustrate our analytical approach: among the articles about media capabilities, we were particularly interested in studies that highlighted the role of specific features or capabilities in collaborative tasks (e.g., heart rate sharing, emojis, etc.). In the literature about affective processes, we focused, among others, on the conditions for emotional contagion that could be relevant to an online environment (e.g., seeing facial expressions, sensing physiological changes, etc.). Figure 7 presents a visual summary of our coding. After extensive coding, peer debriefing, and several rounds of iterations, we developed a synthesis of the literature that captures the phenomenon of affective alignment in online communication and developed the building blocks for a model of *media affectivity*.

Table 2: Ranking system (inclusion criteria)		
Fit	Affective alignment	Media capabilities
Poor fit	Relates to different group phenomena (e.g., cognition, effects of specific emotions) or is methodological in nature	Relates to technological capabilities to detect emotions (e.g., sensors, language models, affective computing techniques)
Medium fit	Provides incremental evidence of affective alignment in a specific context	Captures affective aspects of technology outside the scope of social interaction (e.g., human-technology interaction, individual emotion regulation)
Ideal fit	Describes processes or mechanisms through which affect becomes aligned in a group	Identifies one or more specific capabilities/features for affect communication and explains how it impacts social interaction

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[2] connectedpapers.com identifies papers that are most strongly connected to an origin paper. It is connected to the Semantic Scholar Paper Corpus database.
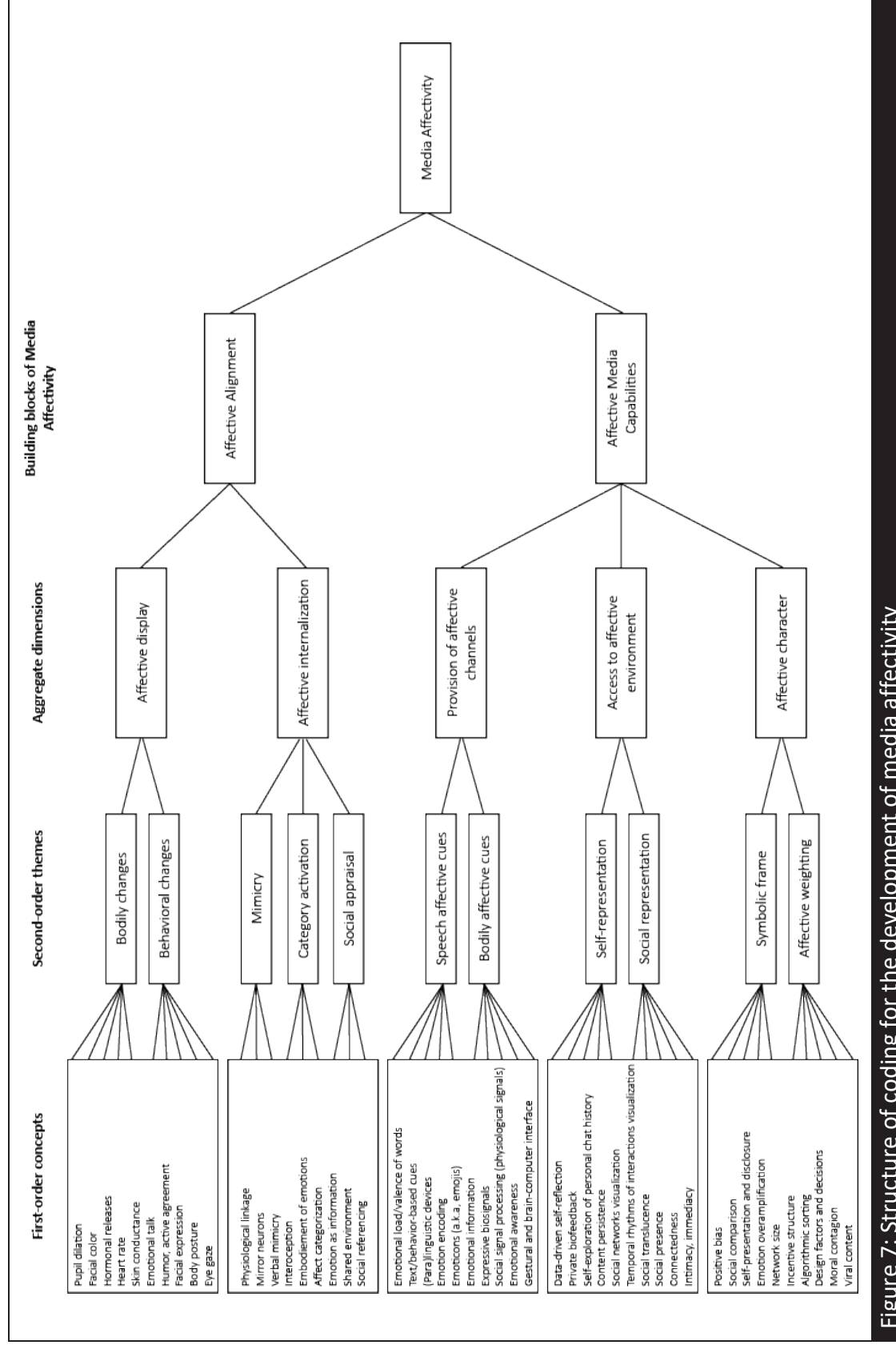
Figure 7: Structure of coding for the development of media affectivity

The Building Blocks of Media Affectivity: Affective Alignment and Affective

Media Capabilities

In this section, we first discuss the two different affective mechanisms at play during affective alignment: affective display and affective internalization. We then identify three types of affective media capabilities that were highlighted by prior studies: the affective channels, affective environment, and affective character. These two mechanisms and three capabilities provide the building blocks for the theory of media affectivity. The following sections discuss how these concepts appear in existing research, and how the different affective media capabilities impact each affective process. Figure 8 visualizes this organizing logic that links each concept into an ongoing process of affective alignment. Note that Figure 8 is an abstraction of the theory of media affectivity – while the theory addresses team-level interaction, Figure 8 only illustrates two users for simplification and readability purposes.

Figure 8: The Building Blocks of Media Affectivity Theory
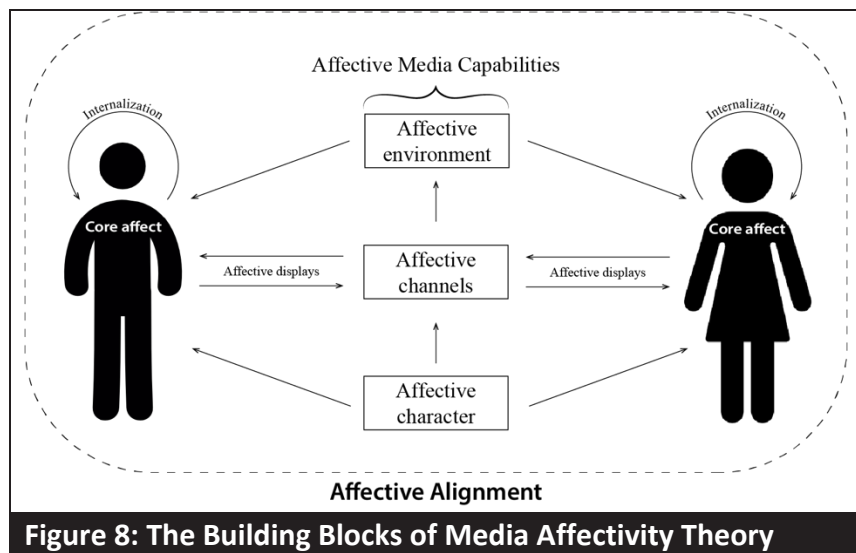
Affective Processes

The sampled literature describes multiple processes through which individuals achieve affective alignment. The focus of these processes varies across psychological, physiological, and neurological levels. However, each of these processes can be abstracted into two iterative and dialectical processes: *affective display* and *affective internalization*. The following section explains these two processes, and highlights some of the practical examples of each that are presented in the literature.

Table 3: Overview of aggregated dimensions from the literature review			
Core component	Aggregated construct	Definition	Sample of sources
Affective Processes for Alignment	Affective display	Physiological and behavioral signals that display the affective state of someone and can be perceived (consciously or non-consciously) by an observer.	Cheshin et al., 2011; Kret, 2015; Montoya et al., 2005; Prochazkova & Kret, 2017; Rhee et al., 2020; Vick et al., 2007
	Affective internalization	A set of biological and social mechanisms that lead people to shift from being exposed to somebody else's affective display to experiencing a similar or complementary affective state.	Arnold et al., 2019; Barrett, 2017a; Barsade et al., 2018; Elfenbein, 2014; Hatfield et al., 2014; Kramer et al., 2014; Nummenmaa et al., 2008; Peters & Kashima, 2015
Affective Capabilities and Constraints	Affective channels	Characteristics of the medium that impact the types of affective information users can express or view when using the medium.	Chanel & Mühl, 2015; Cheshin et al., 2011; Dennis & Kinney, 1998; Janssen et al., 2010; Liu et al., 2019; Park, 2007
	Affective environment	Characteristics of the medium that present users with contextual information about their own and others' past and present affective behavior.	Bartel & Saavedra, 2000; Cramton et al., 2007; Howell et al., 2018; Rafaeli et al., 2012; Tat & Carpendale, 2006
	Affective character	Characteristics of the medium that impact the types of symbolic information users can express or view when using the medium.	Berger & Milkman, 2012; Crockett, 2017; Goldenberg & Gross, 2020; J. Y. Lee et al., 2016; Romi, 2012; Treviño et al., 1987

Affective display

Affective display describes the physiological and behavioral cues that externally signal otherwise internal affective experiences. It is a precondition for affective alignment, as it allows a team member's core affect to become perceptible to others.

Team members continuously experience sensations or feelings (Russell & Barrett, 1999), many of which they communicate to others in the team. Some communications are uncontrolled physiological responses, including changes in pupil dilation (Kret et al., 2014), facial color (Montoya et al., 2005), hormonal levels, heart rate, and sweating (Kret, 2015; Prochazkova & Kret, 2017). These uncontrolled communications contain affective information to varying extents which team members may desire to communicate or not.

Other communications are potentially more conscious and controllable. For example, humans tend to talk about events that trigger a strong emotional response – these are part of verbal cues (Christophe & Rimé, 1997; Derks et al., 2008; Rhee et al., 2020), though the affective information may be inferred from the act of talking, rather than the content of the

communication. Verbal cues can also be used more indirectly, as a means to imply emotions through a particular choice of words, tone, manner, etc. (Cheshin et al., 2011).

Affective displays also include a range of non-verbal motor movements. Perhaps the most obvious of these is a change in facial expression (Vick et al., 2007). The ability to communicate basic emotions such as joy, sadness, fear, anger, surprise, and disgust using facial expressions is well-established (Du et al., 2014). Other changes may be more subtle. For example, a change in body posture may act as an affective display, as it can signal that a team member feels relaxed, excited, or threatened (Prochazkova & Kret, 2017). Likewise, eye gaze may communicate trust, discomfort, engagement, or boredom (Kret, 2015). While many of these displays usually occur naturally and without conscious intention, once they surface, they are often readily accessible to our awareness. Being aware of these affective displays means they can be controlled and reduced, enhanced, or even faked (Kret, 2015). This is especially common in social situations with stronger norms about affective displays (Rafaeli & Sutton, 1987), where the performance of specific emotions may be required – this is often referred to as emotional labor (see Diefendorff & Gosserand, 2003; Grandey & Gabriel, 2015; Morris & Feldman, 1996).

Affective internalization

Affective internalization refers to the set of biological and psychological mechanisms that prompt team members to react to another team member's affective displays, and adjust their own core affect accordingly. Those mechanisms that drive affective alignment are commonly captured under the terms of *mimicry*, *category activation*, and *social appraisal* (Elfenbein, 2014; Parkinson, 2020). Just as affective displays vary in the extent to which they are controllable, some of these internalization processes are more controllable than others.

Mimicry can be differentiated according to three types: motor, autonomic, and verbal (Feldman, 2012; Hatfield et al., 1993; Palumbo et al., 2017; Provine, 1986; Simpson et al., 2014). Motor mimicry refers to the re-creation of facial expressions and movements, including muscles (Simpson et al., 2014), eye contact (Feldman, 2012; Wang et al., 2004), yawning (Provine, 1986), or crying (Simner, 1971). Autonomic mimicry occurs mostly through processes such as physiological linkage and pupil mimicry (Prochazkova & Kret, 2017). Physiological linkage includes heart rate, breathing movements, and temperature synchronization (Feldman, 2012; Palumbo et al., 2017). Vocal mimicry occurs in the use of syntax, linguistic features (including prosodic and phonologic features), words, and clauses (Chartrand & van Baaren, 2009). When individuals mimic affective signals, they receive physiological feedback that translates these sensations into affective alignment. For example, mimicking someone else's smile can make the mimicker feel joy (Barsade et al., 2018).

Category activation (Belkin, 2009; Lindquist & Barrett, 2008; Lindquist & Gendron, 2013). In other words, when observing affective signals in others, people are capable of recognizing categories of emotion (Lindquist & Barrett, 2008), such as anger, disgust, joy, fear, and sadness (Ekman, 1992). Categorical interpretation uses both physiological and behavioral cues and is often reinforced by a natural human tendency to verbalize emotional experiences (Christophe & Rimé, 1997; Rhee et al., 2020). This differs from mimicry in two main ways: the observer neither needs to (i) recreate the affective signals nor (ii) directly observe the affective signals.

Instead, the observer only needs to become aware of the expresser's affective state. In practice, this means that indirect affective displays activate a person's concept of the observed emotion's category. For example, this can occur through symbols, like the use of emoticons, or by making inferences about others. This mechanism helps explain the substantial evidence of affective alignment occurring without in-person interaction (e.g., Belkin, 2009; Cheshin et al., 2011), without direct interaction (e.g., Ferrara & Yang, 2015; Goldenberg & Gross, 2020; Li et al., 2017), or even without any interaction at all (Huntsinger et al., 2009).

Social appraisal, also known as social comparison (e.g., Bartel & Saavedra, 2000; Totterdell, 2000), describes the process through which humans determine whether an event is relevant to their own goals and well-being and whether its impact is likely to be positive or negative. During social appraisal, individuals use other people's affective reactions to inform their own appraisal process (Goldenberg & Gross, 2020; Manstead & Fischer, 2001). Social appraisal is used for two purposes (Parkinson, 2020): (i) to gather information on how to appraise a target event or trigger (Bruder et al., 2014; Elfenbein, 2014), and (ii) to assess the appropriateness of one's affective state in response to a target event or trigger (Manstead & Fischer, 2001). This process is especially common in equivocal situations, where affective information from others might be the most accessible source of information about how one should respond (Schachter, 1959; Van Kleef, 2010). For example, if an employee were to raise their hand to intervene while the CEO is speaking during a meeting, a smile or a frown from a co-worker may indicate that intervening is a good or bad idea and encourage the employee to withdraw or uphold their hand (e.g., Van Kleef, 2010).

Media Capabilities

The previous sections describes how affective communications are perceived. The literature that describes affective communications generally assumes a face-to-face environment where all of the "natural" affective display and internalization processes are available. In a digital environment, the same processes may not be available to team members, and different communication and collaboration platforms may change what can be displayed and internalized. The media capabilities that enable and constrain how affect is displayed and internalized can be grouped under three main capabilities: *affective channels, affective environment,* and *affective character.*

Affective Channels

Digital media offer different affective channels to allow users to make affective communications. These affective channels describe the specific communication modes that enable flows of affective information between users (e.g., text-based communication, media sharing, etc.). These channels enable different degrees of conveying and observing *speech affective cues* and *bodily affective cues*.

Speech affective cues describes the sets of cues and symbols available on digital media. These cues which are known to help team members symbolically express their affective state (Dennis & Kinney, 1998). Some examples are relatively direct, such as loaded and valenced words that explicitly communicate emotions, such as "delighted", "afraid", etc. (Cheshin et al., 2011; Goldenberg & Gross, 2020). When communicating using text, team members can also

augment communications with explicit affective cues such as exclamations marks or emoticons (emojis) (Goldenberg & Gross, 2020; Park, 2007). Team members can also make affective communications using punctuation, repeated characters, and verbosity (Park, 2007; Riordan & Kreuz, 2010). For example, a team member who writes that "wE hAd a MeETiNg aBoUt ThiS" may be expressing frustration with some anticipated response. Less obvious forms of affective communication via speech affective cues include message length, conversational cadence, and affective connotation (Cheshin et al., 2011). For example, an individual who responds with one word answers may communicate hostility. Speech affective cues thus encompass the features a platform provides for users to express their affective state explicitly or implicitly, using a range of symbols available within the medium.

Bodily affective cues describe the extent to which digital media allow team members to display and view bodily manifestations of affect. For each individual, these cues include both their own bodily manifestations and those of other team members. Obvious examples of bodily affective cues are facial expressions, gazes, and body movements. For example, a team member may express relaxation and happiness by smiling, sitting back, and looking another team member in the eye. A team member may also express frustration by frowning, blushing, and refusing to look at another team member. Digital media are not limited to "natural" bodily affective cues, however. Multiple studies have explored the opportunities to expand upon the bodily cues typically experienced in face-to-face interaction. For example, Wang et al. (2004) developed an online chat platform where the galvanic skin response (GSR) of each team member, a common indicator of excitement or stress, was recorded and made available to others, along with self-reported emotional tags. Similarly, Liu and colleagues conducted numerous studies (e.g., Liu, 2019; Liu et al., 2017, 2019) where they communicated physiological data among team members to help them to empathize and understand each other's affective states. There is evidence that the communication of such physiological data, which also includes heart rate and facial expression feedback, is viewed by many team members as an authentic source of affective expression, and as such can foster awareness and social connection between users (Chanel & Mühl, 2015; Hassib et al., 2017; Liu, 2019; Slovák et al., 2012). For example, Janssen et al. (2010) found that when it comes to influencing social behavior, visualizing one another's heartbeat is comparable to traditional intimate signals such as eye gaze or interpersonal distance.

Affective Environment

A medium's affective environment emerges from the digital representations of team members' affective communications, as well as other contextual affective information. Thus, a medium's capacity to construct an affective environment depends on the extent to which the affective channels capture information about team members' ongoing and past affective states. The affective environment typically operates at two levels: *self-representation* and *social representation*.

Self-representation describes the opportunities that digital media provide team members to access and visualize their own affective states and affective communication. For example, some digital media allow users to observe their own faces (e.g., self-view on Zoom). More

sophisticated examples of self-representation have also been developed. For example, Howell et al. (2018) sought to investigate data-driven self-reflection by developing Ripple, a shirt enhanced with subtle electrodermal activity signaling that changed color in response to skin conductance (e.g., when the wearer becomes excited, the shirt's stitches turn red). They found that participants wearing Ripple felt a stronger connection between their own affective states and bodies, and engaged in more intimate conversations. Relatedly, in a broad review of literature, Chanel & Mühl (2015) found that providing team members with private biofeedback to indicate their own affective state encourages meta-cognition and improves social skills in teams, thus improving collaboration. Another component of self-representation is the persistence of affective communications (e.g., chat history can remain available indefinitely or for a fixed amount of time before being erased). Tat & Carpendale (2006) explored the role of communication persistence using CrystalChat, a visualization tool that lets users explore their chat history to help them reflect on their past social behavior. The study found the system triggered (i) the surfacing of memories, thereby encouraging storytelling around these memories, and (ii) the realization of social habits, which can influence future social interactions. Viewed in affective terms, it appears that the key to these impacts was the ability to recall and recreate previous affective states, even when significant time had passed. This ability to transcend time may be important, as existing research has shown that time affects how well individuals recall past affective experiences, and that this ability to recall affective experiences influences their present-time appraisals and decisions (e.g., Fredrickson, 2000; Levine et al., 2001). These ideas inspired multiple design-based explorations of "affect bookkeeping" as a form of self-representation, in which team members recorded and revisited affective reactions as part of routine reflective practices (Daily & Picard, 2007; McDuff et al., 2012; Ståhl et al., 2009).

Social representations describe the different tools that digital media provide to highlight the affective states of other people. Contextual information about other team members enables visibility, awareness, and accountability (Erickson & Kellogg, 2000; Rafaeli et al., 2012). Digital media that can make team members aware of each other helps those team members to make better inferences about their teammates' affective states (Bartel & Saavedra, 2000; Cramton et al., 2007; Rafaeli et al., 2012). Social representation could take the form of displaying team members' current location, local time, or weather conditions. These social representations contribute to feelings of social presence and connectedness (Liu et al., 2019), and they create a sense of intimacy by encouraging team members to consider what others are feeling (Worthy et al., 1969). Social representations thus play an important role in the development of empathy and shared affect. For example, when team members are aware of the times others are online and working, they may become more likely to recognize when specific team members are tired or burnt out. If those team members communicate via video calls, they may also receive intimate contextual information about team members' private living space, household members, etc. This could further help each team member to anticipate the affective states of each other.

Affective Character

While the affective channels and affective environment mediate affective communications among team members, the affective character of a digital medium impacts the affective states of team members more directly. Note that this does not mean the affective character is not subjective, or that the affective character is not entangled with affective communications among team members. Rather, it means the affective character transcends specific relationships among team members. The affective character is constructed by a *symbolic frame* at the content creation level, and an *affective weighting* at the content sorting level.

The symbolic frame describes the degree to which the medium makes affective communications through its aesthetics, and the degree to which it supports symbols for some affective communications and not others. Intuitive examples include the colors, fonts, shapes, and images that an interface presents to users (Cai et al., 2008; Longstreet et al., 2021; Lundholm, 1921; Romi, 2012). For example, color schemes with shorter wavelengths have been associated with more positive affective reactions and lower arousal (e.g., Babin et al., 2003; Crowley, 1993; Valdez & Mehrabian, 1994; Yildirim et al., 2007). The aesthetics of these applications thus lean toward an affective character that suggests positive but moderate interaction. Other examples may be more subtle. For example, many digital media include a "like" button but forego a "dislike" button, as they wish to limit the potential for negative affective communication. Others include a symbolic frame that simplifies the affective communications. For example, Lee et al. (2016) examined the antecedents of the act of "liking" on Facebook, showing that individuals consistently "like" content despite a variety of internal motivations and feelings. Their findings suggest that individuals are limited to expressing themselves through the "like" button despite experiencing a much broader range of attitudes and emotions. Note that this is distinct from the affective channels described earlier, as the symbolic frame describes a medium's prioritization of specific affective states, rather than its ability to make affective communications via different modalities. For example, Zoom lets users react with emojis during calls, but the shortcut prioritizes positive displays such as clapping hands, a thumbs up, smiling faces, etc. (Zoom Support, 2023). This creates a positive bias in how participants of the call interact – they have to expend more effort if they want to communicate a negative or ambivalent reaction. In the future, platforms may implement more exploratory features to influence the moods of their users. So far, researchers have considered the effects of embedding smile reminders (e.g., Moore et al., 2017), emotionally adaptive artifacts (e.g., Farahi, 2018), AI-enabled emotion regulation chatbots (Peng et al., 2019), and visual features of virtual environments such as lighting and colors (e.g., Barsan-Pipu et al., 2020) on users' affective states and responses. Altogether, findings suggest there are many opportunities for platforms to influence how their users feel by means of design and features.

The affective weighting of a digital medium describes the way affective communications are managed after they have been made. There is substantial evidence that affective communications are more likely to prompt an affective reaction when they emphasize specific emotional reactions. Berger & Milkman (2012) found that news content containing activating or arousing emotions (like anger, as opposed to low-activation emotions like sadness) is more

likely to go viral. Others have similarly found that outrage and moral-emotional content attract more attention and result in greater diffusion (Brady et al., 2020). For digital media that monetize engagement, this may incentivize the platforms to promote certain types of communications as part of affective weighting. While this behavior is hardly accessible for researchers to quantify, workarounds have allowed studying "proxies" of algorithmic sorting. Findings suggest that content sorting and recommendation systems are highly intentional on platforms such as Twitter or Facebook (e.g., Huszár et al., 2022; Milan, 2015; Milli et al., 2023; Rathje et al., 2021). This affective weighting can contribute to the affective character of the platform by prioritizing certain emotions when sorting and recommending content to the platform users.

Discussion

A New Theory of Media Affectivity

This study integrates the literature about affective alignment and describes how iterative cycles of affective display and internalization shape coworkers' core affect, resulting in affective alignment. We argue that affective alignment is part of the collaboration process, comprising iterative cycles of affective display and internalization, in which co-workers observe affective cues, and dynamically make sense of them. In doing so, they can experience changes in their own affective states which influence their attitudes and behaviors. Affective alignment can also be regarded as an outcome; an ephemeral state that emerges whenever those iterative cycles result in collective states of shared affect.

Our review of existing literature highlights that media capabilities play an important mediating role in the process of affective alignment. This helps to explain how online collaboration leads to different experiences than in-person. While the need for affective alignment has been around for some time, the ability to enact affective alignment is heavily influenced by the available medium.

Specifically, we find that individuals' ability to display and observe core affect relies on the available media's (i) affective channels (ii) affective environment (iii) affective character. A medium's provision of affective channels supports the sharing of affective information to varying degrees, allowing individuals to communicate their core affect to others, whether intentionally or unintentionally. Channels with high support for affective displays capture and render users' core affect in a vivid manner, while channels with low support for affective displays are more ambiguous. Examples of affective channels include video feeds, voice notes, live heart-rate sharing, etc. These channels communicate individuals' affective states, albeit with different levels of intentionality and symbolization. We also note that, in the absence of substantial support for affective displays, individuals using digital media often over-amplify their affective displays to ensure their core affect is obvious to others (Goldenberg & Gross, 2020).

A medium's affective environment creates affective information for its users by providing them with contextual information about their own and others' past and present affective

behavior, such as chat histories, satisfaction reports, etc. The affective environment allows users to reflect on their own affective, social, and behavioral traces as well as others' affective, social, and behavioral traces, thus influencing continuing interaction. This distinction has important implications in terms of social translucence – as a sparse affective environment pushes others to make (often incorrect) inferences about their teammates' behaviors and attitudes, whereas having information about others' affective environment creates a responsibility to acknowledge a colleague's affective context and act accordingly (Erickson & Kellogg, 2000).

Finally, the affective character of a medium presents a combination of graphical elements, symbol sets, and algorithmic sorting that subtly imply a built-in affective tone. The affective character acts as a constraining force that ranges from weak to strong intensity, and from negative to positive valence. The affective character is likely to be shaped by and reflect brand identities and visions. This suggests that a comparable digital medium (e.g., instant messaging) may provide a comparable affective environment with comparable affective channels, and yet, they may stimulate different affective states due to the colors and fonts used, the images, or the way content is prioritized.

The Unique Contribution of Media Affectivity

Media affectivity does not seek to extend existing media theories or add new capabilities to existing models. Rather, media affectivity seeks to explain a different outcome from existing theories such as media richness, media synchronicity, and media naturalness (affective alignment). To explain this outcome, media affectivity proposes a different way of modeling digital media. To illustrate this, we can consider the key elements of face-to-face communication proposed by media naturalness (colocation, synchronicity, convey/observe facial expressions, convey/observe body language, convey/listen to speech). Media affectivity makes novel assumptions about each of these five elements (see Table 3).

Table 3: Contribution of Media Affectivity with respect to Media Naturalness			
Media Naturalness	Dimension	Media Affectivity	Novel aspect of Media Affectivity
Colocation	Space-time	Affective environment (self- and social representation)	Argues that individuals can experience some of the affective impacts of colocation in digital environments
Synchronicity	Space-time	Affective environment (self- and social representation)	Argues that some of the affective information can change meaning when communication is asynchronous
Convey/observe facial expression, body language, speech	Expressive-perceptual	Affective channels (language, bodily affective cues)	Argues that digital channels can both emulate natural channels and introduce new channels which do not have a natural equivalent

N/A	Expressive-perceptual	Affective character (symbolic frame, affective weighting)	Argues that digital environments actively create affective information that impacts the communication among individuals

Putting the "Location" into "Colocation"

First, space-time capabilities include colocation and synchronicity, which respectively refer to the extent to which individuals share the same context and can see/hear each other, and the speed at which they can exchange communicative stimuli. In media naturalness, the emphasis is on the cognitive processing of information, which is facilitated by colocation and synchronicity. By introducing the concept of an affective environment, media affectivity suggests that the "location" in "co-location" also plays an important role. For face-to-face environments, this means that a location's light, sound, temperature, etc., may all have a significant impact on communication, as may those individuals' previous experiences in that location. Further, media affectivity suggests that, where digital media are used, these digital media also represent a form of "location" that can have a direct impact on individuals' affective states.

Media affectivity also emphasizes that the way individuals perceive that they are co-located within digital media is not only outward-facing (based on social representation); it is also inward-facing (based on self-representation). Media affectivity's view of social representation is similar to the media naturalness concept of colocation, as it refers to the different ways in which a medium helps emphasize the presence and behaviors of one person to others. Media affectivity's addition of self-representation highlights that digital media also allow users to access and visualize their own social behaviors and affective displays. For individuals to make sense of affective reactions and communications, it is important that those individuals can reflect on their own affective states and contextualize them in their environment (Barrett, 2017a). The extent to which a medium helps people to access and visualize their own affective processes thus also impacts shared affective processes like affective alignment.

The Perishability of Affect

The other key element to determine media naturalness, according to Kock (2005), is synchronicity. This concept suggests that media which allow real-time, intuitive feedback allow individuals to identify and resolve divergences quickly (Dennis et al., 2008; Riordan & Kreuz, 2010). Rapid feedback also reassures individuals that others are available and ready to provide assitance, so facilitating informal interactions and ad hoc changes in plan (Schinoff et al., 2020). Just as with colocation, media affectivity demands that we reconsider what is meant by synchronicity.

Mental models tend to remain stable for long periods, often changing only when individuals are actively challenged on their assumptions, or when individuals are asked to collaborate with new people (de Graaf, 2019; Kude et al., 2019). It is for this reason that existing theories of digital media often assume that it is the communications among individuals that prompt changes in mental models. However, affective states are continuously changing. This is one of the reasons that existing research often differentiates fleeting episodic emotions from longer lasting

moods (Frijda, 1993). For affective alignment, a delay in communication thus presents a new concern. If an individual is experiencing some affective state, then uses asynchronous communication to express that affective state (intentionally or via involuntary signals), then that state could have passed by the time the communication is received.

From Natural Media to Embodied Media

Face-to-face-like media have typically been the gold standard for communication in existing studies of digital media. This makes sense, as face-to-face interaction combines a wide range of symbolic channels with rapid feedback, all assembled in a structure that humans have evolved to process efficiently. This means that individuals can communicate with words, gestures, posture, intonation, etc., and other individuals can be relatively confident they understand them as intended. Where a breakdown in understanding occurs, face-to-face interaction often makes it easy for individuals to interrupt each other, and to affirm when they have resolved the breakdown. For these reasons, while asynchronous information is viewed as an effective way to transmit information from one person to another), face-to-face-like interaction is seen as the most effective means of converging on a shared understanding (Dennis et al., 2008).

At first glance, the same logic seems to apply to the communication of affect, meaning that media affectivity should also assume the gold standard of face-to-face-like interaction. However, the review of literature revealed a new category of technologies that challenges this logic. These are technologies that capture bio-signals from users and use the data to shape the interaction. For example, Apple's Digital Touch lets Apple Watch users share their heartbeat and other affective signals with other users (Apple Support, 2023). Emotion-aware proactive and reactive technologies are another example of emerging digital media capabilities that use and process affective input to enhance user experience (Harley et al., 2017). Users can also leverage those affective capabilities to improve emotional control, awareness, and well-being (Orlando et al., 2021; Peake et al., 2018). These new affective channels appear designed to improve convergence, rather than conveyance, and yet they are not designed to resemble face-to-face interaction. This departure from the principle of naturalness reinforces the distinction between the cognitive layer of communication and the foundational affective layer (De Waal, 2012). More importantly, it also highlights opportunities to design innovative new media to enable media affectivity, even if it means those media become less natural.

Proposing a New Affective Dimension of Digital Media

The previous sections identified fundamental changes in how digital media should be conceptualized if we wish to understand affective communication among team members. However, media affectivity also identifies an additional dimension of digital media that does not have an obvious counterpart in existing theories of media: the affective character.

The American architect Frank Lloyd Wright once wrote "Whether people are fully conscious of this or not, they actually derive countenance and sustenance from the atmosphere of the things they live in or with. They are rooted in them just as a plant is in the soil in which it is planted" (Wright, 1954, p. 135). Contemporary architects widely acknowledge the need to balance functional considerations with an understanding of affect when creating physical spaces. This is because these physical spaces provide more than a material structure for individuals;

they set a "tone" that impacts how individuals feel when they occupy those spaces, how they interact, and how they integrate those spaces into their daily lives (Kock & Lynn, 2012; Pallasmaa, 2016).

Digital environments can also be considered "spaces", that is, social and material assemblages that connect individuals with digital representations of objects and other people, bound in systems of practice (Coyne, 2010; Faraj et al., 2016; Grewal et al., 2020; Nah et al., 2011). Despite our growing conceptualization of digital environments as affective spaces, rather than just tools or interfaces, and some early work linking users' moods with effective technology interaction (e.g., Ang et al., 1993), there is little scholarly discourse about affective states being actively generated by digital spaces. This is an important oversight in light of growing concerns about team members' affective states. For example, the emergence of concepts such as "emotional labor" (e.g., Brotheridge & Grandey, 2002; Kruml & Geddes, 2000) suggests that work environments often put pressure on how employees and managers display their core affect. From this perspective, understanding how digital media influence how workers feel is important, because they could make it easier or harder for workers to match normative expectation of affective displays.

Media affectivity suggests that each medium has an *affective character* that influences the core affect of team members. This influence can take place at the level of content creation (e.g., range of reactions available, suggested responses, etc.) which we refer to as the medium's *symbolic frame*, or at the level of content sorting (e.g., algorithmic sorting, upvoting systems, etc.) which we label *affective weighting*. Both dimensions connect intimately to the foundational layer of affective communication because their impact, while opaque, can be far-reaching. Unlike the affective channels and affective environment, the affective character actively influences the users' states, instead of the opposite. This means that users passively experience the effects of the affective character of the platform – even as they create content themselves. Moreover, because the symbolic frame and affective weighting are likely to affect the entire platform, the effects might be subtle – yet powerful. In other words, it might be challenging to clearly identify the influence, but the influence reaches all users, possibly in quite a systematic manner. As a result, the platform itself might be helping affective alignment by contributing to homogenize the users' core affect. Understanding these dimensions of digital media may be important if we are to understand how to integrate digital media into future workplaces, without creating undesirable affective conditions for team members.

Future Research Directions

Media affectivity will help researchers in the future to analyze how different media impact on affective communications. In particular, we highlight three areas where media affectivity could be applied in the future to pursue new phenomena and research questions.

First, we encourage researchers to study affective alignment using media affectivity. This study began by describing the postponement of the NASA Psyche mission. That story illustrates why affective communications are important, and why they must be considered separately (at

least partly) from other types of communications. The Independent Review Board, after investigating the incident, noted that "remote and hybrid work must be minimized on Psyche to give the team the best opportunity to coalesce in a short time" (Zurbuchen & Leshin, 2022, p. 3). Building on (De Waal, 2012) and others, we argue that such a coalescing first requires a capacity for affective alignment at a basic physiological level. Years of research have focused on shared cognition and knowledge management, and these studies have been highly valuable to move the field forward. Media affectivity focuses on something that precedes this type of connection, and yet which contributes to both the individual work experience of team members and the relationships among them.

Second, we argue that media affectivity has important implications to understand workers' mental health[3]. The move to online and hybrid work has created a stronger reliance on technology, and this has created new threats to team members' wellbeing. One well-known threat is the possibility of technostress (Fonner & Roloff, 2010; Weinert et al., 2015) – the stress created by users' inability to cope with or get used to ICTs (Tarafdar et al., 2007). Another example is the concept of "Zoom fatigue", which emerged in recent years from a combination of stressors including mirror anxiety, the sensation of being physically trapped in the Zoom frame, and hyper gaze (Fauville et al., 2021). Concepts such as technostress and Zoom fatigue may have important repercussions for team members, as they are linked with dissatisfaction, fatigue, anxiety, overwork, and subsequently they decrease individual productivity and organizational commitment (Ayyagari et al., 2011; Ragu-Nathan et al., 2008; Tarafdar et al., 2007). Technostress is also linked to burnout, which occurs when a team member experiences work overload, insufficient reward, a breakdown in community, and a conflict in values – all in all, a failure to recognize the human nature of work (Maslach & Leiter, 2008). Media affectivity can help to explain why certain media may enable more or less problematic experiences. Media affectivity may even help designers and managers to nurture positive affective states; states that have the power to correct the aftereffects of negative experiences (Cavanagh & Larkin, 2018; Fredrickson et al., 2001).

Third, media affectivity may help to differentiate the affective traits of digital media and the affective traits of individual team members. For example, an individual team member may feel a lack of connection to their team or role. Media affectivity makes it possible to investigate if this problem is a result of the media that the team use, or whether it is more fundamental. This allows managers to make more thoughtful and precise changes, such as relocating the team member to another role or simply switching up the media through which the team communicates. Media affectivity may also help to explain why specific relationships are stronger or weaker among team members. Different personality traits result in differentiated affective appraisals, experiences, and reactions (George, 1996). For example, individuals scoring high on neuroticism typically use more anger-valenced words in their emails (Akbar et

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[3] Mental health is defined as "a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community" (World Health Organization, 2018)

al., 2019). Moreover, dispositional traits can have important consequences for someone's ability to perceive others' affective displays and internalize them, making them more or less susceptible to affective alignment (Bond & Raleigh, 1999). Media affectivity may therefore provide an important lens through which to understand, and resolve, interpersonal conflict.

Conclusion

This study addresses the growing need to theorize the relationship between digital media and affective communication. This is important to inform the design of systems that foster empathy and allow individuals to feel connected. Specifically, we asked: *how do different media capabilities enable and constrain affective communication among team members?* We reviewed literature on affective alignment and media capabilities. We then proposed a model of media affectivity which outlines the building blocks that enable and constrain the emergence of aligned affective states between team members. This model outlines the affective processes involved in affective communication, and the media capabilities that mediate the flow of affective information. The model further explains how each of these building blocks relate in the process of affective alignment. We call for researchers to apply media affectivity theory to understand how affect is communicated in specific contexts. We argue this will help to make sense of why some teams are better able to form strong relationships, as well as why some team members may suffer from issues of social and mental well-being.

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Appendix A – Search strings

Affective alignment

TITLE ((emotion* OR {affect} OR affective OR mood OR physiolog*) AND (align* OR contagion OR linkage OR entrain* OR collective OR group OR diffusion OR synchrony)) AND NOT TITLE-ABS-KEY ("disease*" OR "virus*" OR "infection*" OR "illness*" OR "sick*" OR "health*" OR "medical*" OR "clinical*" OR "patient*" OR "therapy*" OR "diagnos*" OR "symptom*" OR "epidemic*" OR "pandemic*" OR "rat*" OR "mice*" OR {affects} OR {social media} OR online) AND (LIMIT-TO (SUBJAREA , "PSYC") OR LIMIT-TO (SUBJAREA , "NEUR") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "ARTS")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English")) AND (EXCLUDE (EXACTKEYWORD , "Accuracy") OR EXCLUDE (EXACTKEYWORD , "Adolescent") OR EXCLUDE (EXACTKEYWORD , "Aged") OR EXCLUDE (EXACTKEYWORD , "Agent Based") OR EXCLUDE (EXACTKEYWORD , "Agent Based Simulation") OR EXCLUDE (EXACTKEYWORD , "Agent-based Model") OR EXCLUDE (EXACTKEYWORD , "Air Entrainment") OR EXCLUDE (EXACTKEYWORD , "Animal") OR EXCLUDE (EXACTKEYWORD , "Animal Behavior") OR EXCLUDE (EXACTKEYWORD , "Animal Experiment") OR EXCLUDE (EXACTKEYWORD , "Animalia") OR EXCLUDE (EXACTKEYWORD , "Animals") OR EXCLUDE (EXACTKEYWORD , "Autonomous Agents") OR EXCLUDE (EXACTKEYWORD , "Behavior, Animal") OR EXCLUDE (EXACTKEYWORD , "Chemistry") OR EXCLUDE (EXACTKEYWORD , "Child") OR EXCLUDE (EXACTKEYWORD , "China") OR EXCLUDE (EXACTKEYWORD , "Computation Theory") OR EXCLUDE (EXACTKEYWORD , "Computational Methods") OR EXCLUDE (EXACTKEYWORD , "Computational Model") OR EXCLUDE (EXACTKEYWORD , "Consumption Behavior") OR EXCLUDE (EXACTKEYWORD , "Crowd Simulation") OR EXCLUDE (EXACTKEYWORD , "Customer Satisfaction") OR EXCLUDE (EXACTKEYWORD , "Decision Making") OR EXCLUDE (EXACTKEYWORD , "Economic And Social Effects") OR EXCLUDE (EXACTKEYWORD , "Emotional Intelligence") OR EXCLUDE (EXACTKEYWORD , "Evacuation Process") OR EXCLUDE (EXACTKEYWORD , "Gene Expression") OR EXCLUDE (EXACTKEYWORD , "Human Cell") OR EXCLUDE (EXACTKEYWORD , "Job Satisfaction") OR EXCLUDE (EXACTKEYWORD , "Multi Agent Systems") OR EXCLUDE (EXACTKEYWORD , "Nonhuman") OR EXCLUDE (EXACTKEYWORD , "Personality Traits") OR EXCLUDE (EXACTKEYWORD , "Priority Journal") OR EXCLUDE (EXACTKEYWORD , "Sales") OR EXCLUDE (EXACTKEYWORD , "Scanning Electron Microscopy") OR EXCLUDE (EXACTKEYWORD , "Sex Difference") OR EXCLUDE (EXACTKEYWORD , "Signal Transduction") OR EXCLUDE (EXACTKEYWORD , "Simulation") OR EXCLUDE (EXACTKEYWORD , "Prediction")) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2024))

Media capabilities

(TITLE ((physiological OR affective OR emotion* OR heartbeat OR "heart rate" OR "socio-affective" OR biosignal) W/5 (computing OR communication OR technolog* OR capabilit* OR chat OR messaging OR smartwatch OR application)) AND TITLE-ABS-KEY ((virtual OR online OR remote OR digital OR comput* OR distributed OR technolog* OR textual) W/5 (team OR collaborat* OR interact* OR chat* OR conversation OR communicat* OR chat OR messaging))) AND (EXCLUDE (SUBJAREA , "AGRI") OR EXCLUDE (SUBJAREA , "BIOC") OR EXCLUDE (SUBJAREA , "CENG") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "ECON") OR EXCLUDE (SUBJAREA , "ENER") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "HEAL") OR EXCLUDE (SUBJAREA , "IMMU") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "NURS") OR EXCLUDE (SUBJAREA , "PHAR") OR EXCLUDE (SUBJAREA , "PHYS") OR EXCLUDE (SUBJAREA , "VETE")) AND (LIMIT-TO (LANGUAGE , "English")) AND (EXCLUDE (EXACTKEYWORD , "Adolescent") OR EXCLUDE (EXACTKEYWORD , "Brain Computer Interface") OR EXCLUDE (EXACTKEYWORD , "Character Recognition") OR EXCLUDE (EXACTKEYWORD , "Classification (of Information)") OR EXCLUDE (EXACTKEYWORD , "Cognition") OR EXCLUDE (EXACTKEYWORD , "Computation Theory") OR EXCLUDE (EXACTKEYWORD , "Curricula") OR EXCLUDE (EXACTKEYWORD , "Database Systems") OR EXCLUDE (EXACTKEYWORD , "Deep Learning") OR EXCLUDE (EXACTKEYWORD , "Digital Storage") OR EXCLUDE (EXACTKEYWORD , "Diseases") OR EXCLUDE (EXACTKEYWORD , "Economic And Social Effects") OR EXCLUDE (EXACTKEYWORD , "Feature Extraction") OR EXCLUDE (EXACTKEYWORD , "Female") OR EXCLUDE (EXACTKEYWORD , "Gender") OR EXCLUDE (EXACTKEYWORD , "Health Care") OR EXCLUDE (EXACTKEYWORD , "Linguistics") OR EXCLUDE (EXACTKEYWORD , "Machine Learning") OR EXCLUDE (EXACTKEYWORD , "Machine-learning") OR EXCLUDE (EXACTKEYWORD , "Male") OR EXCLUDE (EXACTKEYWORD , "Man Machine Systems") OR EXCLUDE (EXACTKEYWORD , "Young Adult"))

Appendix B – Full literature lists (1-star)

Affective alignment

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Appendix C – Affective Experiences

The idea that affect is communicated among individuals assumes that core affect is, at least partly, comparable across individuals. This assumption is not without controversy. Several studies have argued that interoception plays a key role in psychologically constructing emotions (e.g., Craig, 2002; Wiens, 2005). This means emotions can be felt differently among individuals and over time, as core affect is continuously constructed based on interoceptive cues rather than just as periodical responses to stimuli (Barrett, 2017b). This explains why different people (or the same people at different points in time) sometimes feel different emotions although they experience similar bodily sensations. While this new knowledge restricts the scope of mimicry, there is still substantial evidence of effective mimicry processes in emotional experiences – indicating that mimicry and interoception are not opposites but most likely coexist. In fact, advances in neuroscience unveiled the existence of mirror neurons in monkeys, constituting a mirror neuron system.

More recently, studies confirmed the existence of a mirror system (MS) in the human brain as well (Iacoboni, 2009; Wild et al., 2003). These unique neurons are increasingly associated with mood contagion (Nummenmaa et al., 2008). Effectively, the MS gets activated both when performing a goal-oriented action (e.g., grabbing an apple with the hand) and when observing the same action performed by someone else (Rizzolatti et al., 2001). The activation of the mirror system may have two main consequences: (i) it enables the observer to understand the observed behavior, and (ii) it facilitates the observer's somatic and autonomic responses to imitate the observed behavior (Brass & Heyes, 2005; Rizzolatti et al., 2001). Several fMRI studies have investigated the role of the MS in the spread of emotions during human social interaction and found that the perception of a specific emotion fired up the neurons that are responsible for generating this same emotion (see Prochazkova & Kret (2017) for a review). An interactive emotional contagion model (Nummenmaa et al., 2008) integrates these various mimicry processes into a cohesive framework that articulates how the different motor and neural elements of emotional contagion work together. Importantly, evidence shows that emotional empathy recruits the mirroring systems more strongly than cognitive empathy does. These findings suggest that it is easier for individuals to simulate others' affective and cognitive states internally when they are exposed to affective situations compared to non-affective situations because the mirror neuron system seems to be more sensitive to emotionally loaded triggers (Nummenmaa et al., 2008).

(3) IN OR OUT OF SYNC? A PSYCHOPHYSIOLOGICAL APPROACH TO UNDERSTANDING CREATIVE COLLABORATION IN ONLINE AND IN-PERSON TEAMS

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Abstract

Creativity is a key area of organizational growth, and teams are often tasked with the most complex problem-solving issues. As organizations increasingly lean on online collaboration, important questions on the effects of remoteness have arisen. Research is in the infancy of uncovering the hidden mechanisms that articulate different outcomes between online and in-person teams, and the focus has been on cognitive processes. However, affective processes such as mood contagion also facilitate or inhibit divergent thinking. In this study, we conduct a laboratory experiment with online vs. in-person dyads who are placed in convergent or divergent moods using mood induction. We observed that (i) online teams produced fewer ideas than in-person, (ii) teams with convergent moods elaborate on their ideas more than their divergent counterparts, and (iii) online teams with convergent moods produced ideas with the least originality. This study has important implications for the design of modern workplaces.

Keywords: Digital collaboration, creative teamwork, digital emotional contagion

Introduction

Geographically-dispersed teams are increasingly tasked with creative work – due in part to the growing importance of online communities, the democratization of crowdsourcing, and more recently, the COVID-19 pandemic (Malhotra, 2021; Nevo & Kotlarsky, 2020). Geographically-dispersed teams are not only more affordable for organizations and often more convenient for employees, they also afford notable creative advantages, such as cultural and cognitive diversity (e.g., Aroles et al., 2021; O'Leary et al., 2022). As a result, online channels are increasingly

preponderant in work tasks that require creative thinking, such as product innovation or complex problem-solving. However, decades of research indicate that certain digital media sometimes make communication less effective. This is because media vary in their ability to transmit information that can be reliably interpreted as intended (Dennis et al., 2008). Moreover, some media are seen as more cumbersome and demotivating, as "less natural" media require the use of more cognitive resources while decreasing physiological arousal (Kock, 2011).

Recently, research on the impact of video collaboration on team performance has offered insightful, new perspectives on the matter. One notable example is the emergence of "Zoom fatigue" – a new type of technostress resulting from mirror anxiety; the sensation of being physically trapped in the Zoom frame, and hyper gaze (Fauville et al., 2021). Recent research by Brucks & Levav (2022) suggests these characteristics of video conferencing affect both users' subjective well-being and cognitive processes, as videoconferencing hampers team members' ability to broaden their focus. They found that in-person teams produce fewer creative ideas than in-person teams, though they are equally effective at selecting the best ideas with which to progress. Relatedly, a recent field experiment showed that "temporal burstiness" (i.e., the temporal concentration of periods of interaction, as opposed to more spread out and continuous communication) is a strong predictor of team performance in the context of complex problem-solving among geographically-dispersed teams (Riedl & Woolley, 2017). Such studies build on a long tradition of research which studied shared cognition in teams (Cohen & Levesque, 1991; Ensley & Pearce, 2001), and how virtual teams can manage cognitive processes such as sensemaking (Rafaeli et al., 2012).

While shared cognition is clearly important, there is also evidence that affective processes influence both individual creativity and group dynamism (Amabile et al., 2005; Bartel & Saavedra, 2000). Some argue these affective processes are an extension of cognitive processes, due to their complex interdependencies (Barrett, 2017; Rafaeli et al., 2012). However, many affective processes operate at a more "basic" level that builds on common, evolutionarily "built-in" mechanisms (Panksepp & Watt, 2011). Affective processes, therefore, provide a foundational layer for social interaction that is distinct from shared cognition (cf. De Waal, 2012). These new perspectives raise interesting questions for IS research, which has historically focused primarily on the cognitive capabilities of media (cf. Dennis et al., 2008). In particular, given that online environments are known to affectively polarize individuals and limit affective convergence (Törnberg, 2022), we argue there is a need to examine how different collaboration media (e.g., in-person, video-conferencing, document sharing, etc.) enable or constrain affective processes. This is especially important if we are to consider growing concerns around job satisfaction, team relationships, and mental wellbeing. Hence, this study asks: *how do online collaborations creative outcomes differ from in-person collaborations when team members are in similar or different affective states?*

Theoretical grounding

Emotional Contagion

Terms such as *affect*, *mood*, and *emotion* are often used interchangeably – yet each has a subtly different meaning. George (1996) explains that "affect is a broad, generic term that covers both the intense feelings and reactions people have, which are commonly referred to as emotions, and the less intense, but no less important, feelings often called moods" (p.145). Thus, the "core affect" of an individual is the result of both emotions and mood (as well as some "trait affect" linked to their personality (Russell, 2003)). While emotions may vary moment-to-moment depending on the stimuli presented to an individual, moods are more diffuse, often longer-lasting, and may have lost their connection to the original trigger object (Frijda, 1993). Moods are also commonly shared through social interaction, meaning they can transcend individual states to produce collective patterns of shared affect (Bartel & Saavedra, 2000). Moods may also form contextual associations, with the result that certain spaces or social contexts enact recurring moods for individuals (Pallasmaa, 2016). While their impact is subtle, shared moods can have a considerable influence on attitudes and behaviors by providing an affective context that tints interpretation and reactions (George, 1996; Weiss & Cropanzano, 1996).

The formation of a shared mood relies, at least partly, on a phenomenon known as *emotional contagion*, whereby individuals "catch" other people's emotions (Barsade, 2002; Hatfield et al., 1992). This primitive behavior occurs unintentionally and is a central feature of social interaction and interpersonal relationships (Hatfield et al., 1992) as it facilitates the development of trust and makes communication more efficient (Barsade et al., 2018). *Emotional contagion* is a powerful mechanism and, while its manifestations are more overt during in-person interaction, there is substantial evidence of *emotional contagion* at a distance, including in e-mail dyadic communication, Instagram browsing (Choi & Kim, 2020), posting behavior on social media (Kramer et al., 2014), and even with no interaction at all (Huntsinger et al., 2009). This is important because it indicates that *emotional contagion* does not require that individuals share a common space (either physical or virtual) to construct shared moods. This suggests that multiple mechanisms underlie emotional contagion and various media capabilities may trigger these mechanisms differently.

Collaborative Team Processes

Collaborative processes help teams progress from a loosely defined problem to an outcome by drawing on the skills and knowledge of multiple team members (Banathy, 2013). Collaboration is usually required for complex problem solving, in which "a collection of self-regulated psychological processes and activities [are] necessary in dynamic environments to achieve ill-defined goals that cannot be reached by routine actions" (Dörner & Funke, 2017, p. 6). This means collaborating individuals must often engage in complex and creative cognitive processes that allow them to achieve higher degrees of resourcefulness and better decision-making. This process can be characterized by two main modes of dialectic exchange within teams: *divergent thinking*, in which teams explore the problem space and search for inspiration, and *convergent thinking*, in which teams apply creative synthesis, elaborate and refine a solution, and search for

ways to resolve emerging tensions (Coursey et al., 2019; Hargadon & Bechky, 2006; Harvey, 2014).

When engaging in *divergent thinking*, people generate a large number of ideas by applying few or no filters to their thinking. A key ingredient for success is that others follow the same rule and avoid filtering out others' ideas and suggestions even if they do not find them suitable. The ability to engage in divergent thinking is usually associated with creative skills because it helps people "[make] unexpected combinations, [recognize] links among remote associates, [and transform] information into unexpected forms". This often involves abandoning or temporarily "forgetting" elements of existing solutions (Storm & Patel, 2014) and deconstructing the "memory traces" embedded in systems to critically reflect on why different associations or disassociations were made (Rerup & Feldman, 2011). Conversely, convergent thinking serves to identify and develop a single, preferred answer or approach to the given problem. This requires that, over the course of collaboration, the team progresses from a challenge to an outcome through successive exploration of an issue and focused action towards the issue (Banathy, 2013). The team enacts ideas within the boundaries of collective attention to integrate cognitive, social, and environmental resources, building on similarities to resolve conflict, with the ultimate goal of synthesizing creative parts into one cohesive whole (Harvey, 2014).

Effective collaboration tends to combine both thinking types, with *divergent thinking* used to find new opportunities and deal with emerging issues and *convergent thinking* translating creative ideas into achievable plans of action (Coursey et al., 2019; Harvey, 2014). There is evidence that affective processes strongly influence both individual creativity and group dynamism (Amabile et al., 2005; Bartel & Saavedra, 2000), which suggests the construction and deconstruction of shared mood plays a role. However, there is little to indicate how these affective influences are enabled and constrained by different communication media, or the impact this may have on collaboration outcomes.

Hypothesis Development

When starting a collaborative project, team members join a collective environment where they bring emotional baggage, including core affect, vivid ephemeral emotions, and residual mood from foregoing events and experiences (Frijda, 1993; Weiss & Cropanzano, 1996). Alternative moods may lead individuals to consider different actions and make different associations. Divergent moods are also likely to produce some strain among team members, due to the discomfort of emotional uncertainty (cf. Jarvenpaa et al., 2018). Jarvenpaa et al. (2018) explain how the exploratory behavior that results from such emotional uncertainty is generative, as new possibilities and suggested compromises act as "probes" that force individuals to confront their differences and reconsider what is essential. The resulting breakdown in routine frees team members to reconsider past decisions and new possibilities in light of new information and uncertainties (Fleming, 2001). Therefore, we expect that the members of a team who are placed in divergent moods will experience greater divergent thinking – at least until they naturally converge.

H1. Teams with divergent moods will be more creative than teams with convergent moods.

Whether or not teams begin to interact in similar or divergent moods, they will typically "catch" each other's emotions through processes of affective contagion (Barsade et al., 2018; Hatfield et al., 1992) and move towards a convergent mood. This process of convergence is important as it reinforces specific emotions within a team and reduces ambivalence among team members (Bettenhausen, 1991; Jehn et al., 1999; Zhu, 2013). Given the connection between attention and emotional arousal (Damasio, 2005), this also means that individuals are more likely to be focused on specific objects and concerns, as their common affective vantage point causes them to fixate on similar perceived threats and opportunities (Vuori & Huy, 2016). This process can occur in-person or online, as individuals can infer affective cues from writing and other "lean" communications (Kramer et al., 2014). Yet, in-person communication provides more cues for this transmission of information, such as subtle changes in facial expression and visible physiological changes (Hatfield et al., 1992), as well as learned social behaviors such as gaze following, which acts as an unconscious signal that individuals have a common object of focus (Bayliss et al., 2006). This type of shared focus allows a team to limit the potential distraction of exploring new possibilities.

H2. In-person teams will be more creative than online teams.

Research Design and Setting

Study Design
The experiment uses a 2x2, between-subjects design with repeated measures and four treatments: i) in-person communication, ii) video-conference-based communication, iii) affective convergence, and iv) affective variation. Thus, the four possible combinations are: i) in-person communication with affective convergence, ii) in-person communication with affective variation, iii) video-conference-based communication with affective convergence, and iv) video-conference-based communication with affective variation. Participants were recruited from the compensated subject pool of a West Coast American university and the study was conducted on campus. The criteria to participate were to be older than 18 and to be affiliated with the university (staff, student, faculty, or alumni). Participants were compensated with a 20$ gift card.

In-person dyads were brought into a shared room and seated at a round table with two workstations (14" laptops) across from one another, separated by a divider (see Figure 9). Online dyads were placed in two separate rooms and seated at individual workstations on which are placed one 14" laptop and one 22" monitor (display only) behind one another (see Figure 9).

Figure 9. Online workstation (left) and in-person workstation (right)

Affective convergence and variation were manipulated via pre-task induction. We developed two different versions of a Pac-man game[4], one of which was designed to elicit negative affect and one of which was designed to elicit positive affect. Converging affect is induced by getting both participants of a dyad to play the same version of the Pac-man game. Diverging affect is induced by getting the two participants of a dyad to play a different version of the game from one another. The game activity lasts five minutes, after which it stops automatically, similar to (Reuderink et al., 2009). The respective effects of the two versions of the Pac-man game were validated in a pilot of this study (Saigot, 2022). Assignment to treatment was randomized.

The experiment was created using Qualtrics (www.qualtrics.com) for questionnaires, Google Sheets for task completion, and iMotions (www.imotions.com) to program the experiment. Only one participant in each dyad was permitted to type into the Google Sheet, while the other participant could only view the shared spreadsheet. The writer's role was assigned randomly prior to the start of the trials and remained assigned to the same participant for all three trials.

Task
Participants were paired into dyads who completed three consecutive trials of the so-called "alternative use task" (AUT) (e.g., Brucks & Levav, 2022; Harada, 2020). For each trial, participants were given the name of an object and asked to generate as many alternative uses as possible for this object in five minutes. They were informed their ideas would be evaluated based on originality, number, uniqueness, and level of detail. After providing instructions through a set of slides, the page automatically advanced to a blank Google Sheet with some instructions and the name of the object for the current trial. For all dyads, the order was: frisbee, then newspaper, then plastic bottle. Once the five minutes were up, the page automatically advanced to the next trial. In-person dyads completed the task face-to-face, only separated by their respective laptops (the divider was removed after the mood induction), while online dyads were connected via Zoom (on the larger display) after the mood induction.

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[4] GitHub repositories: https://github.com/maxkonrad/frustrating-pacman, https://github.com/maxkonrad/regular-pacman.

Instruments

Affective convergence and variation were measured using adapted versions of the Positive Affect and Negative Affect Scale administrated via a Qualtrics questionnaire before and after the mood induction. Creative performance was measured through scores of elaboration, fluency, originality, and flexibility (Guilford, 1975). *Elaboration* was calculated as the average length of ideas generated per dyad (stopwords removed) and *fluency* was calculated as the number of ideas produced per dyad. Originality and flexibility were composite measures based on higher-level categories of ideas. For each trial, a research assistant, a participant, and one of the co-authors manually coded the pool of ideas into higher-levels categories. Categories were then refined and adjusted via discussion among the co-authors (frisbee: n=29, newspaper: n=33, plastic bottle: n=28). To obtain *originality* scores, we first calculated the representation of each category within a trial in percentage, resulting in each idea being given a percentage (e.g., the idea "you can draw on it" belongs to the category "art", which represents 4.4% of the pool of ideas for alternative uses of a plastic bottle). For each dyad, we then retrieved the median percentage out of all their ideas, which we then normalized into an inverted scale such that 1 was the maximum originality and 0 was the minimum. To score *flexibility*, we computed the number of unique categories each dyad contributed to and divided it by the total number of ideas generated by the dyad.

Descriptive statistics

We recruited 86 participants, grouped into 43 dyads (in-person: n=23, online: n=20, convergent mood: n=21, divergent mood: n=21). A total of 1998 ideas were produced across all trials, of which 145 were removed from the dataset as being considered invalid because they either did not constitute a use of the object or constituted a non-alternative use of the object (frisbee: n=600, removed N/A=52; plastic bottle: n=668, removed N/A=32; newspaper: n=730, removed N/A=61). Tables 1, 2, and 3 show descriptive statistics for each trial, displaying each creativity sub-score calculated per dyad. Originality and flexibility scores are normalized to allow for comparisons across trials.

	elaboration	originality	flexibility	fluency	n_originality	n_flexibility
count	43	43	43	43	43	43
mean	13.41087	26.255814	0.751544	13.953488	0.809158	0.570848
std	3.345932	8.255137	0.137988	4.047065	0.170209	0.238343
min	6.954545	17	0.421053	4	0	0
25%	11.7375	24	0.656863	11.5	0.814433	0.407308
50%	13.5	24	0.764706	15	0.85567	0.593583
75%	15.224242	26	0.858333	17	0.85567	0.755303
max	21.25	65.5	1	22	1	1

Table 4. Descriptive statistics of creativity scores for frisbee (trial = 1)

	elaboration	originality	flexibility	fluency	n_originality	n_flexibility
count	43	43	43	43	43	43
mean	13.354602	32.883721	0.761174	16.976744	0.759899	0.492495
std	2.970044	7.957354	0.101439	4.050211	0.215064	0.215558
min	7.210526	24	0.529412	9	0	0

25%	11.555195	28	0.697826	14	0.72973	0.35788
50%	13	31.5	0.764706	18	0.797297	0.5
75%	15.178571	34	0.811012	20	0.891892	0.5984
max	20.846154	61	1	24	1	1

Table 5. Descriptive statistics of creativity scores for newspaper (trial = 2)

	elaboration	originality	flexibility	fluency	n_originality	n_flexibility
count	43	43	43	43	43	43
mean	15.264997	31.127907	0.722756	15.534884	0.572004	0.509491
std	5.920007	4.990578	0.119312	4.615444	0.191945	0.21109
min	6.625	20	0.434783	8	0	0
25%	11.541026	28	0.647059	12	0.5	0.375566
50%	14.117647	31	0.714286	15	0.576923	0.494505
75%	17.147059	33	0.8	18	0.692308	0.646154
max	40.8	46	1	26	1	1

Table 6. Descriptive statistics of creativity scores for plastic bottle (trial = 3)

Results

Manipulation-check data

A 2 × 2 analysis of variance (ANOVA) with time (pre-manipulation vs. post-manipulation) as within- subjects factor and game (negative affect-induction vs. positive affect-induction) as between-subject factor was conducted on the PANAS positive affect data. The results suggest that positive affect was higher for the post-manipulation positive affect-induction dyads (M = 36.0, SD = 8.5) compared to the pre- manipulation positive affect-induction dyads (M = 34.1, SD = 7.4). Positive affect was not higher for the post-manipulation negative affect-induction dyads (M = 33.2, SD = 7.2) compared to the pre-manipulation negative affect-induction dyads (M = 33.1 SD = 6.8). Similarly, the results suggest that negative affect was higher for the post-manipulation negative affect-induction dyads (M = 21.1, SD = 7.6) compared to the pre-manipulation negative affect-induction dyads (M = 18.6, SD = 6.8). Negative affect was not higher for the post-manipulation positive affect-induction dyads (M = 17.5, SD = 7.2) compared to the pre-manipulation positive affect-induction dyads (M = 18.4 SD = 6.8).

Creativity scores

We conducted a three-way ANOVA with O_P (online vs. in-person), CM_DM (convergent mood vs. divergent mood), and trial (1,2, or 3) for each of the creativity subscores. The results are reported in Tables 4, 5, 6, and 7. The results are further plotted for visual inspection in Figures 10, 11, 12, and 13.

	sum_sq	df	F	PR(>F)
C(O_P)	210.257533	1	12.6337	0.000548
C(CM_DM)	59.188969	1	3.556475	0.061793
C(trial)	101.631441	2	3.053353	0.050979
C(O_P):C(CM_DM)	1.251375	1	0.075191	0.784407
C(O_P):C(trial)	29.391072	2	0.883007	0.416275
C(CM_DM):C(trial)	54.615287	2	1.640828	0.198248
C(O_P):C(CM_DM):C(trial)	4.222035	2	0.126844	0.880992
Residual	1947.183752	117	NaN	NaN

Table 4. Three-way ANOVA summary table (y = elaboration)
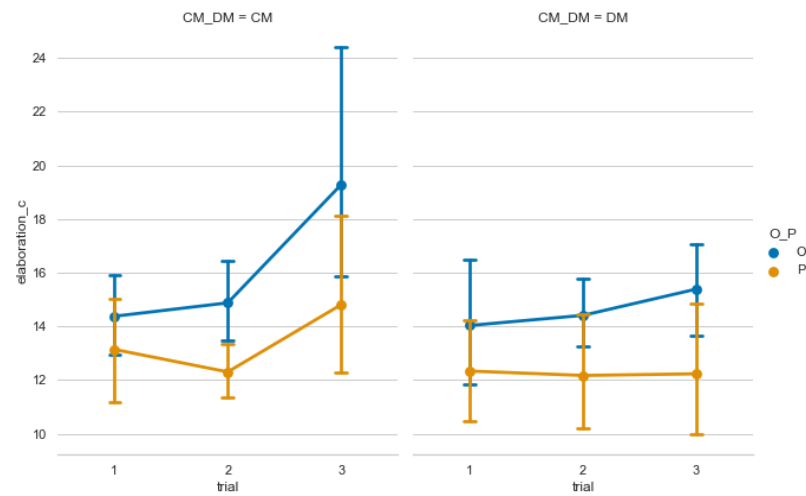
Figure 10. Visual inspection of the effects of O_P, CM_DM, and trial on elaboration

	sum_sq	df	F	PR(>F)
C(O_P)	0.001207	1	0.033795	8.54E-01
C(CM_DM)	0.047508	1	1.330284	2.51E-01
C(trial)	1.346957	2	18.858362	7.96E-08
C(O_P):C(CM_DM)	0.217343	1	6.085916	1.51E-02
C(O_P):C(trial)	0.147403	2	2.063742	1.32E-01
C(CM_DM):C(trial)	0.070127	2	0.981833	3.78E-01
C(O_P):C(CM_DM):C(trial)	0.040832	2	0.571671	5.66E-01
Residual	4.178358	117	NaN	NaN

Table 5. Three-way ANOVA summary table (y = originality)
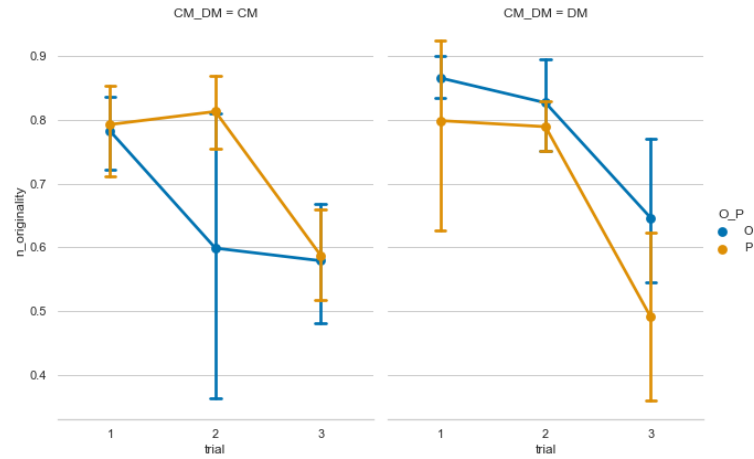
Figure 11. Visual inspection of the effects of O_P, CM_DM, and trial on originality

	sum_sq	df	F	PR(>F)
C(O_P)	0.101984	1	2.152087	0.145059
C(CM_DM)	0.005688	1	0.120036	0.729618
C(trial)	0.146096	2	1.541469	0.218382
C(O_P):C(CM_DM)	0.006541	1	0.138022	0.710927
C(O_P):C(trial)	0.246853	2	2.60456	0.078219
C(CM_DM):C(trial)	0.192403	2	2.030059	0.135928
C(O_P):C(CM_DM):C(trial)	0.104343	2	1.100929	0.335982
Residual	5.544463	117	NaN	NaN

Table 6. Three-way ANOVA summary table (y = flexibility)
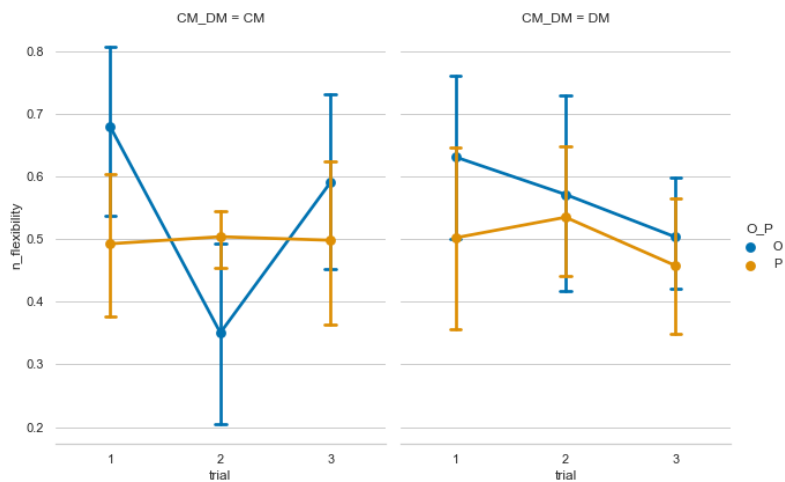
Figure 12. Visual inspection of the effects of O_P, CM_DM, and trial on flexibility

	sum_sq	df	F	PR(>F)

C(O_P)	88.155503	1	4.817882	0.03014
C(CM_DM)	0.659274	1	0.036031	0.849781
C(trial)	196.651163	2	5.373697	0.005852
C(O_P):C(CM_DM)	12.113761	1	0.662042	0.417493
C(O_P):C(trial)	6.998035	2	0.191229	0.826201
C(CM_DM):C(trial)	15.133809	2	0.413547	0.662263
C(O_P):C(CM_DM):C(trial)	7.012788	2	0.191632	0.825869
Residual	2140.815152	117	NaN	NaN

Table 7. Three-way ANOVA summary table (y = fluency)
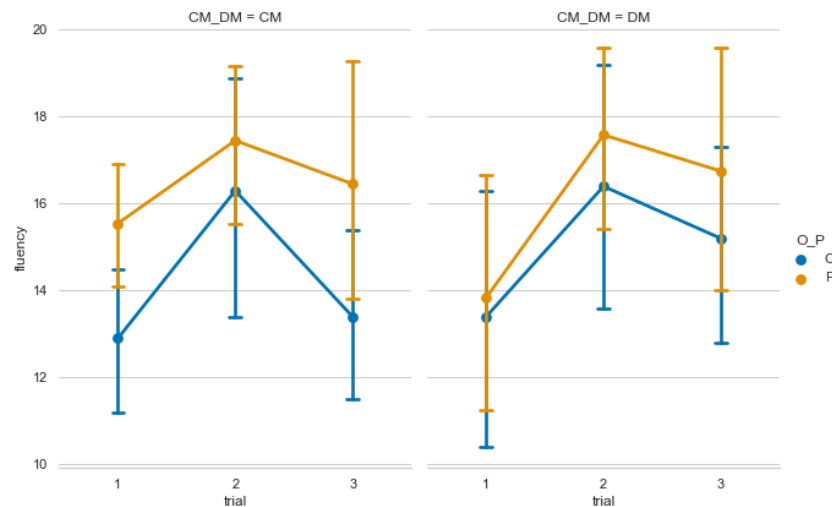
Figure 13. Visual inspection of the effects of O_P, CM_DM, and trial on fluency

For elaboration, the results support a borderline significant effect from CM_DM and trial number, which suggests that convergent dyads elaborated more than divergent dyads, as did dyads in later trials. There is no support for any interactions. For originality, the results support a significant effect from trial number, suggesting that dyads became less original in later trials. The results also support a significant interaction between CM_DM and O_P, which suggests that originality deteriorated more quickly in online dyads with convergent moods, when compared with in-person dyads, or dyads with divergent moods.

For flexibility, the results do not support any significant direct effects. However, the results support a borderline significant interaction between trial number and CM_DM, which suggests that that flexibility dropped sharply in the second trial for online dyads with convergent moods, when compared with in- person dyads, or dyads with divergent moods. For fluency, the results support a significant effect from O_P and trial number, which suggests that in-person dyads generated more ideas, and that dyads generated most ideas in the second trial. There is no support for any interactions.

Discussion

The results present three important contributions. First, we observed that online and in-person teams are likely to produce different outcomes on creative tasks. This finding supports a range of literature which shows that online and in-person environments may be more appropriate for different types of tasks. In particular, in-person teams appear to be better at generating large numbers of creative ideas. This finding echoes those of Brooks and Levav (2022), who used a different protocol to arrive at similar conclusions as regards creative fluency.

Second, we observed that teams in convergent and divergent moods are likely to produce different creative outcomes. This adds to ongoing discussion around the role of mood and emotion in team dynamics (Barsade et al., 2018; Whelan et al., 2018). Specifically, we observed that teams with convergent moods elaborate on their ideas more. This may be viewed as surprising, as teams with a shared affective (and therefore cognitive) state arguably need to elaborate less on their ideas. However, in our findings, it appears that dyads with convergent moods verbalized their ideas more. One explanation is that these dyads not only chose to elaborate on their ideas in more detail, they were able to perform this elaboration better than divergent dyads. Divergent dyads, by contrast, may have kept ideas more vague as a means of maintaining a perceived sense of harmony.

Third, we observed that the least original dyads appear to be those collaborating online dyads with convergent moods. These dyads also seem to drop in flexibility more quickly that other types of dyads. Each of these findings resonate with concerns over the diminishing information search associated with online "echo chambers" (Lu et al., 2022). Many online networks are characterized by shared affect (Bollen et al., 2011) and this is especially true for polarized echo chambers (Del Vicario et al., 2016). Our findings help to explain the role that digital media play in this phenomenon.

This study has several important limitations task. First, our results should be compared and contrasted with other findings with more complex creative endeavors in the future. Second, this study used dyads as a collaborative team structure. Clearly, larger teams with more members could introduce new dynamics and interpersonal structures (Bernstein et al., 2022). Third, we relied on dyads who had not previously worked together on creative tasks. Longitudinal studies in the future may help to capture some of the adaptations that teams make over time, as they learn to account for individual differences, traits, and areas of knowledgeability. Finally, this study used students to participate in creative tasks. While the use of students is widely accepted in such tasks, there may be cultural and demographic differences in creative teams, which our sample was not designed to identify. We invite future research that can build on our findings and apply them with teams of varying demographic and cultural composition.

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(4) UNVEILING TECHNORELIEF: ENHANCING NEURODIVERSE COLLABORATION WITH MEDIA CAPABILITIES

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Abstract

As the workforce settles into flexible work arrangements, researchers have focused on the collaborative and psychological consequences of the shift. While nearly a fifth of the world's population is estimated to be neurodivergent, the implications of remote collaboration on the cognitive, sensory, and socio-affective experiences of autistic workers are poorly understood. Prior literature suggests that information and communication technologies (ICTs) introduce major psychological stressors. Theoretically, these stressors ought to be exceptionally straining considering autistic traits – yet, studies describe a strong attraction to ICTs. We thus ask: how do digital technologies alleviate autistic workers' experiences of their collaborative work environment? Thirty-three interviews were conducted to address this question. Findings suggest that digital media present capabilities that filter input from the environment, turning it into a virtual stage that lets workers "time out". The resulting "technorelief" enables autistic workers to tune into their perceptions and regain control of their collaborative experiences.

Keywords: neurodiversity, autism, technostress, online collaboration, remote work

Introduction

In recent times, "neurodiversity" (Corker & French, 1999) has gained mainstream recognition, covering conditions like autism, ADHD, and dyslexia (Rosqvist et al., 2020). It challenges conventional views, celebrating natural neurological variations (Doyle, 2020). "Neurotypical" denotes typical brain function, while "neurodivergent" refers to different neurodevelopment (Jurgens, 2020). An estimated 15-20% of the world's population exhibit neurodivergence (NCI, 2022), often undiagnosed (cf. Malik-Soni et al., 2022), affecting teamwork with potentially 1 in 5 members being neurodivergent – knowingly or not. Given the acute variance within neurodiversity, this study focuses on autistic traits and contingencies, thus using autism as a revelatory case of neurodiversity (Yin, 2009).

Autism is a lifelong neurodevelopmental condition characterized by differences in communication, social interaction, and constricted and repetitive patterns of behavior, interests, or activities. It can be challenging for autistic adults to cope with the everyday triggers of ill-

fitted work environments (Cooper et al., 2017). Autistic workers often value fixed schedules and structured interactions due to behavioral rigidity, a diagnostic criterion for autism (Petrolini et al., 2023). However, digital media's disruptions, like interruptions and work-life imbalance, conflict with these preferences (Ayyagari et al., 2011). Paradoxically, studies show autistic individuals are drawn to ICTs for social connection (e.g., McGhee Hassrick et al., 2021). Emerging research indicates that digital media hold promise for inclusive workplaces and emotion regulation (e.g., Zolyomi et al., 2019).

Thus, we ask: *how do digital technologies alleviate autistic workers' experience of their collaborative work environment?* This article sets out to re-actualize findings from previous research in light of the changing norms and expectations of post-pandemic work arrangements. Moreover, we seek to uncover how technology may benefit the cognitive, sensory, and affective mechanisms that underlie neurodiverse collaboration. To this end, we engaged in conversations with advocates and conducted semi-structured interviews with autistic participants. In the next section, we provide a short account of prior work to serve as background for the study. We then describe our research approach, including details on data collection and analysis. Next, we report our findings from the interview data. Finally, we discuss those findings in light of the current state of knowledge and develop a model of *technorelief*.

Prior Work

Masking

Autistic individuals typically engage in behaviors and strategies to fit into a neurotypical community more seamlessly (Hull et al., 2017). This set of complicated coping behaviors is often referred to as *camouflaging*, *masking*, or *compensation* (Pearson & Rose, 2021) and may include concealing atypical traits and using techniques to appear socially competent (Hull et al., 2017). Research suggests the main motivations for masking are assimilation (i.e., the pressure to blend in and "seem normal" to attain social and professional goals and protect their safety and well-being) and connection (i.e., the desire to overcome initial obstacles to connection, allowing to develop future relationships) (Hull et al., 2017). Neurotypicals shift identities based on context (Scheepers & Ellemers, 2019), whereas masking entails rejecting one's true self, leading to intense psychological stress (Pearson & Rose, 2021). For example, masking is associated with mental exhaustion, threats to self-perception, and suicidality (Hull et al., 2017; Pearson & Rose, 2021).

Technostress

Technostress refers to the stress experienced by individuals as a result of their use of ICTs (Ragu-Nathan et al., 2008). Technostress creators include factors that create stress from the use of ICTs (e.g., work and emotional overload, role ambiguity, mobbing, obstacles hindering ICT use, etc.). Technostress inhibitors include organizational mechanisms that reduce stress from the use of ICTs (e.g., organizational and technical support, end-user involvement in implementation, etc.). Stressors and inhibitors jointly impact job satisfaction, organizational commitment, and continuance. Technostress can substantially affect well-being: technostrain refers to feelings of anxiety, fatigue, skepticism, and inefficacy beliefs related to the use of technologies (Salanova

et al., 2013). Research indicates individual traits influencing technostress. Higher neuroticism is linked to more technostress (X. Wang et al., 2020), as do external locus of control and low self-esteem (Korzynski et al., 2020; Zielonka & Rothlauf, 2022). Autistic traits often align with these factors, like higher neuroticism (Schriber et al., 2014; Schwartzman et al., 2016) and low self-esteem (Cooper et al., 2017). Common victimization (Trundle et al., 2022) and masking pressure reinforce an external locus of control (Pearson & Rose, 2021). Thus, autistic individuals appear particularly vulnerable to technostrain.

Research Approach

This study adopts a constructivist paradigm, embracing a relativist ontology and an interpretivist epistemology (Denzin & Lincoln, 2011). We aim to understand participant perspectives, unraveling the mechanisms behind diverse experiences (Reid et al., 2005). Designed as an inductive qualitative study, this work uses flexible non-standardized data collection techniques allowing adjustments and iterations.

Data collection

In preparation, four initial unstructured interviews involved multi-cultural, self-proclaimed experts engaged in advocacy via social media, non-profits, or social entrepreneurship. These conversations refined the study scope, crafted the interview guide, established ethical practices, and formed a recruitment strategy. Relevant seminars, webinars, and discussions were also attended by the researcher.

Participant recruitment was primarily conducted over LinkedIn, where potential participants were identified via their public social media activity, including information in their description and engagement with content related to neurodiversity. We purposefully selected participants who were (i) clinically or self-diagnosed with autism (Lewis, 2017) and (ii) engaged in collaborative work over digital media. This includes remote, flexible, hybrid, and office-based workers spanning large distances. While there were no exclusion criteria based on geographical location, the disproportionate Western representation in LinkedIn users made it challenging to recruit participants from other regions. Self-diagnosis was included to mirror real-life workforce diversity. A total of 29 semi-structured interviews were conducted with participants (see Table 8 for full details). Interviews, lasting 51 to 134 minutes, were conducted via video or audio calls, written interview sheets, or synchronous text messaging as preferred by participants. We prioritized informed consent and comfort, conducting quality checks and offering choices related to the use of the camera, virtual background, and closed-captioning. Language use (identity vs. person first) was tailored based on informant input.

Data analysis

Audiovisual interviews were transcribed using Konch.ai, supplemented by manual formatting and verification. Data organization, coding, and interpretation were managed with Atlas.ti. We followed a six-phase thematic analysis to identify and interpret patterns of meanings (Braun & Clarke, 2012). In Phase 1 (familiarization), recordings and transcripts were reviewed multiple times to get into an "insider's perspective". Subsequently, the researcher shifted to an

interpretive stance, making sense of participants' perspectives (steps 2-6). (Reid et al., 2005). In phase 2 (initial coding), semantic and inductive coding resulted in broad categories of content (e.g., difficulties with social cues, advantages of remote work, etc.). In phase 3 (search of themes), latent codes were generated. Patterns became apparent as codes were merged or split. In phase 4 (reviewing themes), initial codes were reviewed and restructured into three emerging themes: (i) technology reduces exposure to work-related stimuli, (ii) the leaner sensory input makes it less straining to shape a response to the input, and (iii) the slower sensory input makes processing emotional and social cues more manageable. In phase 5 (theme naming and definition), themes were defined and interview quotes were mapped into them to validate their homogeneity (see Table 9). Phase 6 (report production) focused on ordering and organizing the themes into a coherent narrative while ensuring that all interpretations stayed true to the participants' words by paying attention to the broader context of the selected quotes. Follow-up questions were sent to participants as needed. Member reflection (Tracy, 2010) and peer debriefing (Lincoln & Guba, 1985) were used to ensure the trustworthiness of the data and analysis.

Table 8. Expert informants and study participants

Alias	Age	Disclosed condition(s)	Occupation	Gender	Location	Role
Cathy	48	ADHD, autism, SPD*	Entrepreneur**	Female	USA	Expert
Rebecca	32	Neurodivergent	Entrepreneur**	Female	Denmark	Expert
Sam	50	Autism	Manager	Male	USA	Expert
John	52	ADHD, autism	Entrepreneur**	Male	India	Expert
Anna	33	ADHD, autism, SPD*	Senior production manager	Non-binary	UK	Participant
Alexa	57	Autism, SPD*	UX design lead	Female	USA	Participant
Alice	45	Autism	Entrepreneur**	Female	USA	Participant
Amy	37	ADHD, autism	Product designer	Female	USA	Participant
Fred	45	ADHD, autism	Chief information security officer	Male	USA	Participant
Robbie	37	ADHD, autism	Quality laboratory technician	Agender	USA	Participant
Cathryn	26	Autism, depression, anxiety	Architectural assistant	Female	UK	Participant
Donald	35	Autism	Software engineer	Male	USA	Participant
Dennie	46	ADHD, autism, autoimmune disease	Software engineer, entrepreneur**	Male	UK	Participant
Ted	54	Autism	Data modeler	Male	UK	Participant
Margot	35	Autism	Lead business analyst	Female	UK	Participant
Bernard	39	Autism	Management consultant, Director**	Male	Australia	Participant
Alfred	63	Autism. SDP	Freelance software engineer	Male	UK	Participant
Ariel	47	Autism	Education and Disability Consultant	Female	USA	Participant
Isadora	36	ADHD, autism	Student (film), Entrepreneur	Female	USA	Participant
Jacob	27	ADHD, autism	Senior software developer	Male	UK	Participant
Jenny	43	Autism (non-speaking)	PhD Student**, Consultant**	Female	UK	Participant
Jeremy	40	Autism	Full stack web developer	Male	USA	Participant
Jonathan	48	ADHD, autism	Managing director (consultant)**	Male	UK	Participant
Anika	44	ADHD, autism	CEO and Founder**	Female	USA	Participant
Melanie	32	Autism	Senior learning designer	Female	USA	Participant
Nicole	24	Autism, connective tissue disorder	Coordinator for Policy & Outreach	Non-binary	USA	Participant
Polly	55	Autism	Education specialist**, entrepreneur**	Female	USA	Participant
Brittany	48	Autism	Senior disaster resilience officer	Female	Australia	Participant
Shawn	26	Autism	Chief technology officer	Male	USA	Participant
Tommy	28	Autism	Autism Advocate, Ph.D. Student	Male	Australia	Participant
Tania	44	Autism	Ph.D. Student, Research Assistant	Female	USA	Participant

| Veronica | 34 | ADHD, autism, neuromuscular disease | Cyber quality assurance manager | Female | USA | Participant |
| Zelie | 31 | Autism, SDP | Financial services professional | Female | Ireland | Participant |

*Spatial Processing Disorder, **Neurodiversity-related activity*

Table 9. Thematic analysis and definitions

Digital filters	Sensory input and cognitive overload	Uncontrollable characteristics of physical work environments (e.g., noise, temperature, movements, etc.) resulting in distraction, physical pain, and mental distress.
	Filtering effects of technology	Media capabilities to increase physical and psychological distance with socio-environmental triggers, creating a protective to preserve perceived homeostasis.
The digital stage	Masking to exhaustion	Self and socially inflicted pressure for typical behavior result in costly adaptation and camouflaging strategies.
	Digital space as a controlled stage	Media capabilities to structure a space where social performance is more easily controllable and less straining.
The digital timeout	Asynchronous socio-emotional processing	Informationally-rich situations and individual interoceptive challenges result in delayed processing of socio-emotional cues.
	Digital timeout for controlled reflection	Media capabilities that embed socio-emotional timeouts into the structure of the interaction for more effective self-reflection and presentation.

Findings

Digital filters

Sensory input and cognitive overload

First, we find that in-situ work brings about multiple sensory challenges, with a preponderance of auditory processing issues. Participants often find it difficult to focus on a single voice, spatially identify where a sound is coming from, and determine whether someone is speaking to them or someone else (cf. Cathy, Anna, Alexa, Zelie). When such issues manifest publicly, they put the workers at risk of stigma – especially when others are unfamiliar with such disorders, their commonality, and their comorbidity with autism. In such cases, they can result in negative attributions or mockery, which challenges the employees' professional identity and self-esteem: "My manager used to say that I have like selective hearing" (Zelie); "[He] thought that was just really funny, so - not in a good way. So it's awkward sometimes" (Anna).

Auditory processing issues also challenge people's ability to cope with their environment. It creates an additional cognitive burden, as they attempt to reconcile sometimes conflicting sensory input: "*People frequently walk up behind you and are talking to you, but they also walk up behind you and are talking to the people behind you. So you just don't know*" (Anna). This invisible labor can impede people's ability to engage in their daily tasks: "*That person is going to be exhausted and then they're not any good probably for the rest of the day*" (Cathy). Importantly, sensory stimuli can sometimes result in intense physical pain and emotional distress: "*There's […] a quality of sound plus loudness that actually can feel like a stabbing*

sensation" (Anna). Characteristics of the space itself can also create additional challenges that capture mental resources, including the lack of control over the ambient temperature, distractions caused by people walking by, sensitivity to bright lights, and other types of physical discomfort: "*Let's just say the room's too hot or too cold or your clothes that day are uncomfortable, or the chair that you got stuck with is the worst one in the whole room and it squeaks*" (Cathy). Again, these uncontrollable variables cause distress and challenge the participants' ability to focus on work: "*There was constant movement all around the room, which again, I just can't help it, if there's movement I'm drawn to it. And it's very distracting*" (Ted). The combinational effects of sensory inputs often result in the temporary incapacity to engage with a situation, respond to a stimulus, control or regulate emotional responses: "*When I am overwhelmed, I would be tuning out or shutting down*" (Tommy). Most concerningly, participants described long-term cognitive, psychological, and physical impairments from repeated exposure to these environments: "*I would be having like digestive problems from like being in the noisy environments and like so drained as well*" (Zelie).

The filtering effect of technology

Controlling the environment is a core benefit of remote work. Participants described several media capabilities that keep triggers at bay. First, being in their home environment allows them to control features of the room, such as ambient brightness, temperature, etc.: "*When I'm at home, I can put on more jumpers or I can put on heating or I can open the window*" (Zelie). Removing unnecessary distractions is paramount to achieving their work goals. Likewise, others' emotions can be distracting. Media capabilities like text formats help tone the intensity down, which helps some participants preserve their emotional stability. In this case, participants describe what seems to act as an emotional filter: "*I am emotionally very sensitive and can directly sense and feel other people's emotional states. It can be very intense. [...] I read emails as they are less demanding cognitively and emotionally*" (Tommy). At the same time, dealing with other people's emotional outbursts takes away some of the finite attention that could otherwise be allocated to work tasks: "*I can sense and feel the emotional states of others, even online, which may make things even more challenging as I need to juggle the task requirements*" (Tommy). Much like other environmental factors, the text format helps reduce the incoming flow of stimuli as well as their negative consequences.

Physical office spaces are also characterized by important sets of unwritten rules. These rules are often taken for granted by neurotypical managers and employees but can be intimidating for others. For example, Jacob explains: "*There's a lot of unwritten rules that you might need to follow, whereas none of that exists online. It's all a lot more clear how things work*" (Jacob). As physical spaces are often perceived as chaotic, participants find that online environments make it easier to establish explicit social rules. For example, co-located colleagues might walk by their office and spark up a conversation. This behavior can annoy some participants as it interrupts their workflow and breaks their focus: "*[Spontaneous calls] used to happen a lot and that used to be really stressful [...]. So what I do now is ask people to put a time in my diary if they want to speak about something that's not relevant to what I'm currently working on*" (Jacob). The digital capability to communicate explicit rules by default when interacting with someone helps

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reduce and triage those requests: "I *don't like unsolicited communications, so I actually have on my email signature "Don't call me unless we've arranged it"*" (Bernard). This practice helps filter interaction to reduce the cognitive burden of task-switching and the emotional burden of social anxiety.

Furthermore, technology seems to be used both as a barrier and an enabler of social connection. Audiovisual channels help participants gain access to important social cues, such as tone or facial expressions while blocking out other elements of social interaction that could be challenging in person: "*It's much easier to catch [cues] on Zoom than it is in person. [...] Because I don't have to think about any physical logistics of space and how often the eye glance is or isn't [...]. You know, those kind of in-person things make it much more data-rich. And the more data-rich, dynamic, the easier it is to miss a microexpression*" (Polly). As such, audiovisual channels provide much more focused access to detailed facial features than in-person interaction does. This level of detail in a physical environment would come with ample background noise that would make it more challenging to catch subtle cues. Sometimes, the richness of the webcam feed is still too intense. In this case, the digital capability to access audio-only channels helps facilitate focused attention: "*I would have my head on the desk with my eyes closed with my head next to the telephone so that I could focus entirely on what they were saying and respond*" (Ted).

Another important digital capability is auto-generated live closed-captioning. Participants deplore that the systematic use of the feature is still limited, as it has a strong potential to significantly impact their ability to perform: "*But most people don't think about that. [...] If you expect me to take in information, process it, respond, engage in that moment...*" (Cathy). Other capabilities that help process fast-paced content include recording or transcribing an interaction. If a meeting is particularly fast or emotionally loaded, participants can use those capabilities to re-visit the content with greater focus and cognitive resources. It enables them to process relevant information without interference, which fosters contribution: "*So for me, the more time I have to digest information... I'm happy to attend the brainstorming meeting provided I do not have to contribute and that everything is written down and that I can then take that away with me. Digest it. Reflect on it, and then contribute later*" (Dennie).

Digital collaboration tools offer many capabilities that filter the incoming flow of sensory input and social triggers. They provide *à la carte* richness, by letting individuals pick and choose which layers of information to leave out or emphasize based on their needs and preferences, resulting in improved health and performance. Filtering capabilities can have tremendous positive effects on quality of life: "*And I'm kind of healthy and happy now and it's the first time I've been healthy and happy. It's really nice. I like it. I really do not want to go back to the office. The office environment is horrific*" (Ted).

The digital stage
Masking to exhaustion
Most participants describe masking regularly. They often do it consciously and intentionally, for example, to de-escalate a conflictual situation or achieve socio-professional goals: "*I'll mask just to shut down a conversation*" (Alice). Masking is often described as a learned behavior, and

seems to be carefully rehearsed and perfected, as described by Bernard: "*I aced the test for masking, and a lot of it comes down to some of my acting training*" (Bernard). However, as an active cognitive and behavioral process that is simultaneous with other ongoing activities, it is often exhausting: "*So it's exhausting to do all of that […]. It absolutely drains more. And it's unnecessary*" (Polly). Importantly, masking can also have important consequences on mental and physical health. Participants explain it creates profound dissonance between their core identity and what they perceive to be an ideal identity to pursue. Even though they consider masking unhealthy, they often feel unsafe unmasking: "*That is not me being a super savvy, self-care person and that isn't being authentic either. That's masking. We mask all the time. It's really not safe to be authentic*" (Polly). For many participants who identify as "late-discovered", this awareness has come later in life, meaning that have lacked the support to engage in healthier coping mechanisms: "*What I thought I was doing was editing myself to be a better person*" (Anna). In some cases, the lack of knowledge and support has resulted in self-medication. Because masking leads to poor self-esteem and negative self-talk, participants became trapped in psychological cycles of sense-making infused with self-doubt. In those cases, the perceived hyperactivity of their mental processes made it difficult to restore emotional stability, seemingly leaving psychoactive substances as the most effective remedy. For example, Alfred used alcohol: "*I take the blame and it depresses me. This is the masking and then the neurodivergent thing. […] Earlier, in earlier parts of my life, I used to drink an awful lot to knock myself out*" (Alfred).

The digital space as a controlled stage
When an actor steps onto a scene, cameras, lights, and props are all tailored to the act. As a result, the actor can dedicate their undivided attention to the act and feel confident that everything else is under control. Similarly, digital media provide capabilities to simulate a "digital stage" that is tailored to the interactive and social act, by filtering out many aspects of ambiguity, uncertainty, or unpredictability. This greatly reduces the strain of masking.

For example, eye contact is a core – yet exhausting – component of masking. During audiovisual interaction, participants use the webcam lens or LED as a proxy for their interlocutor's eye. This technique allows many participants to engage in typical eye contact behavior without experiencing the associated strain: "*I'm looking at the camera a lot because it's a nice little dot, and I can act like I'm looking in your eyes, but I'm looking at the camera. […] In person it's really hard. […] I will make myself look people in the eye because I was brought up to do that. But it's not easy*" (Anna).

Masking is also concerned with the dissimulation of behaviors that may be considered odd by neurotypical colleagues. However, this can be difficult when said behaviors are uncontrolled and often nonconscious. For example, Zelie finds it challenging to control her facial expressions, yet she was told she sometimes emotes inappropriately: "*I actually can't control my facial expressions at all. […] So in that sense, [online] is great because, um, I can roll my eyes as much as I want and no one will see me, um, and I can control my voice better than my face*" (Zelie). The capability to select the channels she interacts through by controlling whether her webcam is on or off protects her from the negative attributions others often make based on her

uncontrolled facial expressions. She can instead "pick her stage", as she feels more confident regulating her vocal tone than her facial expressions. Because emoting can be challenging, the digital capability to use virtual facial expressions (e.g., emojis) in text-based communication enables participants to effortlessly display emotions outwardly – which can otherwise be challenging during face-to-face interaction: "*Emojis on text, I use it quite a lot. […] And I can get people by with me or that as well because they kind of, they get it, they get me. They tend to get me if I throw in a lot of emojis*" (Alfred).

Stimming behaviors are essential to participants' demeanor, and a critical sensory outlet. Their suppression can result in considerable distress: "*I almost started crying. […] I couldn't hold it together that long. Because there was no outlet, you know, all this input, no output that I could do that I felt comfortable doing*" (Tania). Participants explain they feel more comfortable engaging in stimming when they can "hide it" from their interlocutors. Digital tools offer media capabilities to enact a natural interaction while concealing aspects that participants prefer to keep private. Specifically, the visual frame of the communication channel helps participants enhance their social performance because they do not have to worry about behaviors that fall outside of the curated frame: "*So like here, you know, you can only see me from here up, so you can't see that I'm fiddling with something or I'm shaking my leg or I'm moving my hands*" (Tania).

Being released from the perceived obligation to control various aspects of their conduct results in participants feeling more capable to perform their work well: "*So it's like all my resources are going to go to [my presentation]. I'm not going to worry about what I'm doing on camera*" (Tania). These additional cognitive resources can thus be allocated to other aspects of the interaction. For example, Anna explains that some of her most desirable personality traits can become more visible, which improves her experience working with colleagues: "*The thoughts are flying and, and there's no... I know why it's exhilarating. There's no monitoring of my face or my voice, you know?*" (Anna).

The digital timeout
Asynchronous socio-emotional processing
Participants described sometimes complex relationships with socio-affective and interoceptive cues. It can sometimes take additional time for participants to process a situation and experience the resulting emotion: "*You can have an emotional reaction at any amount of time after the event*" (Alfred). This can also happen due to the dynamism of a situation, which does not provide scope for emotional check-in: "*You see, with my sensory perceptual and information processing issues as well as additional communication needs, it is extremely difficult to be consciously aware of my emotions during an event*" (Tommy). These challenges can also be related to impaired: "*Since I experience high alexithymia and low interoception, I don't always feel these physical sensations. My thoughts get processed independently of my emotions, and I'm not sure emotions represent any objective reality*" (Robbie). Participants described needing extended periods before realizing that they are under intense stress: "*I do not notice emotions until they are big. This has had an effect in my work life in multiple ways, most often in the management of stress*" (Jenny). Dennie describes how not being in touch with his emotions

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promptly had major consequences on his relationships, especially in the context of work, as it translates into an "*explosive temper*".

Participants describe experiencing delayed processing of other people's emotions as well: "I sense other people's energies quite strongly, which is one of many reasons I enjoy solitude. I don't always know what their emotions mean in real-time" (Robbie). Oftentimes, dynamic interaction does not provide the time or space for participants to become fully aware of the emotions being communicated by their colleagues: "When it comes to my attention that I've been misinterpreting someone's emotions, and I finally reach clarity, my mind resynchronizes all relevant memories into that context…" (Veronica). In some cases, even when the emotional trigger is explicitly mentioned, the realization that the colleague may need emotional support does not come until after the interaction has taken place: "I felt bad after it, like afterward about this situation because I did feel sorry for her. But it's like delayed" (Zelie).

Catching and accurately interpreting socio-emotional cues can also be challenging, especially when it comes to receiving or providing feedback. In particular, participants experience intense distress when receiving negative feedback while being unable to estimate the gravity of the situation. As Donald puts it: "*I never really understood if my manager was angry or disappointed. Or just wanted me to improve or if I was going to get fired*". This is also true about missing positive cues. Jacob explains that he finds picking up on positive cues from others particularly challenging, which often results in negative attributions about what others think of him: "*I get very insecure about how people feel about me because I'm not picking up that they are expressing positive emotions about me when they are*" (Jacob). Struggling with interpreting cues from others can not only result in worse relationships and social well-being, but it can also breach the participants' self-esteem.

Digital timeout for controlled reflection
The filtering capabilities of digital media seem to create a parallel temporality, where participants can time out for self-reflection without interrupting the communication flow. In particular, participants value the digital capability to rehearse the content and form of a message.

Most participants exhibited strong work engagement and a desire to do a good job – even as some did not enjoy the job or feel close to their colleagues. These strong work ethics mean they often ask tough questions, challenge ways of working, and strive to achieve the best result: "*Sometimes people, for the sake of social niceties, not wanting to harm someone, will go along with an idea that they're not fully convinced of. Whereas I'm the other extreme*" (Jacob). These behaviors can be interpreted by colleagues and managers as a challenge to authority or pettiness, and sometimes result in people taking offense: "*But at that point, I feel like I'm being the one that's rude by trying to correct it because she's not listening*" (Tania). The ability to convey those messages in writing rather than during a live conversation can be advantageous because it makes it possible for participants to craft their message: "*I will write a message and then I'll read it and then I'll go, you know, ask them how they are, and hey, hope your Monday is going well or whatever*" (Anna). In that sense, the digital capability to rehearse is used to preserve others' feelings. While participants often describe not understanding their colleagues' emotions, many show deep care about their colleagues' emotional well-being. For example, Isadora

describes a situation where she had to communicate negative feedback to a member of her team. Despite having rehearsed the (in-person) interaction, things got out of hand when her co-worker got emotional. She regretted not using text messaging, which would have made it easier to stick to the script and preserve her colleagues' feelings: "*And I was afraid to do that to her because, like, she doesn't deserve that*" (Isadora). While in-person interaction can be rehearsed, it seems that text-based communication makes it possible to rehearse and make sure the interaction follows the rehearsed path. Moreover, it also provides the psychological safety of knowing that the interaction will go as planned.

Media capabilities add a temporal buffer that also helps participants reflect on their thoughts and feeling before they respond to a communication: "*I find the option of a chat function especially helpful, enabling me to reflect on my words and reorder them as necessary before sending them into the conversation*" (Jenny). This timeout lets participants make an informed decision when they respond, either by being in tune with their inner reaction and knowing how to best communicate it outward – or by adopting a more socially acceptable response. Participants describe using artificial intelligence to leverage those digital timeouts, typing response drafts into an AI chatbot: "*Seeing an already written email will either help me phrase things that I'm already feeling, or I'll see something, know that it's wrong, and then want to express it in a different*" (Jacob). With this practice, they leverage the digital capability to generate communication prompts to produce a message that they feel is true to their thoughts and intentions. They may also paste messages from others that they find confusing, using the AI to help clarify subtle cues that may be concealed in wordiness. This is also helpful to tailor a more appropriate response: "*[Chat GPT] tells me I'm being insensitive*" (Jacob); "*I have turned to ChatGPT to soften and correct my content to get the same impact in more neutral words because my choices are historically bad at triggering a) neurotypicals b) those who are particularly narcissistic*" (Alfred).

Finally, media capabilities that instill more distance between participants and potentially triggering emotions from others make room for making sense of and rationalizing their emotional experiences: "*Well, I have more of a barrier, I suppose, from that emotion. It's easier for me to tell what's my emotion versus someone else's*" (Brittany). This is especially helpful when participants feel vulnerable to negative emotions and thus susceptible to being substantially emotionally affected: " *So that's why the ability to do remote meetings and things of that caliber, I can let go of that toxicity in an environment*" (Fred). An advantage of technology in this regard is that individuals feel more comfortable taking a break and walking away from the digital environment – whereas, in an office, they feel the pressure to stay at their desk: "*I usually like to have like 1 or 2 hours and then, you know, a couple hours to recover*" (Fred). This is made possible by the asynchronous capabilities of virtual environments.

Discussion

Our key contribution lies in three themes that illuminate how media capabilities can alleviate autistic people's experience of collaborative work environments. First, we identified media

capabilities that can filter out distressing sensory, emotional, or cognitive input. For example, the capability to access a work environment remotely makes it possible to engage in meaningful aspects of work without suffering sensory distress from a physical office. Textual channels help reduce the emotionality of the received content, and other textual features, like email signatures, make it possible to automatically accompany text-based conversations with information about communication preferences. This helps reduce incoming flows of spontaneous interaction that can be disruptive. The digital capability to extract text from conversations (e.g., live captioning, transcripts) helps de-emphasize noisy audiovisual contexts and facilitates focused attention to relevant content. Similarly, camera-based communication downplays noisy input out-of-the-box by offering a zoomed-in view of an interlocutor's face. We refer to these capabilities as *digital filters*.

Another key theme pertains to the taxing nature of masking. Our findings align with previous research, indicating that masking drains mental health (cf. Hull et al., 2017), yet participants engage in it habitually. A significant burden involves distancing from one's authentic self, echoing existing literature (Pearson & Rose, 2021). Together with the digital filters, other media capabilities help curate an environment where individuals regain agency in how they relate to masking. Using a webcam as a proxy for eye contact is an example of using those media capabilities for assimilation goals (Hull et al., 2017) while alleviating the strain of masking. The visual frame available through audiovisual communication channels is another capability serving assimilation goals by concealing behaviors that may be considered unprofessional or socially unacceptable. This enables workers to fully engage with the interaction while being in control of what is visible in the frame, as the strain of monitoring everything else is alleviated. Our data also supports the connection thesis (Hull et al., 2017), as we found that participants leverage media capabilities that enable them to shape their way of presenting to build coworker relationships. The controlled visual frame is one such capability, another is the use of symbols to exert more control over the interpretation of their emotional displays or intentionality. For example, emojis clarify the tone that could otherwise be misinterpreted in audiovisual or plain text communication. Those capabilities help individuals can access a new level of relationship-building, as stigmatizing barriers are minimized or mediated. Media capabilities thus (i) provide assistive support that makes it less exhausting to mask and (ii) render masking unnecessary by concealing behaviors that pose threats to assimilation goals. They effectively transform the work environment into a *digital stage* that inherently supports masking, easing its usual strain. In this space, autistic individuals redirect cognitive resources to less strenuous forms of masking.

The third theme describes the media capabilities that structure the temporal interplay between work demands and personal needs. As many workers may require additional time to process sensory, cognitive, and affective input, typical work routines often fail to accommodate those needs. Reprocessability and rehearsability were previously identified as important information-processing capabilities (Dennis et al., 2008). We note similar capabilities holding particular importance in neurodiverse collaboration because they act as a temporal buffer that reconciles individual needs with typical work demands. For example, capabilities that help craft content

with greater awareness and intentionality, such as asynchronous channels or generative AI, support self-reflection before responding. These capabilities dynamically facilitate the better communication of one's authentic reaction or the more effective crafting of more suitable responses. At the same time, they support connection goals as workers consciously leverage them to enhance their relationships with colleagues. The capability to momentarily disengage from ongoing interaction further makes room for recovery. As social demands can pile up and cause exhaustion, asynchronous channels make it possible for workers to momentarily leave the psychological space of work and engage in a psychological space of self-care. Slowing down and reflecting on the internal and external cues that are often more challenging to catch in typical work temporalities contributes to better performance, relationships, and individual well-being. Figure 14 illustrates the relationships between the three themes, conceptualizing what we call technorelief: digital collaboration media offer capabilities to filter out input from colleagues and the work environment (digital filters) as well as create a virtual space where autistic individuals are more empowered in how they present to others (digital stage) while creating an individual-scale time that is compatible with and enhances collaborative work (digital timeout).
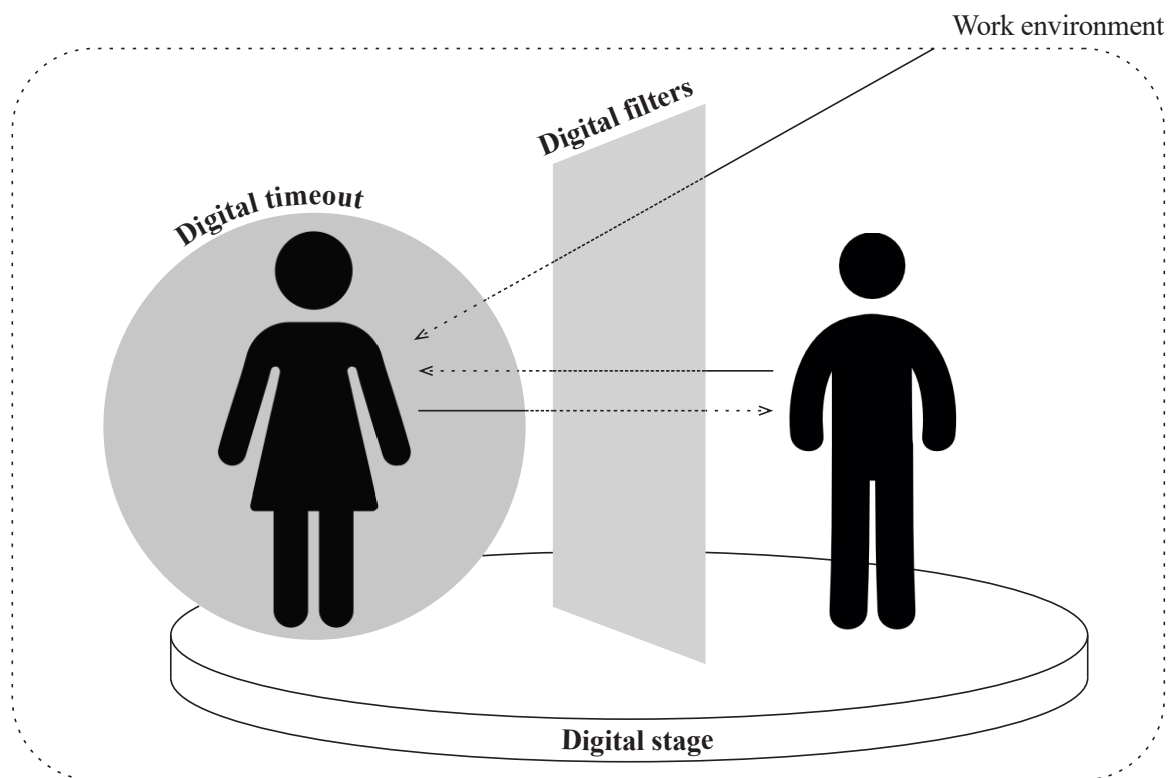
Figure 14. The Technorelief Model.

Our second most important contribution is the concept of *technorelief*. With it, we shed unprecedented light on the specific ways media capabilities interact with autistic adults' collaboration experiences. A large stream of research has studied the concept of technostress (Ayyagari et al., 2011), described as the anxiety, tension, or distress resulting from someone's inability to cope with the stressors created by technology. *Technorelief* describes

thepsychological relief achieved through the use of technology to cope with stressors from the work environment. We identified several media capabilities that drive technorelief through a network of sensory, cognitive, and affective mechanisms. We invite future research to further develop the concept, including in typically developing populations.

Third, our findings have implications for information-processing researchers. While there are extensive empirical studies of media richness, synchronicity, and naturalness theories, this work suggests that new analytical frameworks might be needed to include media capabilities that moderate sensory stimuli and affective cues.

Conclusion

This study explores the interaction of digital media with neurodiverse collaboration, focusing on the experiences of autistic individuals. By conducting a thematic analysis of 33 interviews, three key themes emerge. First, media capabilities act as *digital filters* that help manage overwhelming sensory inputs. Second, they aid in navigating the challenges of masking, allowing more agency in how individuals present themselves in the *digital stage*. Third, they enable a *digital timeout*, offering a temporal buffer for self-care and reflection. The concept of *technorelief* complements technostress, highlighting technology's positive role in managing collaboration stress for neurodivergent workers. This study offers insights into enhancing work experiences for neurodiverse individuals, fostering inclusive and supportive work environments.

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[1] The term "affective divergence" is commonly used to describe "mismatched affective states" (Barsade & Knight, 2015). However, "affective divergence" is used both to refer to *opposing* affective states (Weisbuch & Ambady, 2008) and *dissimilar* affective states (Barsade & Knight, 2015). To avoid confusion, we thus use the term "affective variation" (Tiedens et al., 2004).

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