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COMMUNICATIVE PATTERNS IN ORGANIZATIONAL (HEALTHCARE) TEAMS

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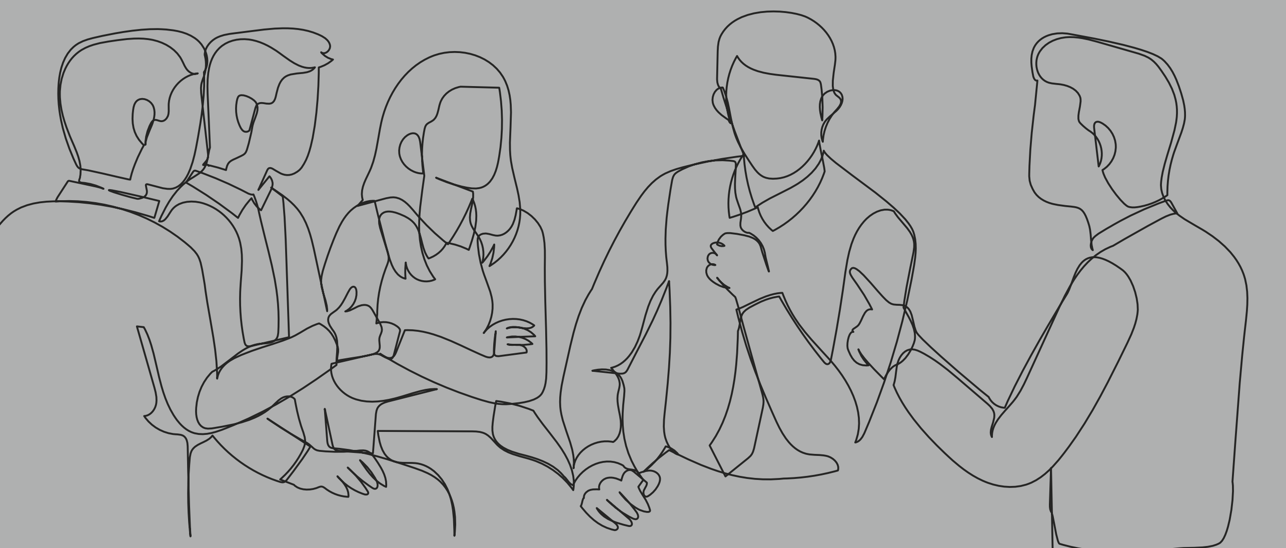

CHAPTER 1

Communicative patterns in organizational (healthcare) teams: an introduction

SETTING THE STAGE

Most readers of this dissertation are in everyday work life part of organizational teams. As you may recognize, the success of your team is highly dependent on the way in which you and your fellow team members integrate unique perspectives, experiences, and knowledge through communicative practices. What might be less obvious to the unaided eye is that, through team communication, we produce *communicative patterns*, mostly without being aware of their occurrence, nor the impact it has on subsequent collaboration. To illustrate, team members may repeatedly use joking to ease tensions or smooth over disagreements. Or, if you think more carefully, you may realize that some colleagues tend to agree more with suggestions made by higher-status team members. Or, remember the end of a lengthy team meeting, do you notice yourself generally slowing down in conversational pace?

The examples described above show that, indeed, we produce patterns in everyday organizational team collaborations. Interestingly, we are mostly unaware of their presence, nor do we consciously reflect on whether our communicative patterns serve some sort of (latent) function when they are established, develop, or change over time (see also; Gersick & Hackman, 1990). We argue that a significant portion of team communication is governed by communicative patterns, and that any research concerning how (and how well) teams work must address this prevalent yet frequently neglected aspect of team behavior. The underlying premise of this dissertation is that by understanding patterned communication and its (underlying) function, we can further contribute to the understanding and improvement of organizational teams' functioning.

INSIDE THE BLACK BOX

The role of communicative patterns in the IPO model

This dissertation departs from positioning communicative patterns in the traditional Input-Process-Output (I-P-O) model[1] (Hackman, 1987; McGrath, 1984; Pavitt, 2014), in which team communication is a process that transform inputs (e.g., members expertise)

[1] An important note is that Marks et al. (2001) and Ilgen et al. (2005) have put forward that many of the mediating factors linking inputs and outcomes are not behavioral communicative processes, rather also include affective and cognitive elements. Thus, the term mediating mechanisms (M) has come to replace the original P, meaning that IPO models have been replaced by IMO models. However, as we focus in particular on the behavioral communicative processes, we follow the IPO terminology in this dissertation.

into meaningful outputs (e.g., attaining organizational or team goals). As communicative processes are oftentimes consigned to a ‘black box’ between input and outputs and seldom studied directly (van Swol & Ahn, 2021), *this dissertation aims to contribute to the understanding of what transpires inside the black box of real-life organizational teams*. We aim to advance our understanding of communicative processes by examining the communicative patterns that emerge over time in the discourses of organizational teams. Through unitization and coding of communicative transcripts, we aim to make valid interpretations and inferences in the context in which these observations occur, mostly beyond the level of awareness of team members at the time of its occurrence (Keyton, 2018).

STRUCTURE OF THE DISSERTATION

Table 1.1 provides an overview of the structure of this dissertation, that is composed of two main sections and includes four research papers. The first section, comprising the second and third chapter, focuses on conceptual and review work on collective intelligence and communicative patterns in organizational teams. The second section, comprising the fourth and fifth chapter, presents empirical work on overarching patterns within communicative processes in multidisciplinary decision-making healthcare teams (MDTMs).

Section 1

Collective intelligence and communicative patterns in organizational teams

In the first paper in this section, we come to challenge the collective intelligence literature by proposing an extension from outcomes (teams that find the best solutions are the most collectively intelligent), to a more process-oriented perspective (teams that solve problems in a mutually intelligent manner are collectively intelligent). We draw from various theoretical frameworks such as the multilevel theory of emergence (Kozlowski & Chao, 2018) and the theory of ecological rationality (Raab & Gigerenzer, 2005) to define collective intelligence in terms of its behavioral processes inside team communication, that must be aligned with environmental demands in order to be evaluated as ‘intelligent.’ With that in mind, we arrive at more fine-grained understanding of when teams behave more or less intelligently over time.

Table 1.1

PhD Dissertation Structure

		I-P-O MODEL (McGrath, 1984)					
		Research questions	**INPUT**	**PROCESS**			**OUTPUT**
SECTION 1	**CHAPTER 1** Conceptual paper	*What is collective intelligence in organizational teams and how can we understand the concept from a process-oriented view?*		*Collective intelligence in teams as a process*			
	CHAPTER 2 Review paper	*How do communicative patterns manifest in organizational team research and what are the consequences for important (team) outcomes?*		**Communicative patterns**			
				Content	*Structure*	*Temporality*	e.g., team and organizational-level performance, effectiveness, satisfaction
SECTION 2	**CHAPTER 3** Empirical work	*To what extent do multidisciplinary healthcare teams move through (linear) decision-making pathways and which factors influence this movement?*		Orientation (time)	→ Decision-making pathway movement		Task efficiency
	CHAPTER 4 Empirical work	*To what extent do naturally occurring workflow interruptions emerge in multidisciplinary healthcare teams and how do they relate to changes in the decision-making process?*		Workflow interruptions	→ communicative clarification → communicative valence		

In our second paper, we conduct a rigorous and selective review study that examines how various aspects of communicative patterns are manifested in organizational teams. Leveraging unique datasets of real-life team communication, we synthesize empirical research from 48 papers, comprising 1623 organizational teams. Drawing from this extensive sample, we develop a comprehensive team communication framework for researchers and practitioners. Our framework captures the *content*, *structural*, and *temporal* elements of communicative patterns. This enables a more holistic understanding of how team-level communicative processes impact important outcomes, for example, team or organizational-level performance, effectiveness, and satisfaction. We show that a thorough integration of various aspects of communicative patterns, offers great promise for advancing team science and collaborative practices, which is in prior research mostly studied in isolation.

Section 2

Communicative patterns in Multidisciplinary Healthcare Teams

The Dutch government's national research agenda and vision for science has identified a variety of societally relevant challenges facing our society. As Figure 1.1 shows, one important area is connected to how to improve multidisciplinary healthcare, while ensuring it is affordable. In the second section of this PhD dissertation, we delve into the functioning of multidisciplinary healthcare teams and examine the communicative processes that underlie the collaboration of medical physicians when formulating treatment plans for patients diagnosed with cancer. In addition, given the significant costs associated with lengthy MDTMs, we offer valuable insights into more efficient methods for organizing MDTMs that aligns with the need for affordable healthcare in our society.

In chapter four, we address how healthcare professionals arrive at treatment plans for patients in 38 MDTMs encompassing 565 patient case discussions. We find empirical evidence for communicative patterns that illustrate back-and-forth communicative shifts underlying the decision-making process. Furthermore, building on theoretical assumptions of the shared mental model literature (Mohammed & Dumville, 2001), we find that teams who devote more time to collectively building a shared representation of the patients background exhibit fewer communicative shifts and engage in more efficient communication thereafter. Our qualitative analysis further highlights that insufficient initial orientation tends to contribute to back-and-forth communicative shifts.

Figure 1.1
The Dutch National Research Agenda[2]

[2] Retrieved from https://www.nwo.nl/en/researchprogrammes/dutch-research-agenda-nwa

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How do we improve the quality of health care as much as possible while keeping it affordable?

Explanation

Health care systems all around the world are under tremendous pressure. Advances in technology, ageing populations, new health risks, and cultural trends are driving up the demand for care and the cost so fast that current financing systems cannot keep up. More and more aspects of care are regarded as an individual responsibility, putting greater pressure on family care givers, for example. Research can help solve this problem in various ways. Research on new treatment methods can help professionals do their work more efficiently. Organisational studies can help institutions operate more efficiently. Health economics research can help policymakers make the right decisions.

Connective power

Multidisciplinarity is the key to health care research. Researchers in health economics, health care law, organisation science, public administration, medical sociology, ethics, anthropology, and other disciplines work together closely on health care-related questions. They will also need to cooperate with technology researchers, since technology can lead to cost savings. The use of ICT is frequently cited as a tool for streamlining the organisation of health care. Some of the questions involve basic and others applied research. Many questions have an ethical dimension. Cooperation with civil society organisations, for example patient interest groups, is emphasised in this research, guaranteeing its ongoing relevance and applicability.

Submitted questions illustrating depth and connective power

- **How can we assess Dutch medical guidelines on their effect, usefulness, and cost-effectiveness?**
- **How can technology help improve the quality and lower the cost of health care?**
- **To what extent does value-based health care (care based on value creation as defined by patients) improve outcomes in terms of survival and quality of life?**

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Chapter five addresses how workflow interruptions naturally occur in MDTMs and how they change the way in which members communicate. We find evidence for a highly interruptive meeting environment in fourteen MDTMs, characterized by videoconferencing issues, disruptive beepers/phones that go off, and people leaving and entering the meeting room during collaborative intellectual activities. Contrary to what was expected, team members initially respond to the interruption with positive statements (i.e., humor) as a coping mechanism, which decreases significantly in the minutes after the interruptive event. After the interruptive episode, significantly more negative statements, as well as conversational repetitiveness occurs. We contribute to understanding naturally occurring workflow interruptions in actual organizational healthcare teams, by providing objective and fine-grained empirical insights into how workflow interruptions relate to changes in the teams communication.

MAIN CONTRIBUTIONS

Contributing to real temporality in team research

In this dissertation, I address the repeated appeals made by prominent scholars in the field to treat *team dynamics* as a serious subject of study and explore their real-world *temporal* manifestations in-depth (Cronin et al., 2011; Kozlowski & Chao, 2018; McGrath, 1984; Mohammed et al., 2008). Instead of solely focusing on static snapshots of team-level aggregates (e.g., frequencies of communicative statements aggregated at the team level), in this dissertation, we aim to disaggregate temporal aspects in team-level communicative process by understanding how communicative processes unfold or change in response to (naturally) occurring events. The following example, adapted from Waller et al. (2021), illustrates the importance of temporal disaggregation. In one team, juniors are ignored when they ask questions, but seniors occasionally provide unsolicited information. In another team, juniors ask questions and seniors immediately address the question by providing substantial information. Although the total number of ‘questions’ and ‘information statements’ are the same in both teams, the immediate temporal ensemble of communicative statements reveals important differences in communication dynamics between the two teams. Throughout all chapters in this dissertation, a temporal approach is emphasized in both the conceptualization and operationalization of my research. To illustrate, in rethinking the concept of collective intelligence (CI) we posit that CI needs to be understood in a temporal manner, as we put forward that the intelligence lies in how team members share and discuss ideas, construct knowledge, coordinate and integrate efforts *over time* to ultimately reach a shared decision or goal. In chapter two, we review the literature on communicative patterns in organizational teams, defined as regular sets of communicative statements that occurs above chance and thus repeatedly *over time.* Additionally, we show that time can be captured in various ways within the patterns, such as in conversational rhythm, interactional peaks, temporal sequences or developmental stages/phases. Moreover, in chapter four and five, we draw from the insights gained from our review study and apply various temporal perspectives in our own empirical work. First, we examine, in a fine-grained manner, the temporal development of team decision-making processes. In the final chapter, we show how communicative patterns change within five-minute time-windows following naturally occurring workflow interruptions. In sum, this dissertation makes a significant contribution to the academic literature by taking temporal elements seriously in the study of communicative practices in organizational teams and show how researchers can be creative with embracing varying perspectives of time in (organizational) research designs.

Contributing to observational fine-grained research designs in organizational teams

In the second section of the dissertation, we respond to the repeated call for 'rich observational studies' (Mathieu et al., 2019) in 'real-life' organizational teams (Klonek et al., 2020; Lehmann-Willenbrock & Allen, 2018a; Maynard et al., 2021). Granular observational research designs allow us to detect real-time communicative patterns, whereas other research designs, such as self-report or interviews, are less suitable as we produce patterns largely *unconsciously.* In addition to the rigorous selection criteria (i.e., observational studies in organizational teams) employed in our review study in chapter three, chapter four and five presents our own fine-grained observational research, further contributing to the academic community's call for such studies. Specifically, we focus on the highly nuanced levels of minute-to-second unfolding of communication that takes place during real-life MDTMs. Overall, the first section of this dissertation reviews and syntheses rich observational data, while the second section provides a wealth of rich real-life data on medical MDT functioning.

Contributing to multi-level thinking in organizational team research

Organizational teams are inherently multilevel systems, consisting of individual team members, embedded in teams that are part of larger organizations (Kozlowski & Klein, 2000; Ramos-Villagrasa et al., 2018). While this dissertation does not claim to account for the fully-fledged complexity of all levels of analysis in organizational teams, we do contribute to multilevel thinking by incorporating an important set of levels in conceptual and empirical research work. To illustrate, communicative patterns are inherently multilevel in nature as they emerge from individual-level contributions and eventually form communicative patterns (e.g., dyad-level) that may characterize the team-level system. Although the majority of this dissertation focusses on individual contributions and interaction between team members, chapter three also reviews research that shows how communicative patterns relate to organizational-level outcomes (i.e., cross-level effects). In sum, this dissertation contributes to a multilevel understanding of communicative patterns by highlighting the importance of considering various levels of analysis.

REFERENCES

Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? *Academy of Management Annals*, *5*(1), 571–612.

Gersick, C. J., & Hackman, J. R. (1990). Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*, *47*(1), 65–97.

Hackman, J. R. (1987). *The design of work teams. InHandbook of Organizational Behavior, ed. JW Lorsch*. Englewood Cliffs, NJ: Prentice-Hall.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annu. Rev. Psychol.*, *56*, 517–543.

Keyton, J. (2018). Interaction analysis: An introduction. *The Cambridge Handbook of Group Interaction Analysis*, *10*(9781316286302.002), 3–19.

Klonek, F. E., Meinecke, A. L., Hay, G., & Parker, S. K. (2020). Capturing team dynamics in the wild: The communication analysis tool. *Small Group Research*, *51*(3), 303–341.

Kozlowski, S. W., & Chao, G. T. (2018). Unpacking team process dynamics and emergent phenomena: Challenges, conceptual advances, and innovative methods. *American Psychologist*, *73*(4), 576.

Kozlowski, S. W., & Klein, K. J. (2000). *A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes.*

Lehmann-Willenbrock, N., & Allen, J. A. (2018). Modeling temporal interaction dynamics in organizational settings. *Journal of Business and Psychology*, *33*(3), 325–344.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, *26*(3), 356–376.

Mathieu, J. E., Gallagher, P. T., Domingo, M. A., & Klock, E. A. (2019). Embracing complexity: Reviewing the past decade of team effectiveness research. *Annual Review of Organizational Psychology and Organizational Behavior*, *6*, 17–46.

Maynard, M. T., Conroy, S., Lacerenza, C. N., & Barnes, L. Y. (2021). Teams in the wild are not extinct, but challenging to research: A guide for conducting impactful team field research with 10 recommendations and 10 best practices. *Organizational Psychology Review*, *11*(3), 274–318. https://doi.org/10.1177/2041386620986597

McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14). Prentice-Hall Englewood Cliffs, NJ.

Mohammed, S., & Dumville, B. C. (2001). Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *22*(2), 89–106.

Mohammed, S., Hamilton, K., & Lim, A. (2008). The incorporation of time in team research: Past, current, and future. *Team Effectiveness in Complex Organizations*, 355–382.

Pavitt, C. (2014). An interactive input–process–output model of social influence in decision-making groups. *Small Group Research*, *45*(6), 704–730.

Raab, M., & Gigerenzer, G. (2005). Intelligence as smart heuristics. In *Cognition and intelligence: Identifying the mechanisms of the mind* (pp. 188–207). Oxford University Press.

Ramos-Villagrasa, P. J., Marques-Quinteiro, P., Navarro, J., & Rico, R. (2018). Teams as complex adaptive systems: Reviewing 17 years of research. *Small Group Research*, *49*(2), 135–176.

van Swol, L. M., & Ahn, P. H. (2021). Inside the Black Box: Group Processes and the Role of Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 157–170). Emerald Publishing Limited.

Waller, M. J., Uitdewilligen, S., Rico, R., & Thommes, M. S. (2021). Interaction Pattern and Trajectory Analysis for Studying Group Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 135–153). Emerald Publishing Limited.

CHAPTER 2

Collective Intelligence in Teams: Contextualizing Collective Intelligent Behavior over Time

ABSTRACT

Collective intelligence (CI) in organizational teams has been predominantly understood and explained in terms of the quality of the outcomes that the team produces. This manuscript aims to extend the understanding of CI in teams, by disentangling the core of actual collective intelligent team behavior that unfolds over time during a collaboration period. We posit that outcomes do support the presence of CI, but that collective intelligence itself resides in the interaction processes within the team. Teams behave collectively intelligent when the collective behaviors during the collaboration period are in line with the requirements of the (cognitive) tasks the team is assigned to and the (changing) environment. This perspective results in a challenging, but promising research agenda armed with new research questions that call for unraveling longitudinal fine-grained interactional processes over time. We conclude with exploring methodological considerations that assist researchers to align concept and methodology. In sum, this manuscript proposes a more direct, thorough, and nuanced understanding of collective intelligence in teams, by disentangling micro-level team behaviors over the course of a collaboration period. With this in mind, the field of CI will get a more fine-grained understanding of what really happens at what point in time: when teams behave more or less intelligently.

Keywords: collective intelligence$_1$, team processes$_2$, interaction$_3$, team behavior$_4$, time$_{5,}$ environment$_6$.

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INTRODUCTION

Intelligence has captured the attention of scientists and practitioners because it portrays a desired state: we want to be called intelligent, show intelligent behaviors, and work in intelligent teams or organizations. Intelligence is an established concept at an individual level, but even there, various approaches and debates exist on how intelligence should be defined or operationalized (Deary, 2012; Funke, 2022). In general, researchers agree that individual intelligence is some sort of mental capability that involves the understanding of complex ideas, the reasoning about various courses of action, planning, and the solving of problems. Intelligence reflects a deeper capability of understanding the environment and making sense of what needs to be done (Funke, 2022). In fact, the etymology of the word intelligence highlights this very aspect: the Latin term “intelligentia” includes the verb “legere” (meaning: “to select, to choose”) and “intellegere” (meaning: to “understand, comprehend”) (Holm-Hadulla and Wendler, 2022). At its core, individual intelligence revolves around one’s ability to make sense of the world and circumstances and to actively select appropriate ways of dealing with challenges that require solutions.

Understanding individual intelligence has been very useful in understanding why some people thrive in our modern world, whereas other people struggle. In order to achieve a more complete understanding of this phenomenon, the concept of individual intelligence has been extended with multiple types of intelligence, beyond cognitive intelligence: e.g. emotional intelligence and social intelligence. One important impetus for some of these types of intelligences is the fact that much of human life occurs in social groups, not in isolation. In fact, in settings such as work teams — where team members work interdependently to achieve a common objective — individual intelligence is not always a strong predictor for important team outcomes. Teams are widely implemented in a variety of organizational settings because they can tap into a broad set of knowledge and capabilities to solve (complex) problems that are otherwise difficult to tackle by individuals (Glassop, 2002; Aguinis and Kraiger, 2009). However, this does not mean that a team is collectively highly intelligent. Although teams have at their disposal various bases of knowledge and member experience, the team is also highly dependent on the ability of its members to integrate these resources, combine individual knowledge into joint problem-solving solutions, and the joint ability to implement the solution in practice. Whereas much of the academic findings regarding collective intelligence are based on studies in laboratory settings (where groups are asked to solve, e.g., cognitive puzzles that can also be performed by individuals), real teams in organizations often need to find approaches to tackle complex, multi-faceted problems that do not have a single best answer. It requires both coordinated effort to come up with a feasible plan and to implement this plan over time. In essence, the ability for teams to act truly intelligently is embedded in the repertoire of possible between-member interaction patterns that a team has (or is able to develop over time). In essence, we argue that an important way to advance our understanding of collective intelligence is to focus on the behavioral side of teams.

To do this, we start this manuscript by reviewing two research streams that have largely shaped the collective intelligence literature. In one stream, CI is defined as the general ability of a group to perform a wide variety of cognitive tasks (Woolley et al., 2010; Engel et al., 2014; Kim et al., 2017; Mayo and Woolley, 2017), resulting in a c-factor. This c-factor is similar to defining and measuring individual intelligence in terms of the general intelligence cognitive testing (Spearman, 1904; Fletcher and Hattie, 2011). A second research stream focuses on synergy and proposes that CI arises when a team outperforms the aggregated capabilities of individual team members (Kurvers et al., 2015a,b). Teamwork is assumed to provide advantages compared to individuals working alone, resulting in process gains or "synergy" in teams (Larson, 2010; Hertel, 2011; Mojzisch and Schulz-Hardt, 2011; Volmer and Sonnentag, 2011). A consistent finding in both research streams is that teams vary considerably with respect to their collective intelligence levels. This indicates that there is potential for teams to achieve high levels of intelligence, nevertheless it is not yet fully clear why some teams behave more intelligent than others. A recent meta-analysis found that an important predictor of CI is the collaboration process between team members (Riedl et al., 2021), hinting at the vital relevance of interpersonal interaction for CI. It is exactly the between-member interaction processes that is the focus of our perspective in this paper.

In this paper, we start from the two established streams of CI and subsequently propose three main theoretical extensions. One extension relates to shifting the focus from outcomes ("teams that find the best solutions are the most collectively intelligent"), to a behavioral focus ("teams that solve problems in a mutually intelligent manner are collectively intelligent"). Next, we discuss giving 'time' a more central role in the CI conceptualization. Time plays a role both in the way the team interaction process unfolds and in how a team develops its collective intelligence. Finally, we suggest a stronger focus on the importance of the environment, because behavior can only be evaluated as intelligent if it matches (changing) environmental needs (Raab and Gigerenzer, 2005). Central in our argument is the idea of the team's interaction process. The established CI streams suggest that the way in which team members interact is important to the team's ability to be collectively intelligent, but they do not measure and operationalize the overall process explicitly. Rather, these studies focus on aggregated process measures as antecedents to predict (intelligent) team outcomes. To illustrate, a previous insight in the CI literature shows that equality of speaking time (aggregated over the full performance episode) predicts team performance (Woolley et al., 2010). However, such a summary index reduces the richness and complexity of the real life collaboration process, in which at some points in time, more equality speaking episodes take place, while at other times more centralized speaking episodes might be present. Therefore, we suggest in our process-oriented CI approach to disaggregate the intelligent process in relation to (changing) environmental demands and evaluate at each point in time how the team behaves as more or less intelligent.

Overall, this manuscript suggests a shift in focus when studying the complex phenomenon of CI by advocating a process-oriented perspective regarding actual team behavior relative to environmental demands. Given the above, we define CI in teams as an unfolding process of collective behaviors, originating in coordinated inter-individual behavioral acts, in alignment with the environment in which the team operates and focused on the achievement of joint objectives. We give theoretical primacy to collective behavior, which refers to any observable movements, interactions, and communications in which teams engage (Baumeister et al., 2007; Lehmann-Willenbrock and Allen, 2018). We argue that a team's intelligence is more than a fixed concept, reflected in a static performance score. Rather, we propose a more temporal approach in which team intelligence emerges through unfolding communication, while the team aligns its behavior with the requirements of the environment.

Below, we will briefly sketch the two research streams that the current CI field is based on and suggest three extensions to the field, focusing on how CI actually occurs and is shaped in real world organizational teams. From there, we identify several intriguing research directions that unlock the temporal aspect of process-oriented collective intelligence. We conclude this manuscript by presenting a variety of methodological considerations involved in this ambitious approach.

COLLECTIVE INTELLIGENCE: A BRIEF REVIEW OF TWO FOUNDATIONAL STREAMS

The current CI literature has largely been shaped by two streams of research: 'c-factor' and 'synergy'. Although there are more research approaches in the CI literature at large, these two streams of research have been selected because they (1) define collective intelligence at the team level (i.e., wisdom of the crowds is excluded from this review because of the higher level of analysis) and (2) explicitly define and measure CI (broader group process literature such as team learning and groupthink do not fit within the scope of our focused review). Below, we briefly establish the main approaches within these literature streams (c-factor and synergy). We do not aim to provide an all-encompassing overview of the literature in these streams; our objective is to establish their main tenets, to clarify how our suggestions build on and extend the status-quo in the field of CI.

Collective intelligence as the c-factor

The c-factor research stream emanates from a seminal paper by Woolley et al. (2010). Similar to the general intelligence factor ("g-factor") identified in individual intelligence testing (Spearman, 1904), this stream indicates the presence of a general ability factor for teams ("c-factor") collectively performing a wide range of cognitive tasks (e.g., Mao and Woolley, 2016; Mayo and Woolley, 2017). The c-factor emerges from correlations among how well teams perform on a variety of cognitive tasks (Woolley et al., 2010). Additionally, the c-factor has been argued to predict future collective team performance on more complex tasks, which cannot be explained by the average individual intelligence of the team members (Woolley et al., 2010, 2015). One of the main predictors of the c-factor is 'social perceptiveness' or 'social sensitivity' of team members (Engel et al., 2014, 2015; Meslec et al., 2016), defined as the ability of team members to reason about the mental states of others (Baron-Cohen et al., 2001).

Although empirical support for the c-factor was found across a variety of studies (Engel et al., 2014, 2015; Kim et al., 2017; for a more comprehensive overview see Table 2.1), the c-factor also faced some controversy. In contrast to the original findings, Barlow and Dennis (2016), found empirical support for two dominant factors instead of a single 'c-factor'. Further, Bates and Gupta (2017) could not replicate the original c-factor findings. Finally, Credé and Howardson (2017) showed statistical artifacts suggesting insufficient support for the existence of a c-factor construct after re-examining pooled data across six studies. Woolley et al. (2018) later countered the criticisms by pointing to misinterpretations in their scoring procedure and by pointing out that the assumptions underlying the simulation by Credé and Howardson (2017) did not match the majority of tasks that were actually performed.

Table 2.1.

Representative sample of the collective intelligence factor research stream

Prior Research	Definition collective intelligence	Research questions	Study number	Sample info	Number of teams	Employed treatment	Research design	Major findings
Woolley et al. (2010)	"the general ability of the group to perform a wide variety of tasks" p. 687	Does a collective intelligence exist for groups of people?	Study 1	General population United States	40	Face-to-face	Observational design using correlations	- Empirical support for existence c-factor - Individual intelligence score is not correlated with c-factor - C-factor predicts group performance better than average or maximum individual intelligence - Average social sensitivity predicts c-factor - Number of speaking turns is negatively correlated with the c-factor
			Study 2		152			
Engel et al. (2014)	"It is a measure of the general effectiveness of a group on a wide range of tasks" p. 3	Does c arise in online groups and which role plays social sensitivity?	Study 1	General population United States	32 36	Face-to-face Online	Observational design using correlations	- Empirical support for existence c-factor - Reading the mind in the eyes test predicts the c-factor in face-to-face and online conditions - Total amount of communication positively correlates with the c-factor

Table 2.1.
Continued

Prior Research	Definition collective intelligence	Research questions	Study number	Sample info	Number of teams	Employed treatment	Research design	Major findings
Engel et al. (2015)	"is a property of groups that emerges from the coordination and collaboration of members and predicts group performance on a wide range of task" p. 3769	Does c emerges across a variety of settings?	Study 1	General population United States	68	Face-to-face; text chat	Meta-analytic design using factor analytic approaches and correlations	- Empirical support for existence of the c-factor in different cultural settings, across communication media and group contexts - C-factor is correlated with performance on complex tasks
			Study 2	German student sample	25	Face-to-face; video; voice; text chat		
			Study 3	Japanese organizational context	116	Online		
Barlow and Dennis (2016)	"an ability of groups to perform consistently well across a variety of group-based task" p.685	Is c similar or different when groups work using computer mediated communication?	Study 1	Student sample in Midwestern university business school	86	Online	Correlational	- No empirical support for the existence of the c-factor in computer mediated context

Table 2.1.
Continued

Prior Research	Definition collective intelligence	Research questions	Study number	Sample info	Number of teams	Employed treatment	Research design	Major findings
Bates and Gupta (2017)	"strong general ability or group IQ factor" p. 46	What allows groups to behave intelligently?	Study 1	Student sample	26	Face-to-face	Correlational	- Empirical support for existence c-factor, but individual IQ accounted for the majority of group-IQ differences
			Study 2	General population India	40	Face-to-face	Correlational	
			Study 3	General population Scotland	40	Face-to-face	Correlational	
Kim et al. (2017)	"ability of the group to perform across a wide variety of tasks" p. 2	Does c translates into the world of teams in online video games?	Study 1	Gamers in North America	248	Online	Correlational	- The c-factor predicts a team's future performance in League of Legend game - Social perceptiveness is a significant positive predictor of the c-factor

A recent meta-analysis including 22 studies and 1,356 group found evidence for a c-factor (Riedl et al., 2021). The sample included various populations from university students to military personnel, online gamers and workers, showing the existence of c-factor across a variety of settings. The meta-analysis also showed that the strongest predictor of the c-factor is by far the group collaboration process (Riedl et al., 2021). The group collaboration process was operationalized as the group's ability to reach agreement between member's skills and contributions to a task and also the group's ability to coordinate their work in order to complete a task.

Collective Intelligence as synergy

The concepts 'team synergy' and 'collective intelligence' are often used interchangeably (Wolf et al., 2015; McHugh et al., 2016; Mann and Helbing, 2017). More specifically, scholars refer to teamwork which can provide advantages described as 'process gains' or 'synergy' in teams (Kurtzberg and Amabile, 2001; Hertel, 2011) (e.g., greater creativity and multiple perspectives) compared to people working alone. The idea behind team synergy is that teams can go beyond the performance level expected based on the (aggregated) capabilities of its individual members (Hertel, 2011). The synergy literature distinguishes between weak and strong synergy. Weak synergy refers to the ability of the team to perform better than the average of its team members (Larson, 2010; Hertel, 2011), while strong synergy refers to the ability of the team to perform better than its best performing individual (Larson, 2010; Carey and Laughlin, 2012). This stream of literature uses one particular research paradigm: comparing individual performance with team performance (Taylor et al., 1958; Sniezek, 1989; Volmer and Sonnentag, 2011; for a more comprehensive overview see Table 2.2). In essence, the main argument for CI in terms of synergy is that intelligence emerges when the team collectively outperforms the (best) performing team member(s).

Within the synergy stream there are two main approaches. In the first approach, scholars pool individual responses by combining independent judgements of individuals (e.g., Wolf et al., 2015; Kurvers et al., 2015a). For example, Bettencourt (2009) describes the importance of having sufficient independence amongst judges to prevent people from copying reactions of others, and ensure they provide independent judgements. Similarly, Wolf et al. (2015) describe the need for independent assessment of multiple radiologists in a final decision for detecting breast cancers within patients. This approach assumes that team members do not interact while collaborating and consequently construct their contributions independently. Accordingly, Steiner (1972) concludes that some team tasks require simple pooled individual aggregations and are additive in nature. However,

Table 2.2
Representative sample of the strong and weak synergy literature stream in teams

Prior Research	Research questions	Sample info	Number of teams	Treatment	Research design	Major findings
Carey and Laughlin (2012)	Are 3 person groups necessary and sufficient to perform better than the best individual on highly intellective tasks?	Students at University of Illinois	40	2 person team	Experimental study	The results suggest that groups of 3 members are necessary and sufficient to perform better than the best of an equivalent number of individuals on solving intellective problems. - Empirical evidence for strong synergy
			40	3 person team		
			40	4 person team		
			40	5 person team		
Volmer and Sonnentag (2011)	Do experts in task and team functions predict team performance over and above the team's average expertise level?	29 software development teams from 28 different organizations in Germany	29	/	Longitudinal, multi-source data	- Experts positively predicted team performance 12 months later over and above team's average expertise level - No evidence for synergetic effects
Sniezek, (1989)	What is the relationship among individual predictive judgement accuracy, confidence, influence and group judgment?		4	/	Longitudinal within subject design	- Group judgements are significantly more accurate than mean or median individual judgements - Empirical evidence for strong synergy
Taylor et al. (1958)	What is the effectiveness of group brainstorming?	Yale University undergraduate students	12	Individual vs Group condition	Controlled experimental study	- Interacting groups generated significantly fewer ideas than pooled individual ideas. - No evidence for synergetic effects in brainstorming tasks

2

individual behavior does not always simply combine to determine the behavior of the team (Goldstone and Gureckis, 2009). Interaction is a key feature differentiating a team from an aggregate of individuals: one person's behavior forms the basis for another's response (Driskell and Salas, 1992). Likewise, McGrath (1984) states that the central feature, the essence of a team, lies in the interaction of its members. This is exactly what the second approach within the synergy stream emphasizes: teams outperform the individual (and hence are collectively intelligent) because of what happens in the team's explicit communication (Larson, 2010). Previous research has focused on disentangling decision rules guiding the team's interaction, ultimately fostering the team's synergy. Decision rules are prescribed norms, guiding the interaction of team members and influencing how information is communicated and integrated (Meslec et al., 2014). For instance, the 'collaborative decision rule' encourages opinion sharing and equal participation of all group members during discussions (Curşeu et al., 2013). Another decision rule is the 'majority rule' reflecting a voting system in which the team adopts the decision made by the majority of members (Montes de Oca et al., 2011; Wolf et al., 2015). These examples demonstrate a first effort in disentangling how the team interacts to solve the tasks at hand in relation to its intelligence. Although most of the 'CI as synergy' literature states 'intelligence' lies in the quality of the outcome produced by the team (Baruah and Paulus, 2009; Hertel, 2011), some however emphasize that the decision rules themselves are intelligent (Wolf et al., 2015).

THE CURRENT STATUS QUO IN THE FIELD AND THE BEHAVIORAL APPROACH

From the two main research streams that have largely defined the CI literature to date, we draw a few conclusions regarding the current state of the field. Both streams agree that collective intelligence is real, is important, and requires systematic investigation. Although researchers may differ in their approaches, they uniformly argue that teams can be intelligent - and that some teams achieve this better than other teams. Both streams consider this variation as an indicator that collective intelligence exists beyond anecdotal evidence. Additionally, accumulating evidence shows that the quality of interactions displayed by team members is key in explaining collective intelligence. For example, amount of communication, equal participation to group discussions, and group collaboration process have been found to be associated with the c-factor (Woolley et al., 2010; Engel et al., 2014; Riedl et al., 2021). Similarly, in the synergy stream, alterations of group interactions (e.g., through decision rules and norms) were associated with changing levels of synergy (Montes de Oca et al., 2011; Wolf et al., 2015).

We build our suggestions for a more behavioral view of collective intelligence from these joint findings, namely that collective intelligence is real, and it resides in the interactions between the team members. We base our arguments on collective intelligence in organizational teams, but they apply more broadly. Teams in organizations are often tasked with assignments that go beyond the ability of individual team members (e.g., Kratzer et al., 2004; Yu, 2005; Mathieu et al., 2017), because the task requires more time or more diverse knowledge and expertise than any individual in the organization has. The consequence of this is that team tasks in organizations necessarily require collaboration between the team members. Distinct from students jointly finding a solution to a solvable game or puzzle in a lab session, real organizational teams are often tasked with complex, multi-faceted, ambiguous tasks where the implemented solution has real implications for those involved (e.g., effect on sales, effect on the speed of product development).

We therefore conceive of collectively intelligent teams as those teams where members jointly identify and make sense of problems/issues/tasks that require solving, mutually coordinate activities, and jointly are able to implement their chosen solution. This view has several research implications, resulting in three main extensions that are outlined below.

EXTENSIONS OF THE CI STREAM OF RESEARCH

Extension 1: From intelligence-as-outcomes to intelligence-as-behavior

The lion's share of the current CI literature defines and measures collective intelligence through the performance of a team; the central argument is that teams that consistently produce good outcomes, are collectively intelligent. Although we believe that higher collective intelligence will often lead to higher performance, we do not believe that outcomes reflect collective intelligence *per se*. Hence, we suggest that the field is better served by focusing on the interaction process that the team uses during their problem-solving activities, rather than mainly on the final outcomes.

A first argument focuses on the substantive nature of collective intelligence in teams. The essence of a team lies in the interactions between its members, and most real-life team tasks necessarily require the concerted efforts of team members with different backgrounds, expertise, and abilities. Thus, it becomes obvious that (much of) the collective intelligence of organizational teams is rooted in the ability of the team to organize, collaborate, and coordinate appropriately. Therefore, we argue that understanding exactly how teams differ in their internal organization (in terms of the patterns of interaction between the team members) will get researchers closer to the core of what really makes teams collectively intelligent. In sum, we argue for looking into what the team does at each point in time and evaluate its intelligence in terms of team behavior.

Another reason why moving away from outcomes advances CI research, is because performance scores tend to assume the existence of an 'optimal solution' or a 'right answer,' which does not capture the complexities of today's team functioning. Real world teams operate in unpredictable and uncertain conditions that change over time (Stagl et al., 2006; Ramos-Villagrasa et al., 2018; Hoogeboom and Wilderom, 2020). That is, the team's product or outcome may ultimately not be attained due to external or internal contingencies. A single 'best answer' occurs mostly in trivial, contrived settings, while the construct of CI has relevance in a broad number of organizational settings. Just as highly intelligent individuals do not always reach the "correct" solutions, we argue that team intelligence should be assessed by the way team members collaborate over time in their quest to find an appropriate (not necessarily best) solution, rather than by whether their solution is optimal. Apart from the question of whether optimal solutions are relevant in business settings (Simon and Barnard, 1947; Brown, 2004), we contend that collectively intelligent teams will have a higher probability than teams lacking collective intelligence to develop feasible and appropriate solutions to complex problems, and will be more likely to do so repeatedly over time.

A final argument in favor of this shift is methodological. We agree with authors who argue that constructs should be defined and understood independent of their effects (Antonakis et al., 2016; Alvesson, 2020). Studying the underlying nature of a phenomenon while measuring through the phenomenon's outcome has shortcomings. Mathematically, this approach bears the dangers of confusing a construct with its mediators, moderators, confounding variables, and spuriously correlating variables. This risk diminishes as the same patterns are found across an increasing set of studies. However, equating a concept with its consequence will still be of little help to understanding the antecedents and nuances of a concept.

Extension 2: From static to dynamic evaluations of intelligent collective behavior

Our second extension reflects a conceptual shift towards a focus on dynamic aspects of collective intelligence. By its very nature, CI takes time in order to develop and solidify and thus needs to be understood in a temporal manner (Ballard et al., 2008; Gorman et al., 2017). Team members need to make sense of the complex task at hand, share and discuss information and ideas and co-construct knowledge, develop alternative strategies to find appropriate solutions, coordinate and integrate to actually develop feasible solutions, weigh alternative solutions against each other, reach a shared decision on one (or more) strategy solutions, and, where applicable, implement the chosen solution(s). In sum, CI tends not to emerge in a single moment, but rather through a series of interactions unfolding over time (Allen and O'Neill, 2015) - possibly quite long stretches of time for organizational teams. Unfortunately, the vast majority of CI research builds on static glimpses of team performance that occur at a single point in time, assuming that various levels of intelligence are due to collective behaviors, without actually measuring them. Conclusions drawn from these investigations do not shed light on the dynamic, unfolding nature of the collective intelligent team process that may distinguish intelligent teams from less intelligent ones.

Our suggestion is in line with the multilevel theory of emergence, that encompasses a dynamic process of lower level units (team members) over time, coalescing to create a collective entity (intelligent behavior) at a higher level of analysis (Kozlowski and Klein, 2000; Waller et al., 2016; Carter et al., 2018). Emergence theory emphasizes the processes embedded in dynamic interactions amongst units (i.e., the interactions between the team members) and stresses that it takes time to develop an entity (i.e., intelligent behavior) at the higher collective level (Kozlowski et al., 2013). Hence, we argue that CI needs to be conceptualized as multilevel and dynamic, focusing on how intelligent team behavior emerges over time across levels of analysis.

Extension 3: Acknowledging the role of the environment

As explained in our overview of the CI literature, the c-factor approach is based on the idea of a single 'collective intelligence factor' across settings. The argument for this approach is that teams with a high c-factor are expected to perform well across a wide range of tasks, regardless of the task or conditions they will encounter in the future. Instead, we suggest that the CI literature should develop a focus on the relationship between teams and their environments. For instance, how CI unfolds in surgical teams differs substantially from how it unfolds in a sales unit team. In particular, the interpersonal behaviors that are required of a surgical team to solve medical tasks during routine surgery will largely be based on protocol, routine, and standardization. However, when a patient goes into unexpected cardiac arrest, or unexpectedly and prematurely wakes up from anesthesia, the team's interpersonal behaviors will require some level of improvisation, more speed, and impromptu problem-solving (Gorman et al., 2012). During unexpected crisis situations, flexible, non-standardized communicative patterns that reorganize routines is often an intelligent approach to break out of normal structures and improvise (Stachowski et al., 2009; Bechky and Okhuysen, 2011). Therefore, different conditions require different interaction processes for the team to intelligently solve the issues at hand. Collective intelligent behavior is contingent on its environment, as certain team behaviors may not be viable given a particular task or situation (Kämmer et al., 2014). Thus, collective behavior can only be judged as intelligent if we evaluate that behavior against a broader set of environmental needs in which the collaboration takes place.

Incorporating the environment in the conceptualization of a team's intelligence aligns with the theory of ecological rationality (Goldstein and Gigerenzer, 2002). Ecological rationality investigates which behaviors are better than others in a given setting; 'better – not best – because in large worlds optimal behaviors are unknown' (Gigerenzer and Gaissmaier, 2011, p. 456). Collective behavior is ecologically rational to the degree that it is adapted to the structure of the environment (Gigerenzer and Todd, 1999). Subsequently, specific team interactions are not good or bad per se, rather they are more or less appropriate to the environmental conditions in which that behavior takes place (Gigerenzer, 2004). No single behavior works at all times, just as a hammer does not work for all home repairs (Gigerenzer, 2015).

As we contend, intelligent teams engage in (adaptive) collective behaviors by matching their interaction patterns to fit the nature of the environment (Waller, 1999; Lei et al., 2016), or - where feasible - actively shape the environment to develop a match with the collective behavior (Ancona, 1990; Marks et al., 2005). We note that we conceptualize "environment" broadly and consider both internal and external environmental demands: the team needs to deal with 'challenges' of what happens either outside or inside the team boundary (Maloney et al., 2016; Johns, 2018). Teams must constantly update their repertoire of collective behaviors in relation to their environment.

External needs are located in the environment outside of the team's boundary, usually at a higher level of analysis (Mowday and Sutton, 1993; Maloney et al., 2016). Although teams usually have only limited control over external conditions, these are important given their role in guiding collective behavior. In concert with the framework of Mowday and Sutton (1993), we distinguish between proximal external needs that are situated closer to the team (e.g., organizational culture) and distal external needs (e.g., industry). An example of proximal external needs includes the strategy and core values of the organization. When the core values of the organization focus on creativity and innovation, collective behaviors in teams that enhance creative thinking (e.g., low centralization in interaction) would be an intelligent behavioral pattern to follow (Leenders et al., 2007a,b; Kratzer et al., 2008), whereas collaboration patterns aimed at maintaining routines and efficiency are less likely to stir team-level creativity and are a sign of a team that is behaving in a much less collectively intelligent manner within this organizational environment.

Internal needs are situated within the team boundary, originating from within the team itself (Maloney et al., 2016; Georganta et al., 2019). For example, a change in team composition regarding the loss of a team member requires the team to collectively respond (e.g., redistributing roles and workload) (Siegel Christian et al., 2014). Another example of an internal need is when a software development team faces a critical software failure during a development project. In this example the team must temporarily refocus on finding solutions to the error, before it can continue with the project execution. Collective intelligent behavior in this case is the team's ability to recognize the changing needs, to shift focus to the new/unexpected specific task and restructure its internal collaboration process in order to tackle the software error (for example by organizing a collectively divided search for causes of the error in the code).

The number and heterogeneity of components in the environment that teams must engage with and understand, in addition to managing (conflicting) relationships amongst these components, are the foundations of grounding teams' collective responses. Collective intelligent teams navigate this environmental complexity by actively and appropriately scanning their internal and external environment and consequently behaving collectively so their actions and interactions fit the variation in the environment (Wiersema and Bantel, 1993). In some cases, the interpersonal dynamics and member characteristics (internal demands) mainly drive the collective behavior, while in other cases the competitiveness of the industry is one of the main drivers for collective behavior (external demands). The challenge is to consider at which level(s) environmental demands are most likely to matter for the team collaboration. Environmental demands might change over time, yet collective intelligent teams are able to align their internal process with such changes.

The team environment not only shapes which collective behavior is more or less intelligent, but teams can often shape their environment as well. Although most studies consider environmental demands as requiring modified collective behavior from the team (e.g., Gersick, 1988; Waller, 1999; Lei et al., 2016), some studies consider how the team reaches out to its environment to potentially modify external and/or internal needs (Ancona, 1990; Marks et al., 2005). Teams can reduce uncertainty by negotiating malleable environmental conditions, for example proactively increasing resources by lobbying for additional human capital to manage the team's workload. We believe that collectively intelligent teams not only respond smartly to their (internal and external) environment, but also actively try to manage the environment to support the suitability of the team's internal processes.

A BEHAVIORAL PERSPECTIVE ON COLLECTIVE INTELLIGENCE

The objective of this paper is to outline a different approach to the understanding of collective intelligence in teams. Our approach shifts the focus from outcomes-as-CI to process-as-CI. Although teams that embody collectively intelligent interaction processes are more likely to consistently deliver high quality output, we argue that the collective intelligence of teams is reflected by the intelligence of their internal processes, not by their output. Just like the intelligence of an individual enables him/her to perform well at an IQ test, the person's (percentage of) correct answers given at the test is not that person's intelligence, they are only the consequence of it. We suggest adopting a similar approach to the study of team intelligence: the intelligence of the team is the ability to consistently act "smart" as a team, it is not the output, or number of correct answers given by a team in a test. Thus, the more appropriately team members interact with each other (i.e., who does what with whom and when), building interaction routines, making team processes sufficiently efficient while retaining the cognitive and procedural flexibility to adapt to changing environmental demands, the more we view this team as being collectively intelligent. This is why we define collective intelligence as an unfolding process of collective behaviors, originating in coordinated inter-individual behavioral acts, in alignment with the environment in which the team operates and focused on the achievement of joint objectives.

The question remains which of the interpersonal team members' behaviors sufficiently describe the elements of collective intelligent behavior in teams. We suggest that collective behaviors unfold mainly through team interaction, defined as any verbalization and nonverbal action intended for collective action and coordination (Zellmer-Bruhn et al., 2004). Communication is the primary mechanism for interaction, serving as a conduit through which information gets exchanged (Marks et al., 2000) and is of particular significance for the teams' intelligence because 'it is the vehicle through which the majority of collaboration is accomplished' (McComb and Kennedy, 2020, p.2). Building on the framework of McComb and Kennedy (2020), the communication processes can look at e.g., the content of the topics discussed (e.g., planning how to approach the task), the degree of participation (e.g., equality of speaking time), and the rhythm of communication (e.g., pace, speed).

The content of the interaction focuses on the 'what' of the conversation. The subject of what is being discussed is often important for determining whether the team engages in collective intelligent behavior. For example, interaction content can be oriented towards developing a common representation of the problem, generating possible solutions (DeChurch and Mesmer-Magnus, 2010), or structuring and organizing the discussion. These content behaviors can be more or less intelligent given their timing: developing a common representation of the problem at hand is generally more suitable or 'intelligent' at the beginning of a collaboration period than at the end. The degree of participation reflects the 'who' in terms of the actors involved. Conversations can be concentrated amongst only a few team members, or equally distributed among all team members (Warner et al., 2012). At the same time, teams can benefit from equality in participation during some periods of the execution of the team task, in combination with episodes of concentrated centralized 'speak-ups' during other periods (e.g., in multidisciplinary decision-making teams, when experts in the field need to speak up regarding particular topics). Lastly, between-member interaction can be characterized by its rhythm or pace and intensity. During crisis situations, high pace and intense burst of interaction can be highly intelligent (combining important pieces of information rapidly) while in stable situations, such as reflective meetings, a slower pace may be more appropriate. In sum, we expect that collective intelligent teams are aware of these three communication aspects and adjust them in such ways that the team members' processes correspond to the needs of the environment at that time.

At this point, it might be insightful to provide a practical example of how our suggestions extend and differ from the c-factor and synergy literature streams. We do so by putting forward a case of an actual organizational team we studied, showing how collective intelligence would be defined and operationalized in each research stream. Our example focuses on a multidisciplinary health care setting, in which a group of physicians come together on a weekly basis to discuss and decide on treatment plans for patients (see Table 2.3 for a comparison across research streams).

Table 2.3

Comparison of CI applications across c-factor, synergy as well as process-oriented view

	C-FACTOR	SYNERGY	PROCESS-ORIENTED CI
DEFINITION	CI is defined as the general ability of the team to perform well across a variety of cognitive tasks. In the context of multidisciplinary health care teams, the underlying premise is that if the team collectively scores high on a generic collective ability test, it is collectively intelligent and hence can ‘transfer’ it’s intelligence to other contexts as well.	CI is defined as whether the team outperforms the (best) individual team member. In the context of multidisciplinary health care teams, a team would be collectively intelligent if it jointly makes better decisions regarding treatment plans for patients compared to when one physician comes up with a treatment plan individually.	Intelligence is defined as an unfolding process of collective behaviors (content, rhythm, participation) that originate in individual level behavioral acts, that are appropriate for the tasks that are assigned to the team and in alignment with the environmental needs in which the team operates. In the context of multidisciplinary health care teams, the team would be intelligent if the content of the conversation, the way in which they discuss, as well as who participates is appropriate and effective to solve the task the team is working on and is also in line with changing environmental needs. One important change in the environment in multidisciplinary health care teams is that patient cases vary in terms of complexity. In low complexity patient case discussions, a more fast-paced, standardized process with fewer people contributing to the discussion is often considered as an intelligent way of organizing (by medical experts). However, in complex patient case discussions, a low pace, with input from varied medical experts, combined with actively questioning one another is generally considered as intelligent behavior. In sum, a relevant/salient changing environmental need (i.e., complexity/rareness of disease) requires different ways of organizing interactional structure and thus the team needs to be adaptive towards changing environmental needs. Collective intelligence is now considered high for medical teams that easily shift between discussion formats as they move from case to case, whereas less intelligent medical teams would be more stuck to a single way of discussing, regardless of the complexity of each specific case.

Table 2.3
Continued

	C-FACTOR	SYNERGY	PROCESS-ORIENTED CI
OPERATIONALIZATION	Collective intelligence is measured by giving teams various cognitive tasks (e.g., spatial reasoning, mathematical, linguistics tasks). Factor analytic approaches are used to identify one latent underlying ability factor reflecting the team's intelligence. The higher the performance across cognitive tasks, the higher the team's intelligence and hence the better the team is expected to come up with suitable treatment plans, now and in the future. One assumption is that the performance of the team can be measured correctly and objectively.	Each physician would be asked to come up with a treatment plan for patients individually. Subsequently, the team would be asked to collectively come up with a treatment plan, following group interaction. The health care team would be evaluated as intelligent if the team comes up with a 'better' or 'more suitable' treatment plan for the patient, compared to the physician making the best decision individually. One underlying assumption is that individuals can do the task, so a team is not necessary. Also, it is assumed that it is possible to objectively judge which treatment plan is "best."	In the process-oriented CI approach the researcher analyzes transcripts of who says/does what at what point in time during the medical team meeting and investigates how medical expertise is shared across patient cases. First, the evaluation must be made whether the content is aligned with the needs of the patient and whether sufficient information and relevant medical expertise is communicated within the team. Second, it is evaluated whether the experts speaking up are also the ones that would be expected to contribute given the background/complexity of the patient case. Lastly, the researcher would look at the rhythm or pace of the decision-making process; do team members follow logical sequences of decision making? Or is the conversation totally scattered? Is the conversational pace efficient and clear for members to follow? Each of these features must be evaluated in context to reflect on the intelligence of the behaviors that take place within the team. Having interpreted the appropriateness of the interaction process for each patient case, the researcher then assesses to what extent the team was able to adopt fitting discussion procedures over the course of the entire meeting (so across all patient cases/tasks that the team had to formulate a solution for). The better the team adjusted its discussion format to the requirements of the specific case, the more intelligent it was. Then, if it is possible to collect such data over multiple meetings, it can be assessed whether collective intelligent teams are indeed able to display the required procedural flexibility in later meetings as well.

2

Our proposed behavioral understanding of collective intelligence creates the opportunity for new research directions and methodological developments. Below, we will first present a series of research questions that can be addressed by prioritizing the team's interpersonal processes. After that, we discuss methodological challenges and opportunities that arise when taking this research perspective.

THE ROAD AHEAD: RESEARCH DIRECTIONS

Taking a behavioral approach to collective intelligence shifts the focus to research questions that may differ from those currently addressed in the CI literature. There is surprisingly little known about which micro-level interaction processes support which problem-solving tasks, so this research question is both important and still largely unexplored. In general, it makes sense to expect that the specific elements of the team's internal interaction processes will likely depend on the task at hand and on environmental demands. The main research question we address here is how the interpersonal team members' behaviors, that embody collective intelligence, vary across environmental conditions. Related to this we wonder which set of conditions might be coped with by similar sets of team behaviors whereas other conditions might require very different joint behaviors.

There are many conditions that can affect which interpersonal processes are appropriate in a specific situation. These include team composition: a highly diverse team in terms of expertise and experience may benefit from different interaction patterns than homogenous teams. Another condition is team size: larger groups will more naturally split apart into smaller subgroups, hence an attempt to constantly mutually discuss and coordinate is often less desirable in large teams than in small teams. Team longevity may play a role too since teams where members have worked together for a long time can more easily build efficient routines, but are also more at risk of "forgetting" to challenge each other and will have a harder time integrating newcomers into their interpersonal routines (Katz, 1982; Esser, 1998).

Another condition that may be highly important is the extent to which environmental conditions are stable or unstable. The more stable the environment, the more the team can develop efficient routines and procedures. This is a sign of collective intelligence, as it shows that the team understands that the environment is unlikely to change, providing the opportunity to optimize internal processes. Routinizing interactions also allows teams to easily deal with changes in team member composition: the clearer the norms and procedures around who does what with whom and when, the more clarity there will be for newcomers regarding what is expected of them. Alternatively, the more unstable the environment, the more such routines and fixed expectations hinder the team in adapting to new environmental requirements. In these conditions, collective intelligent teams aim to create interpersonal procedural flexibility, which requires different ways of interacting (Kratzer et al., 2010; Schönrok, 2010).

In order to understand interpersonal processes in teams, there is a need to focus on the flow of interactions between the team's members, considering (shifts in) e.g. pace, rhythm and order, rather than aggregating the actual process away by only considering averages and general summaries of a process that is dynamic at its core. The main research question here is which temporal aspects of team member interaction and which resolutions need to be considered in operationalizing collective intelligence. When teams need to solve tasks that require days, weeks, or longer to solve, there may be short term flows in the interaction (following a daily rhythm), but there will often also be an overarching dynamic over the course of the project. Intelligent teams will probably try to plan and schedule ahead and decide early on about the order and timing of various subtasks, while leaving enough slack in the schedule to account for unforeseen circumstances. In product development teams it is often the case that the team aims to be as creative as possible in the early stages (in order to generate as many feasible solutions as possible), and then, after one promising solution has been selected, aims to be as lean as possible in the later stages when the focus is on implementation. In other words, the intelligent way of organizing in the early stages revolves around stimulating effectiveness, whereas the later stages require interpersonal interaction aimed at efficiency. The collective intelligent interaction underlying these two rough phases are quite different and require shifts in their interaction process.

A second way in which time plays a role is in the questions how does CI develop over time and to what extent is CI stable. Teams learn which behaviors work best given a situation, based on prior collective experiences (Edmondson, 1999; Raes et al., 2015). Through this process of team learning, we posit that collective intelligent behavior may develop (non-linearly) over time. New teams may take some time for the members to get to know each other and to learn how to relate to one another vis-à-vis a specific joint task. It is likely that CI may then develop fairly quick, up to a point. From there, CI may plateau before it (gradually) increases. With changing environmental conditions, some teams may suffer a loss in CI and need to increase their interpersonal behavioral repertoire to cope with a wide range of conditions. This issue may be of particular interest to organizational practitioners wanting to understand how teams maintain their CI.

Methodological challenges

Although we believe that an increased focus on interpersonal team member behavior can advance understanding of collective intelligence in teams, it is not necessarily straightforward how to incorporate the full agenda in empirical research. Focusing on actual behavior rather than on outcomes, requires the collection and analysis of fine-grained data. This poses several challenges and opportunities for methodological innovations. Below, we will briefly touch upon three main areas: collection, coding, and analysis of data.

Data collection: Capturing high-resolution, longitudinal team interaction

In order to adequately map activity in team behaviors over the timeframe of a task, high sampling frequencies are needed (Klonek et al., 2016; Lehmann-Willenbrock and Allen, 2018). If we were to measure interaction only once or twice during the collaboration period, we would not be able to answer research questions such as how CI develops over time. Accordingly, studying CI in teams will benefit from unobtrusively capturing ongoing longitudinal interactions in real time - which translates to high-resolution datasets (Kozlowski, 2015; Klonek et al., 2016). Particularly, it is valuable to capture the trajectory of what has been said by one team member to one or more different team members at each point in time, to get a near continuous movie-like representation of the collaboration process (Leenders et al., 2016; Meijerink-Bosman et al., 2022a). Time-based sampling of interaction behaviors allows for in-depth analysis of what happens over time and when teams act more or less intelligently. We acknowledge that it requires effort to disentangle micro-level behavioral dynamics underlying the collaboration processes, especially in projects with longer time spans (e.g., months or even years). In this case, not only is infeasible to capture the full interaction details of what happens minute by minute, but it may also not be necessary. For teams whose tasks take long periods of time, measures of the interaction process may be gained by simpler means such as looking at minutes of team meetings to distill who met with whom, when, what was discussed and what was decided. Also, regular brief surveys or intermittent observations may be effective approaches. Other data collection tools that are frequently used to get a fitting image of the interaction dynamics inside the team include capturing electronic traces of team member interactions. Examples include email records (who sends a message to whom when), electronic badges (capturing co-location in rooms), company discussion boards (such as yammer), or message exchanges on project-specific software platforms.

Over time, as we perform more empirical studies on collective intelligence and develop a better overview of which aspects of team member interaction process are critical for collective intelligence, better data collection strategies can be designed and demarcated as well.

Data coding: Behavioral coding schemes

Once we have collected data capturing who does what, with whom, when (at the resolution that fits with the team and the task at hand), we still do not have a dataset that allows us to analyze collective intelligent behaviors. First, we need to identify the actual behaviors taking place during the collaboration trajectory, characterize them, and evaluate them against relevant environmental demands (Lehmann-Willenbrock and Allen, 2018). In short, the interactional data needs to be coded to be able to subsequently make sense of the behavior.

In the literature, a variety of theory-based, validated coding schemes for measuring the fine-grained team interaction exist, distinguishing between mutually exclusive and exhaustive behavioral categories. The work of Robert Bales has been particularly important for the development of useful behavioral coding approaches (Bales, 1950; Bales and Strodtbeck, 1951; Bales et al., 1951; see Brauner et al., 2018 for an overview of team interaction coding schemes). Behavioral coding means that researchers or trained coders assign codes to behavioral acts using a predefined coding scheme (Klonek et al., 2020), resulting in an overview of the entire flow of conversational events exchanged among group members. This facilitates comparison within and across teams. A variety of software programs to facilitate the transcribing and coding has become available, such as MAXQDA (Kuckartz and Rädiker, 2019) and ATLAS.ti (Paulus and Lester, 2016). More recently, researchers are working on developing innovative deep learning algorithms to automatically code behavior in videos, which is promising for coding large amounts of data on interpersonal behavior in teams (Gibson et al., 2022). Time-stamped and behavioral coded data allows researchers to investigate how different team behaviors are interrelated and dependent on environmental demands, which is exactly what is needed to unravel the nature of CI.

Analysis of interactional data

Having coded fine-grained longitudinal interactions, the focus in research projects can turn to the actual analysis of this data. Despite collecting high-resolution data, researchers too often aggregate fine-grained process data over time to form static summarized variables (Klonek et al., 2016). For instance, a previous insight in the CI literature shows that equality of speaking time (aggregated over the full performance episode) predicts team performance (Woolley et al., 2010). Such a summary index reduces the richness and complexity of the data to support ease of statistical analysis. However, this comes at the expense of precluding the researcher from truly capturing the effect of temporal dynamics (Klonek et al., 2016). Collapsed temporal data often oversimplifies reality, as the equality of speaking time is almost never constant over time. When variance across time is collapsed into a static summary indicator, this removes the potential to uncover temporal effects (Leenders et al., 2016).

Several researchers developed tutorials on how to analyze this complex type of interactional data (Dabbs and Ruback, 1987; Lehmann-Willenbrock and Allen, 2018; Nyein et al., 2020). Lag sequential analysis, pattern analysis, sequential synchronization analysis, and statistical discourse analysis have recently gained ground among team researchers and psychologists, in their efforts to achieve a good grip of the actual flow of interactions in organizational teams.

We briefly highlight a few other recent developments for the analysis of high-resolution time-stamped interaction data. First, we suggest relational event models as uniquely suitable as they have been developed to analyze time-stamped (or ordered, without the precise time-stamp) interaction patterns across members of a team (Quintane et al., 2014; Leenders et al., 2016; Pilny et al., 2016; Schecter et al., 2018; Mulder and Leenders, 2019; Meijerink-Bosman et al., 2022b). Relational event models are built on a simple idea: the rate at which two individuals interact at a specific point in time is determined by past team interactions. The statistical model itself is a simple event history model, but one that considers that observations are not independent of each other (because the intensity of the interactions may be affected by prior interaction). The result of this type of model is a set of variables that predict who interacts with whom, at what point in time (or in what order). These variables can then be taken as representative of the dynamic interaction patterns in the team. Subsequently, it can be assessed how appropriate these interaction behaviors are for the task and given the broader environment.

A machine-learning modeling approach known as THEME, which is quite different from the relational event model, was developed by Magnusson (1996, 2000). THEME detects specific patterns of event sequences (called "T-patterns") which has been used in the study of organizational teams (Ballard et al., 2008; Stachowski et al., 2009; Zijlstra et al., 2012). The THEME approach searches for so-called "hidden patterns" emerging from the data, and that occur more frequently than would be expected by chance encounters —typically, a few dozen such patterns will be found in an analysis.

Finally, once we understand the behaviors of team members and the fine-grained manner in which they co-construct knowledge and information, we can move towards the use of innovative simulation techniques such as agent-based modeling (ABM)

(Gómez-Cruz et al., 2017). Agent-based models are computational models in which agents as autonomous individuals behave in a given environment or space according to established rules (Bonabeau, 2002; van Veen et al., 2020). These models are simplified representations of reality defined by the researcher. To start with, the agents in the model are team members and can be defined with unique individual characteristics. Second, the agents interact with one another following specific predefined rules. Researchers can define the possibilities for each team member's behavior, based on insights gained from the transcripts and coding of prior team collaborations, or take the output of any of the previously mentioned statistical approach as input for the ABM. The environment for each team member in the model is a simulated multidimensional space that can represent any physical, economic, or psychological features (Secchi, 2015). Subsequently, team members in the simulated space can act in a variety of ways given their characteristics - again, these rules are typically informed by the results from the previous statistical analyses. These rules are set to 'program' the team members so that they behave accordingly, given specific conditions (Secchi, 2015). By keeping the behaviors the same but, simultaneously, varying conditions (such as team composition, changing tasks, or adding or removing team members) it can be assessed to what extent specific interaction behaviors that are intelligent in one condition are equally intelligent under different conditions.

CONCLUSION

Some teams are more collectively intelligent than others, but we are far from understanding the exact group processes or behaviors that might explain these differences. In this paper, we embrace a behavioral approach to CI that suggests to focus research on the dynamic interpersonal interactions between team members. This is where collective intelligence resides, hence we suggest that this is where we should focus our research attention on. These interactions can vary in terms of content (e.g., engaging in planning activities), participation (e.g., who is talking), and rhythmic characteristics (e.g., conversational pace). The behavioral repertoire employed by the team must be appropriate for environmental needs: either collective behaviors must be adapted such that they align with environmental needs, or the environment should be shaped such that the collective behaviors are better suited.

Besides presenting a plea to shift the focus of the field to a behavioral view, we also outlined that this approach opens up a series of new research questions and methodological challenges and opportunities. The collective intelligence field is closely connected to several other fields, such as organizational and group learning. In this vein, we strongly believe that taking this next step in the collective intelligence literature might also inspire adjacent fields to take a more behavioral approach.

REFERENCES

Abd El-Shafy, I., Delgado, J., Akerman, M., Bullaro, F., Christopherson, N. A., & Prince, J. M. (2018). Closed-loop communication improves task completion in pediatric trauma resuscitation. *Journal of Surgical Education*, *75*(1), 58–64.

Addas, S., & Pinsonneault, A. (2013). *IT Interruptions and Coordination Effectiveness in Software Development Groups: A Conceptual, Multilevel Model*. 6.

Addas, S., & Pinsonneault, A. (2018). E-mail interruptions and individual performance: Is there a silver lining? *MIS Quarterly*, *42*(2), 381–406. https://doi.org/10.25300/MISQ/2018/13157

Alexandersson, N., Rosell, L., Wihl, J., Ohlsson, B., Steen Carlsson, K., & Nilbert, M. (2018). Determinants of variable resource use for multidisciplinary team meetings in cancer care. *Acta Oncologica*, *57*(5), 675–680. https://doi.org/10.1080/0284186X.2017.1400682

Altmann, E. M., Trafton, J. G., & Hambrick, D. Z. (2014). Momentary interruptions can derail the train of thought. *Journal of Experimental Psychology: General*, *143*(1), 215–226. https://doi.org/10.1037/a0030986

Alvarez, G., & Coiera, E. (2006). Interdisciplinary communication: An uncharted source of medical error? *Journal of Critical Care*, *21*(3), 236–242.

Ancona, D. G., Goodman, P. S., Lawrence, B. S., & Tushman, M. L. (2001). Time: A new research lens. *Academy of Management Review*, *26*(4), 645–663.

Arber, A. (2008). Team Meetings in Specialist Palliative Care: Asking Questions as a Strategy Within Interprofessional Interaction. *Qualitative Health Research*, *18*(10), 1323–1335. https://doi.org/10.1177/1049732308322588

Arrow, H., McGrath, J. E., & Berdahl, J. L. (2000). *Small groups as complex systems: Formation, coordination, development, and adaptation*. Sage Publications.

Aubé, C., & Rousseau, V. (2016). Yes, we complain … so what? *Journal of Managerial Psychology*, *31*(7), 1137–1151. https://doi.org/10.1108/JMP-08-2015-0304

Ayoko, O. B., Konrad, A. M., & Boyle, M. V. (2012). Online work: Managing conflict and emotions for performance in virtual teams. *European Management Journal*, *30*(2), 156–174. https://doi.org/10.1016/j.emj.2011.10.001

Baethge, A., & Rigotti, T. (2013). Interruptions to workflow: Their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands. *Work & Stress*, *27*(1), 43–63. https://doi.org/10.1080/02678373.2013.761783

Baethge, A., Rigotti, T., & Roe, R. A. (2015). Just more of the same, or different? An integrative theoretical framework for the study of cumulative interruptions at work. *European Journal of Work and Organizational Psychology*, *24*(2), 308–323.

Bales, R. F. (1950). A set of categories for the analysis of small group interaction. *American Sociological Review*, *15*(2), 257–263.

Barsade, S. G. (2002). The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly*, *47*(4), 644–675.

Barsade, S. G., & Knight, A. P. (2015). Group affect. *Annual Review of Organizational Psychology and Organizational Behavior*, *2*(1), 21–46.

Barth, S., Schraagen, J. M., & Schmettow, M. (2015). Network measures for characterising team adaptation processes. *Ergonomics*, *58*(8), 1287–1302. https://doi.org/10.1080/00140139.2015.1009951

Begemann, V., Lübstorf, S., Meinecke, A. L., Steinicke, F., & Lehmann-Willenbrock, N. (2021). Capturing Workplace Gossip as Dynamic Conversational Events: First Insights From Care Team Meetings. *Frontiers in Psychology*, *12*. https://www.frontiersin.org/article/10.3389/fpsyg.2021.725720

Bennett, M. S., Erchul, W. P., Young, H. L., & Bartel, C. M. (2012). Exploring Relational Communication Patterns in Prereferral Intervention Teams. *Journal of Educational and Psychological Consultation*, *22*(3), 187–207. https://doi.org/10.1080/10474412.2012.706128

Bonito, J. A., & Keyton, J. (2018). Introduction to machine learning. *The Cambridge Handbook of Group Interaction Analysis*, 387–404.

Boos, M. (2018). CoCo: A category system for coding coherence in conversations. *The Cambridge Handbook of Group Interaction Analysis*, 502–509.

Bruine de Bruin, W., & Morgan, M. G. (2019). Reflections on an interdisciplinary collaboration to inform public understanding of climate change, mitigation, and impacts. *Proceedings of the National Academy of Sciences*, *116*(16), 7676–7683.

Burgoon, J. K., & Dunbar, N. E. (2018). *Coding nonverbal behavior.*

Carey, H. R., & Laughlin, P. R. (2012). Groups perform better than the best individuals on letters-to-numbers problems: Effects of induced strategies. *Group Processes & Intergroup Relations*, *15*(2), 231–242. https://doi.org/10.1177/1368430211419174

Cheshin, A., Rafaeli, A., & Bos, N. (2011). Anger and happiness in virtual teams: Emotional influences of text and behavior on others' affect in the absence of non-verbal cues. *Organizational Behavior and Human Decision Processes*, *116*(1), 2–16.

Cochran, A., & Elder, W. B. (2015). Effects of disruptive surgeon behavior in the operating room. *The American Journal of Surgery*, *209*(1), 65–70.

Cohen, M. D., & Bacdayan, P. (1994). Organizational routines are stored as procedural memory: Evidence from a laboratory study. *Organization Science*, *5*(4), 554–568.

Crawford, E. R., & Lepine, J. A. (2013). A configural theory of team processes: Accounting for the structure of taskwork and teamwork. *Academy of Management Review*, *38*(1), 32–48.

Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? *Academy of Management Annals*, *5*(1), 571–612.

David, L. Z., & Schraagen, J. M. (2018). Analysing communication dynamics at the transaction level: The case of Air France Flight 447. *Cognition, Technology & Work*, *20*(4), 637–649.

Davis, J., Burrows, J. F., Ben Khallouq, B., & Rosen, P. (2017). Predictors of patient satisfaction in pediatric oncology. *Journal of Pediatric Oncology Nursing*, *34*(6), 435–438. psyh. https://doi.org/10.1177/1043454217717239

Davis, W. A., Jones, S., Crowell-Kuhnberg, A. M., O'Keeffe, D., Boyle, K. M., Klainer, S. B., Smink, D. S., & Yule, S. (2017). Operative team communication during simulated emergencies: Too busy to respond? *Surgery*, *161*(5), 1348–1356. https://doi.org/10.1016/j.surg.2016.09.027

Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*, 19–43.

Devitt, B., Philip, J., & McLachlan, S.-A. (2010). Team dynamics, decision making, and attitudes toward multidisciplinary cancer meetings: Health professionals' perspectives. *Journal of Oncology Practice*, *6*(6), e17–e20.

Dew, K., Stubbe, M., Signal, L., Stairmand, J., Dennett, E., Koea, J., Simpson, A., Sarfati, D., Cunningham, C., & Batten, L. (2015). Cancer care decision making in multidisciplinary meetings. *Qualitative Health Research*, *25*(3), 397–407.

Dinh, J. V., Traylor, A. M., Kilcullen, M. P., Perez, J. A., Schweissing, E. J., Venkatesh, A., & Salas, E. (2020). Cross-Disciplinary Care: A Systematic Review on Teamwork Processes in Health Care. *Small Group Research*, *51*(1), 125–166. https://doi.org/10.1177/1046496419872002

Edney, L. C., Gray, J., & Karnon, J. (2020). A scoping review of the economics of multidisciplinary teams in oncology care. *Journal of Cancer Policy*, *26*, 100257. https://doi.org/10.1016/j.jcpo.2020.100257

Espevik, R., Johnsen, B. H., & Eid, J. (2011). Communication and Performance in Co-Located and Distributed Teams: An Issue of Shared Mental Models of Team Members? *Military Psychology*, *23*(6), 616–638. https://doi.org/10.1080/08995605.2011.616792

Feyerherm, A. E., & Rice, C. L. (2002). EMOTIONAL INTELLIGENCE AND TEAM PERFORMANCE: THE GOOD, THE BAD AND THE UGLY. *The International Journal of Organizational Analysis*, *10*(4), 343–362. https://doi.org/10.1108/eb028957

Fischer, U., McDonnell, L., & Orasanu, J. (2007). Linguistic correlates of team performance: Toward a tool for monitoring team functioning during space missions. *Aviation, Space, and Environmental Medicine*, *78*(5), B86–B95.

Fletcher, K. A., Potter, S. M., & Telford, B. N. (2018). Stress outcomes of four types of perceived interruptions. *Human Factors*, *60*(2), 222–235.

Forsyth, D. R. (2018). *Group dynamics*. Cengage Learning.

Fox, S., & Comeau-Vallée, M. (2020). The negotiation of sharing leadership in the context of professional hierarchy: Interactions on interprofessional teams. *Leadership*, *16*(5), 568–591. https://doi.org/10.1177/1742715020917817

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4), 331–362.

Galluch, P., Grover, V., & Thatcher, J. (2015). Interrupting the Workplace: Examining Stressors in an Information Technology Context. *Journal of the Association for Information Systems*, *16*(1). https://doi.org/10.17705/1jais.00387

Gerpott, F. H., Chiu, M. M., & Lehmann-Willenbrock, N. (2020). Multilevel antecedents of negativity in team meetings: The role of job attitudes and gender. *Managing Meetings in Organizations*.

Gersick, C. J., & Hackman, J. R. (1990). Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*, *47*(1), 65–97.

Gibbs, J. L., Sivunen, A., & Boyraz, M. (2017). Investigating the impacts of team type and design on virtual team processes. *Human Resource Management Review*, *27*(4), 590–603. https://doi.org/10.1016/j.hrmr.2016.12.006

Gillespie, B. M., Chaboyer, W., & Fairweather, N. (2012). Interruptions and Miscommunications in Surgery: An Observational Study. *AORN Journal*, *95*(5), 576–590. https://doi.org/10.1016/j.aorn.2012.02.012

Gorse, C. A., & Emmitt, S. (2007). Communication behaviour during management and design team meetings: A comparison of group interaction. *Construction Management and Economics*, *25*(11), 1197–1213. https://doi.org/10.1080/01446190701567413

Gundrosen, S., Andenæs, E., Aadahl, P., & Thomassen, G. (2016). Team talk and team activity in simulated medical emergencies: A discourse analytical approach. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *24*(1), 135. https://doi.org/10.1186/s13049-016-0325-1

Hackman, J. R. (1987). *The design of work teams. InHandbook of Organizational Behavior, ed. JW Lorsch*. Englewood Cliffs, NJ: Prentice-Hall.

Hareli, S., & Rafaeli, A. (2008). Emotion cycles: On the social influence of emotion in organizations. *Research in Organizational Behavior*, *28*, 35–59.

Härgestam, M., Lindkvist, M., Brulin, C., Jacobsson, M., & Hultin, M. (2013). Communication in interdisciplinary teams: Exploring closed-loop communication during in situ trauma team training. *BMJ Open*, *3*(10), e003525.

Higgins, L. E., & Smith, J. M. (2022). Documenting development of interdisciplinary collaboration among researchers by visualizing connections. *Research Evaluation*, *31*(1), 159–172.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin*, *121*(1), 43.

Hirokawa, R. Y., & Poole, M. S. (1996). *Communication and Group Decision Making*. SAGE Publications, Incorporated. http://ebookcentral.proquest.com/lib/uvtilburg-ebooks/detail.action?docID=996520

Hmieleski, K. M., & Cole, M. S. (2022). Laughing all the way to the bank: The joint roles of shared coping humor and entrepreneurial team-efficacy in new venture performance. *Entrepreneurship Theory and Practice*, *46*(6), 1782–1811.

Hohenstein, C., Fleischmann, T., Rupp, P., Hempel, D., Wilk, S., & Winning, J. (2016). German critical incident reporting system database of prehospital emergency medicine: Analysis of reported communication and medication errors between 2005-2015. *World Journal of Emergency Medicine*, *7*(2), 90. https://doi.org/10.5847/wjem.j.1920-8642.2016.02.002

Hoogeboom, M. A., & Wilderom, C. P. (2020). A complex adaptive systems approach to real-life team interaction patterns, task context, information sharing, and effectiveness. *Group & Organization Management*, *45*(1), 3–42.

Horlait, M., Baes, S., Dhaene, S., Van Belle, S., & Leys, M. (2019). How multidisciplinary are multidisciplinary team meetings in cancer care? An observational study in oncology departments in Flanders, Belgium. *Journal of Multidisciplinary Healthcare*, *12*, 159–167. https://doi.org/10.2147/JMDH.S196660

Humphrey, S. E., Hollenbeck, J. R., Meyer, C. J., & Ilgen, D. R. (2007). Trait configurations in self-managed teams: A conceptual examination of the use of seeding for maximizing and minimizing trait variance in teams. *Journal of Applied Psychology*, *92*(3), 885.

Hung, H., Murray, G., Varni, G., Lehmann-Willenbrock, N., Gerpott, F. H., & Oertel, C. (2020). Workshop on Interdisciplinary Insights into Group and Team Dynamics. *Proceedings of the 2020 International Conference on Multimodal Interaction*, 876–877.

Ibrahim, T., Flamini, E., Fabbri, L., Serra, P., Mercatali, L., Ricci, R., Sacanna, E., Falasconi, M. C., Casadei, R., & Galassi, R. (2009). Multidisciplinary approach to the treatment of bone metastases: Osteo-Oncology Center, a new organizational model. *Tumori Journal*, *95*(3), 291–297.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annu. Rev. Psychol.*, *56*, 517–543.

Jacobsson, M., Hargestam, M., Hultin, M., & Brulin, C. (2012). Flexible knowledge repertoires: Communication by leaders in trauma teams. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *20*(1), 44. https://doi.org/10.1186/1757-7241-20-44

Janssens, M., Meslec, N., & Leenders, R. (2022). Collective intelligence in teams: Contextualizing collective intelligent behavior over time. *Frontiers in Psychology*.

Jett, Q. R. (2003). Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life. *Academy of Management Review*, 14.

Johns, G. (2006). The essential impact of context on organizational behavior. *Academy of Management Review*, *31*(2), 386–408.

Jouanne, E., Charron, C., Chauvin, C., & Morel, G. (2017). Correlates of team effectiveness: An exploratory study of firefighter's operations during emergency situations. *Applied Ergonomics*, *61*, 69–77. https://doi.org/10.1016/j.apergo.2017.01.005

Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. *Small Group Research*, *43*(2), 130–158.

Kauffeld, S., & Meyers, R. A. (2009). Complaint and solution-oriented circles: Interaction patterns in work group discussions. *European Journal of Work and Organizational Psychology*, *18*(3), 267–294.

Ke, K. M., Blazeby, J. M., Strong, S., Carroll, F. E., Ness, A. R., & Hollingworth, W. (2013). Are multidisciplinary teams in secondary care cost-effective? A systematic review of the literature. *Cost Effectiveness and Resource Allocation*, *11*(1), 1–13.

Kesson, E. M., Allardice, G. M., George, W. D., Burns, H. J. G., & Morrison, D. S. (2012). Effects of multidisciplinary team working on breast cancer survival: Retrospective, comparative, interventional cohort study of 13 722 women. *BMJ*, *344*, e2718. https://doi.org/10.1136/bmj.e2718

Keyton, J. (2018). Interaction analysis: An introduction. *The Cambridge Handbook of Group Interaction Analysis*, *10*(9781316286302.002), 3–19.

Keyton, J., & Beck, S. J. (2009). The influential role of relational messages in group interaction. *Group Dynamics: Theory, Research, and Practice*, *13*(1), 14.

Klonek, F. E., Meinecke, A. L., Hay, G., & Parker, S. K. (2020). Capturing team dynamics in the wild: The communication analysis tool. *Small Group Research*, *51*(3), 303–341.

Klonek, F. E., Quera, V., Burba, M., & Kauffeld, S. (2016). Group interactions and time: Using sequential analysis to study group dynamics in project meetings. *Group Dynamics: Theory, Research, and Practice*, *20*(3), 209.

Koduru, A., Valiveti, H. B., & Budati, A. K. (2020). Feature extraction algorithms to improve the speech emotion recognition rate. *International Journal of Speech Technology*, *23*(1), 45–55.

Kolbe, M., Grote, G., Waller, M. J., Wacker, J., Grande, B., Burtscher, M. J., & Spahn, D. R. (2014). Monitoring and talking to the room: Autochthonous coordination patterns in team interaction and performance. *Journal of Applied Psychology*, *99*(6), 1254.

Kozlowski, S. W., & Chao, G. T. (2018). Unpacking team process dynamics and emergent phenomena: Challenges, conceptual advances, and innovative methods. *American Psychologist*, *73*(4), 576.

Kozlowski, S. W., & Klein, K. J. (2000). *A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes.*

Lee, A. H., Wang, K., Scott, J. A., Yau, K. K. W., & McLachlan, G. J. (2006). Multi-level zero-inflated Poisson regression modelling of correlated count data with excess zeros. *Statistical Methods in Medical Research*, *15*(1), 47–61. https://doi.org/10.1191/0962280206sm429oa

Leenders, R. T. A., Contractor, N. S., & DeChurch, L. A. (2016). Once upon a time: Understanding team processes as relational event networks. *Organizational Psychology Review*, *6*(1), 92–115.

Lehmann-Willenbrock, N., & Allen, J. A. (2014). How fun are your meetings? Investigating the relationship between humor patterns in team interactions and team performance. *Journal of Applied Psychology*, *99*(6), 1278–1287. https://doi.org/10.1037/a0038083

Lehmann-Willenbrock, N., & Allen, J. A. (2018a). Modeling temporal interaction dynamics in organizational settings. *Journal of Business and Psychology*, *33*(3), 325–344.

Lehmann-Willenbrock, N., & Allen, J. A. (2018b). Modeling Temporal Interaction Dynamics in Organizational Settings. *Journal of Business and Psychology*, *33*(3), 325–344. https://doi.org/10.1007/s10869-017-9506-9

Lehmann-Willenbrock, N., Allen, J. A., & Kauffeld, S. (2013). A sequential analysis of procedural meeting communication: How teams facilitate their meetings. *Journal of Applied Communication Research*, *41*(4), 365–388.

Lehmann-Willenbrock, N., Beck, S. J., & Kauffeld, S. (2016). Emergent team roles in organizational meetings: Identifying communication patterns via cluster analysis. *Communication Studies*, *67*(1), 37–57.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2013). *The upward spirals in team processes: Examining dynamic positivity in problem solving teams*.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2017). Understanding positivity within dynamic team interactions: A statistical discourse analysis. *Group & Organization Management*, *42*(1), 39–78.

Lei, Z., Waller, M. J., Hagen, J., & Kaplan, S. (2016). Team adaptiveness in dynamic contexts: Contextualizing the roles of interaction patterns and in-process planning. *Group & Organization Management*, *41*(4), 491–525.

Leroy, S., Schmidt, A. M., & Madjar, N. (2020). Interruptions and task transitions: Understanding their characteristics, processes, and consequences. *Academy of Management Annals*, *14*(2), 661–694.

Liu, F., & Maitlis, S. (2014). Emotional Dynamics and Strategizing Processes: A Study of Strategic Conversations in Top Team Meetings. *Journal of Management Studies*, *51*(2), 202–234. https://doi.org/10.1111/j.1467-6486.2012.01087.x

Luciano, M. M., DeChurch, L. A., & Mathieu, J. E. (2018). Multiteam systems: A structural framework and meso-theory of system functioning. *Journal of Management*, *44*(3), 1065–1096.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, *26*(3), 356–376.

Marlow, S. L., Lacerenza, C. N., Paoletti, J., Burke, C. S., & Salas, E. (2018). Does team communication represent a one-size-fits-all approach?: A meta-analysis of team communication and performance. *Organizational Behavior and Human Decision Processes*, *144*, 145–170. https://doi.org/10.1016/j.obhdp.2017.08.001

Mathieu, J. E., Gallagher, P. T., Domingo, M. A., & Klock, E. A. (2019). Embracing complexity: Reviewing the past decade of team effectiveness research. *Annual Review of Organizational Psychology and Organizational Behavior*, *6*, 17–46.

Mathieu, J. E., Hollenbeck, J. R., van Knippenberg, D., & Ilgen, D. R. (2017). A century of work teams in the Journal of Applied Psychology. *Journal of Applied Psychology*, *102*(3), 452.

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. (2002). *Multiteam systems.*

Maynard, M. T., Conroy, S., Lacerenza, C. N., & Barnes, L. Y. (2021). Teams in the wild are not extinct, but challenging to research: A guide for conducting impactful team field research with 10 recommendations and 10 best practices. *Organizational Psychology Review*, *11*(3), 274–318. https://doi.org/10.1177/2041386620986597

McComb, S., & Kennedy, D. (2020). *Computational methods to examine team communication*. Springer.

McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14). Prentice-Hall Englewood Cliffs, NJ.

Mehta, D., Siddiqui, M. F. H., & Javaid, A. Y. (2019). Recognition of emotion intensities using machine learning algorithms: A comparative study. *Sensors*, *19*(8), 1897.

Mitchell, A. J., Hussain, N., Grainger, L., & Symonds, P. (2011). Identification of patient-reported distress by clinical nurse specialists in routine oncology practice: A multicentre UK study. *Psycho-Oncology*, *20*(10), 1076–1083. psyh. https://doi.org/10.1002/pon.1815

Mohammed, S., & Dumville, B. C. (2001). Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *22*(2), 89–106.

Mohammed, S., Hamilton, K., & Lim, A. (2008). The incorporation of time in team research: Past, current, and future. *Team Effectiveness in Complex Organizations*, 355–382.

Moirano, R., Sánchez, M. A., & Štěpánek, L. (2020). Creative interdisciplinary collaboration: A systematic literature review. *Thinking Skills and Creativity*, *35*, 100626. https://doi.org/10.1016/j.tsc.2019.100626

Moreland, R. L. (2010). Are dyads really groups? *Small Group Research*, *41*(2), 251–267.

Mullan, B. J., Brown, J. S., Lowe, D., Rogers, S. N., & Shaw, R. J. (2014). Analysis of time taken to discuss new patients with head and neck cancer in multidisciplinary team meetings. *British Journal of Oral and Maxillofacial Surgery*, *52*(2), 128–133.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Murugappan, M., & Mutawa, A. (2021). Facial geometric feature extraction based emotional expression classification using machine learning algorithms. *Plos One*, *16*(2), e0247131.

Nancarrow, S. A., Booth, A., Ariss, S., Smith, T., Enderby, P., & Roots, A. (2013). Ten principles of good interdisciplinary team work. *Human Resources for Health*, *11*(1), 19. https://doi.org/10.1186/1478-4491-11-19

Nicholson, G., Pugliese, A., & Bezemer, P.-J. (2017). Habitual accountability routines in the boardroom: How boards balance control and collaboration. *Accounting, Auditing & Accountability Journal*, *30*(2), 222–246. https://doi.org/10.1108/AAAJ-07-2015-2143

Nyoni, C. N., Grobler, C., & Botma, Y. (2021). Towards Continuing Interprofessional Education: Interaction patterns of health professionals in a resource-limited setting. *PLOS ONE*, *16*(7), e0253491. https://doi.org/10.1371/journal.pone.0253491

Okhuysen, G. A., & Eisenhardt, K. M. (2002). Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility. *ORGANIZATION SCIENCE*, *13*(4), 18.

Oldeweme, M., Konradt, U., & Brede, M. (2021). The rhythm of teamwork: Discovering a complex temporal pattern of team processes. *Group Dynamics: Theory, Research, and Practice*. https://doi.org/10.1037/gdn0000175

Omilion-Hodges, L. M., Imes, R., & Hester, J. (2021). Editorial: Team and Leader Communication in the Healthcare Context: Building and Maintaining Optimal Transdisciplinary Teams. *Frontiers in Communication*, *6*. https://www.frontiersin.org/article/10.3389/fcomm.2021.669399

Parush, A., Kramer, C., Foster-Hunt, T., McMullan, A., & Momtahan, K. (2014). Exploring similarities and differences in teamwork across diverse healthcare contexts using communication analysis. *Cognition, Technology & Work*, *16*(1), 47–57. https://doi.org/10.1007/s10111-012-0242-7

Pavitt, C. (2014). An interactive input–process–output model of social influence in decision-making groups. *Small Group Research*, *45*(6), 704–730.

Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Research Synthesis Methods*, *5*(4), 371–385. https://doi.org/10.1002/jrsm.1123

Poole, M. S., & Baldwin, C. L. (1986). Developmental processes in group decision making. *Communication and Group Decision-Making*, 35–62.

Puranik, H., Koopman, J., & Vough, H. C. (2020). Pardon the Interruption: An Integrative Review and Future Research Agenda for Research on Work Interruptions. *Journal of Management*, *46*(6), 806–842. https://doi.org/10.1177/0149206319887428

Puranik, H., Koopman, J., & Vough, H. C. (2021). Excuse me, do you have a minute? An exploration of the dark-and bright-side effects of daily work interruptions for employee well-being. *Journal of Applied Psychology*.

Purvanova, R. K., & Kenda, R. (2021). The impact of virtuality on team effectiveness in organizational and non-organizational teams: A meta-analysis. *Applied Psychology*.

Raab, M., & Gigerenzer, G. (2005). Intelligence as smart heuristics. In *Cognition and intelligence: Identifying the mechanisms of the mind* (pp. 188–207). Oxford University Press.

Raes, E., Boon, A., Kyndt, E., & Dochy, F. (2015). Measuring team learning behaviours through observing verbal team interaction. *Journal of Workplace Learning*.

Ramos-Villagrasa, P. J., Marques-Quinteiro, P., Navarro, J., & Rico, R. (2018). Teams as complex adaptive systems: Reviewing 17 years of research. *Small Group Research*, *49*(2), 135–176.

Rezvani, A., Barrett, R., & Khosravi, P. (2018). Investigating the relationships among team emotional intelligence, trust, conflict and team performance. *Team Performance Management: An International Journal*, *25*(1/2), 120–137. https://doi.org/10.1108/TPM-03-2018-0019

Rivera-Rodriguez, A. J., & Karsh, B.-T. (2010). Interruptions and distractions in healthcare: Review and reappraisal. *BMJ Quality & Safety*, *19*(4), 304–312.

Rosell, L., Wihl, J., Hagberg, O., Ohlsson, B., & Nilbert, M. (2019). Function, information, and contributions: An evaluation of national multidisciplinary team meetings for rare cancers. *Rare Tumors*, *11*, 2036361319841696.

Ruhstaller, T., Roe, H., Thürlimann, B., & Nicoll, J. J. (2006). The multidisciplinary meeting: An indispensable aid to communication between different specialities. *European Journal of Cancer*, *42*(15), 2459–2462. https://doi.org/10.1016/j.ejca.2006.03.034

Saini, K. S., Taylor, C., Ramirez, A.-J., Palmieri, C., Gunnarsson, U., Schmoll, H.-J., Dolci, S. M., Ghenne, C., Metzger-Filho, O., & Skrzypski, M. (2012). Role of the multidisciplinary team in breast cancer management: Results from a large international survey involving 39 countries. *Annals of Oncology*, *23*(4), 853–859.

Santos, R., Bakero, L., Franco, P., Alves, C., Fragata, I., & Fragata, J. (2012). Characterization of non-technical skills in paediatric cardiac surgery: Communication patterns†. *European Journal of Cardio-Thoracic Surgery*, *41*(5), 1005–1012. https://doi.org/10.1093/ejcts/ezs068

Sauer, N. C., & Kauffeld, S. (2013). Meetings as Networks: Applying Social Network Analysis to Team Interaction. *Communication Methods and Measures*, *7*(1), 26–47. https://doi.org/10.1080/19312458.2012.760729

Schaink, A. K., Kuluski, K., Lyons, R. F., Fortin, M., Jadad, A. R., Upshur, R., & Wodchis, W. P. (2012). A scoping review and thematic classification of patient complexity: Offering a unifying framework. *Journal of Comorbidity*, *2*(1), 1–9.

Schecter, A., Pilny, A., Leung, A., Poole, M. S., & Contractor, N. (2018). Step by step: Capturing the dynamics of work team process through relational event sequences. *Journal of Organizational Behavior*, *39*(9), 1163–1181. https://doi.org/10.1002/job.2247

Schellenberger, B., Diekmann, A., Heuser, C., Gambashidze, N., Ernstmann, N., & Ansmann, L. (2021). Decision-Making in Multidisciplinary Tumor Boards in Breast Cancer Care – An Observational Study. *Journal of Multidisciplinary Healthcare*, *14*, 1275–1284. https://doi.org/10.2147/JMDH.S300061

Schippers, M. C., Edmondson, A. C., & West, M. A. (2014). Team reflexivity as an antidote to team information-processing failures. *Small Group Research*, *45*(6), 731–769.

Schmutz, J. B., Lei, Z., Eppich, W. J., & Manser, T. (2018). Reflection in the heat of the moment: The role of in-action team reflexivity in health care emergency teams. *Journal of Organizational Behavior*, *39*(6), 749–765. https://doi.org/10.1002/job.2299

Schmutz, J., Hoffmann, F., Heimberg, E., & Manser, T. (2015). Effective coordination in medical emergency teams: The moderating role of task type. *European Journal of Work and Organizational Psychology*, *24*(5), 761–776. https://doi.org/10.1080/1359432X.2015.1018184

Schraagen, J. M. (2011). Dealing with unforeseen complexity in the OR: The role of heedful interrelating in medical teams. *Theoretical Issues in Ergonomics Science*, *12*(3), 256–272. https://doi.org/10.1080/1464536X.2011.564481

Shen, W., Kiger, T. B., Davies, S. E., Rasch, R. L., Simon, K. M., & Ones, D. S. (2011). Samples in applied psychology: Over a decade of research in review. *Journal of Applied Psychology*, *96*(5), 1055.

Siassakos, D., Bristowe, K., Draycott, T. J., Angouri, J., Hambly, H., Winter, C., Crofts, J. F., Hunt, L. P., & Fox, R. (2011). Clinical efficiency in a simulated emergency and relationship to team behaviours: A multisite cross-sectional study. *BJOG*, *118*(5), 596–607. https://doi.org/10.1111/j.1471-0528.2010.02843.x

Siassakos, D., Draycott, T., Montague, I., & Harris, M. (2009). Content analysis of team communication in an obstetric emergency scenario. *Journal of Obstetrics and Gynaecology*, *29*(6), 499–503. https://doi.org/10.1080/01443610903039153

Sillars, A. L. (2018). *VTCS: Verbal Tactics Coding Scheme.*

Simon, H. A. (2013). *Administrative Behavior, 4th Edition*. Simon and Schuster.

Sniezek, J. A. (1989). An examination of group process in judgmental forecasting. *International Journal of Forecasting*, *5*(2), 171–178.

Soukup, T., Gandamihardja, T. A., McInerney, S., Green, J. S., & Sevdalis, N. (2019). Do multidisciplinary cancer care teams suffer decision-making fatigue: An observational, longitudinal team improvement study. *BMJ Open*, *9*(5), e027303.

Soukup, T., Lamb, B. W., Arora, S., Darzi, A., Sevdalis, N., & Green, J. S. (2018). Successful strategies in implementing a multidisciplinary team working in the care of patients with cancer: An overview and synthesis of the available literature. *Journal of Multidisciplinary Healthcare*, *11*, 49–61. https://doi.org/10.2147/JMDH.S117945

Soukup, T., Lamb, B. W., Morbi, A., Shah, N. J., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S., & Sevdalis, N. (2020). A multicentre cross-sectional observational study of cancer multidisciplinary teams: Analysis of team decision making. *Cancer Medicine*, *9*(19), 7083–7099. https://doi.org/10.1002/cam4.3366

Soukup, T., Lamb, B. W., Shah, N. J., Morbi, A., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S. A., & Sevdalis, N. (2020). Relationships Between Communication, Time Pressure, Workload, Task Complexity, Logistical Issues and Group Composition in Transdisciplinary Teams: A Prospective Observational Study Across 822 Cancer Cases. *Frontiers in Communication*, *5*, 101. https://doi.org/10.3389/fcomm.2020.583294

Soukup, T., Murtagh, G., Lamb, B. W., Green, J. S., & Sevdalis, N. (2021). Degrees of multidisciplinarity underpinning care planning for patients with cancer in weekly multidisciplinary team meetings: Conversation analysis. *Journal of Multidisciplinary Healthcare*, *14*, 411.

Soukup, T., Murtagh, G. M., Lamb, B. W., Bali, A., Gandamihardja, T., Darzi, A., Green, J. S. A., & Sevdalis, N. (2021). Gaps and Overlaps in Cancer Multidisciplinary Team Communication: Analysis of Speech. *Small Group Research*, *52*(2), 189–219. https://doi.org/10.1177/1046496420948498

Spates, S. A., Kingsley Westerman, C. Y., Laam, L. A., & Goke, R. (2020). Exploring Challenges of Hospital Chaplains in Transdisciplinary Teams. *Frontiers in Communication*, *5*. https://www.frontiersin.org/article/10.3389/fcomm.2020.582626

Stachowski, A. A., Kaplan, S. A., & Waller, M. J. (2009). The benefits of flexible team interaction during crises. *Journal of Applied Psychology*, *94*(6), 1536.

Sutcliffe, K. M., Lewton, E., & Rosenthal, M. M. (2004). Communication failures: An insidious contributor to medical mishaps. *Academic Medicine*, *79*(2), 186–194.

Taberna, M., Gil Moncayo, F., Jané-Salas, E., Antonio, M., Arribas, L., Vilajosana, E., Peralvez Torres, E., & Mesía, R. (2020). The multidisciplinary team (MDT) approach and quality of care. *Frontiers in Oncology*, *10*, 85.

Tamburini, N., Maniscalco, P., Mazzara, S., Maietti, E., Santini, A., Calia, N., Stefanelli, A., Frassoldati, A., Santi, I., & Rinaldi, R. (2018). Multidisciplinary management improves survival at 1 year after surgical treatment for non-small-cell lung cancer: A propensity score-matched study. *European Journal of Cardio-Thoracic Surgery*, *53*(6), 1199–1204.

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly*, 23–47.

Thenappan, A., Halaweish, I., Mody, R. J., Smith, E. A., Geiger, J. D., Ehrlich, P. F., Jasty Rao, R., Hutchinson, R., Yanik, G., & Rabah, R. M. (2017). Review at a multidisciplinary tumor board impacts critical management decisions of pediatric patients with cancer. *Pediatric Blood & Cancer*, *64*(2), 254–258.

Tiferes, J., & Bisantz, A. M. (2018). The impact of team characteristics and context on team communication: An integrative literature review. *Applied Ergonomics*, *68*, 146–159. https://doi.org/10.1016/j.apergo.2017.10.020

Tschan, F. (2002). Ideal cycles of communication (or cognitions) in triads, dyads, and individuals. *Small Group Research*, *33*(6), 615–643.

Tschan, F., Vetterli, M., Semmer, N. K., Hunziker, S., & Marsch, S. C. U. (2011). Activities during interruptions in cardiopulmonary resuscitation: A simulator study. *Resuscitation*, *82*(11), 1419–1423. https://doi.org/10.1016/j.resuscitation.2011.06.023

Uitdewilligen, S., Rico, R., & Waller, M. J. (2018). Fluid and stable: Dynamics of team action patterns and adaptive outcomes. *Journal of Organizational Behavior*, *39*(9), 1113–1128. https://doi.org/10.1002/job.2267

Uitdewilligen, S., & Waller, M. J. (2018a). Information sharing and decision-making in multidisciplinary crisis management teams. *Journal of Organizational Behavior*, *39*(6), 731–748. https://doi.org/10.1002/job.2301

Uitdewilligen, S., & Waller, M. J. (2018b). Information sharing and decision-making in multidisciplinary crisis management teams. *Journal of Organizational Behavior*, *39*(6), 731–748.

van den Oever, F., & Schraagen, J. M. (2021). Team Communication Patterns in Critical Situations. *Journal of Cognitive Engineering and Decision Making*, *15*(1), 28–51. https://doi.org/10.1177/1555343420986657

van der Haar, S., Koeslag-Kreunen, M., Euwe, E., & Segers, M. (2017). Team Leader Structuring for Team Effectiveness and Team Learning in Command-and-Control Teams. *Small Group Research*, *48*(2), 215–248. https://doi.org/10.1177/1046496417689897

van der Meer, S. A., Lehmann-Willenbrock, N., Delahaij, R., & Homan, A. C. (2022). The Influence of Intrusions on Team Interaction: An Explorative Field Study. *Small Group Research*, 10464964211073590.

Van Der Vegt, G. S., & Bunderson, J. S. (2005). Learning and performance in multidisciplinary teams: The importance of collective team identification. *Academy of Management Journal*, *48*(3), 532–547.

Van Knippenberg, D., De Dreu, C. K., & Homan, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology*, *89*(6), 1008.

van Oortmerssen, L. A., van Woerkum, C. M. J., & Aarts, N. (2015). When Interaction Flows: An Exploration of Collective Creative Processes on a Collaborative Governance Board. *Group & Organization Management*, *40*(4), 500–528. https://doi.org/10.1177/1059601114560586

van Swol, L. M., & Ahn, P. H. (2021). Inside the Black Box: Group Processes and the Role of Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 157–170). Emerald Publishing Limited.

Vollrath, D. A., Sheppard, B. H., Hinsz, V. B., & Davis, J. H. (1989). Memory performance by decision-making groups and individuals. *Organizational Behavior and Human Decision Processes*, *43*(3), 289–300.

Volmer, J., & Sonnentag, S. (2011). The role of star performers in software design teams. *Journal of Managerial Psychology*, *26*(3), 219–234. https://doi.org/10.1108/02683941111112659

Wallace, I., Barratt, H., Harvey, S., & Raine, R. (2019). The impact of Clinical Nurse Specialists on the decision making process in cancer multidisciplinary team meetings: A qualitative study. *European Journal of Oncology Nursing*, *43*. psyh. https://doi.org/10.1016/j.ejon.2019.101674

Waller, M. J., & Kaplan, S. A. (2018a). Systematic behavioral observation for emergent team phenomena: Key considerations for quantitative video-based approaches. *Organizational Research Methods*, *21*(2), 500–515. https://doi.org/10.1177/1094428116647785

Waller, M. J., & Kaplan, S. A. (2018b). Systematic Behavioral Observation for Emergent Team Phenomena: Key Considerations for Quantitative Video-Based Approaches. *Organizational Research Methods*, *21*(2), 500–515. https://doi.org/10.1177/1094428116647785

Waller, M. J., Uitdewilligen, S., Rico, R., & Thommes, M. S. (2021). Interaction Pattern and Trajectory Analysis for Studying Group Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 135–153). Emerald Publishing Limited.

Walraven, J. E., van der Hel, O. L., van der Hoeven, J. J. M., Lemmens, V. E., Verhoeven, R. H., & Desar, I. M. (2022). Factors influencing the quality and functioning of oncological multidisciplinary team meetings: Results of a systematic review. *BMC Health Services Research*, *22*(1), 1–27.

Walraven, J. E., van der Meulen, R., van der Hoeven, J. J., Lemmens, V. E., Verhoeven, R. H., Hesselink, G., & Desar, I. M. (2022). Preparing tomorrow's medical specialists for participating in oncological multidisciplinary team meetings: Perceived barriers, facilitators and training needs. *BMC Medical Education*, *22*(1), 502.

Walter, J. K., Schall, T. E., DeWitt, A. G., Faerber, J., Griffis, H., Galligan, M., Miller, V., Arnold, R. M., & Feudtner, C. (2019). Interprofessional team member communication patterns, teamwork, and collaboration in pre–family meeting huddles in a pediatric cardiac intensive care unit. *Journal of Pain and Symptom Management*, *58*(1), 11–18.

Wang, B., Liu, Y., & Parker, S. K. (2020). How does the use of information communication technology affect individuals? A work design perspective. *Academy of Management Annals*, *14*(2), 695–725.

Wang, D., Gao, Q., Tan, H., Liu, Z., Zhou, L., Jia, L., & Li, Z. (2020). Coordination breakdowns in nuclear power plant control rooms: Cause identification and behaviour-sequence analysis. *Ergonomics*, *63*(6), 660–681.

Weigl, M., Antoniadis, S., Chiapponi, C., Bruns, C., & Sevdalis, N. (2015). The impact of intra-operative interruptions on surgeons' perceived workload: An observational study in elective general and orthopedic surgery. *Surgical Endoscopy*, *29*(1), 145–153. https://doi.org/10.1007/s00464-014-3668-6

Weingart, L. R. (2012). Studying dynamics within groups. In *Looking back, moving forward: A review of group and team-based research* (Vol. 15, pp. 1–25). Emerald Group Publishing Limited.

Weiss, H. M., & Cropanzano, R. (1996). Affective events theory. *Research in Organizational Behavior*, *18*(1), 1–74.

Wiesche, M. (2021). Interruptions in Agile Software Development Teams. *Project Management Journal*, *52*(2), 210–222. https://doi.org/10.1177/8756972821991365

Wittenbaum, G. M., Hollingshead, A. B., Paulus, P. B., Hirokawa, R. Y., Ancona, D. G., Peterson, R. S., Jehn, K. A., & Yoon, K. (2004). The functional perspective as a lens for understanding groups. *Small Group Research*, *35*(1), 17–43.

Wittenberg-Lyles, E., Goldsmith, J., & Ferrell, B. (2013). Oncology nurse communication barriers to patient-centered care. *Clinical Journal of Oncology Nursing*, *17*(2), 152–158. psyh. https://doi.org/10.1188/13.CJON.152-158

Wright, F. C., De Vito, C., Langer, B., & Hunter, A. (2007). Multidisciplinary cancer conferences: A systematic review and development of practice standards. *European Journal of Cancer*, *43*(6), 1002–1010. https://doi.org/10.1016/j.ejca.2007.01.025

Xiao, Y., Hunter, W. A., Mackenzie, C. F., Jefferies, N. J., Horst, R. L., & Group, L. (1996). SPECIAL SECTION: Task Complexity in Emergency Medical Care and Its Implications for Team Coordination. *Human Factors*, *38*(4), 636–645. https://doi.org/10.1518/001872096778827206

Xie, L., Beyerlein, M., & Han, S. J. (2022). Revealing deep interaction patterns of team learning processes through video-based interactive analysis. *International Journal of Human Resources Development and Management*. https://www.inderscienceonline.com/doi/abs/10.1504/IJHRDM.2021.120307

Zajac, S., Woods, A., Tannenbaum, S., Salas, E., & Holladay, C. L. (2021). Overcoming challenges to teamwork in healthcare: A team effectiveness framework and evidence-based guidance. *Frontiers in Communication*, *6*, 606445.

Zellmer-Bruhn, M., Waller, M. J., & Ancona, D. (2004). THE EFFECT OF TEMPORAL ENTRAINMENT ON THE ABILITY OF TEAMS TO CHANGE THEIR ROUTINES. In S. Blount (Ed.), *Time in Groups* (Vol. 6, pp. 135–158). Emerald Group Publishing Limited. https://doi.org/10.1016/S1534-0856(03)06007-9

Zijlstra, F. R., Waller, M. J., & Phillips, S. I. (2012). Setting the tone: Early interaction patterns in swift-starting teams as a predictor of effectiveness. *European Journal of Work and Organizational Psychology*, *21*(5), 749–777.

Zoethout, H., Wesselink, R., Runhaar, P., & Mulder, M. (2017). Using transactivity to understand emergence of team learning. *Small Group Research*, *48*(2), 190–214.

CHAPTER 3

Communicative Patterns in Organizational Teams: a scoping review study

ABSTRACT

In order to advance understanding of team-level communicative processes in real-life organizations, we conducted a highly rigorous scoping review study summarizing how various aspects of communicative patterns manifest in organizational teams. Reviewing empirical work from 48 publications, we integrated unique insights on real-life team communication stemming from 1623 organizational teams. We develop a guiding framework for scientists and practitioners to capture the *content*, *structure,* and *temporality* aspects of communicative patterns in unity, allowing us to more comprehensively explain how communication-related team processes relate to important team and organizational-level outcomes. We conclude that a more thorough integration of various aspects of communicative patterns in relation to important contingencies offer great promise for advancing team science and practice.

Keywords: teams, communication, patterns, review, organizations

INTRODUCTION

An increasingly popular way of organizing in modern-day organizations are team-based designs, widely enacted across industries and countries (Bruine de Bruin & Morgan, 2019; Higgins & Smith, 2022; Moirano et al., 2020; Taberna et al., 2020). As individual workers rarely possess all necessary knowledge or skills to adequately solve multifaceted organizational tasks (Mitchell et al., 2011), organizations widely adopt teams to integrate complementary knowledge and perspectives (e.g., Van Der Vegt & Bunderson, 2005; Van Knippenberg et al., 2004). In short, teams have become the basic building blocks in organizations and with that, research literature on teams has expanded exponentially in the past decades (e.g., Mathieu et al., 2019).

In order to understand organizational team functioning, researchers follow the traditional Input-Process-Output (I-P-O) model as a generally accepted framework in the science of teams (Hackman, 1987; McGrath, 1984; Pavitt, 2014). Processes (P) in this model are activities that mediate the relationship between input factors (e.g., group composition, team members characteristics) and team outputs (e.g., performance, effectiveness)[1] and thus represent how team members collaborate while combining resources (e.g., knowledge, skills and abilities). A particularly important aspect of the team process is 'team communication' because it is the vehicle through which the majority of collaboration is accomplished (McComb & Kennedy, 2020).

To date, review studies on communicative processes in teams are characterized by two major drawbacks. First, review results are difficult to generalize to real-life organizational teams because of sample characteristics (56 percent of empirical work are either 'student' or 'ad hoc' team samples; Marlow et al., 2018; Tiferes & Bisantz, 2018). Scholars have long argued that results from non-organizational samples are not generalizable to naturally occurring organizational teams (Gibbs et al., 2017; Maynard et al., 2021; Purvanova & Kenda, 2021; Shen et al., 2011), resulting in conclusions that are 'less than optimal at best, flawed or irrelevant at worst' (Weingart, 2012, p.17). Second, review results including particular research designs (e.g., self-report, interviews) fail to reflect what transpires during team's conversations in real-time (Arrow et al., 2000; Weingart, 2012; Xie et al., 2022). As a result, several prominent scholars have urged

[1] An important note is that Marks et al. (2001) and Ilgen et al. (2005) have put forward that many of the mediational factors linking inputs and outcomes are not behavioral communicative processes, rather also include affective and cognitive elements. Thus, the term mediating mechanisms (M) has come to replace the original P, meaning that IPO models have been replaced by IMO models. However, as we focus in particular on the behavioral communicative processes, we follow the IPO terminology in this review.

the field to study team communication through observing real-time behavior (Cronin et al., 2011; Leenders et al., 2016; Waller & Kaplan, 2018b), which is not shown in current review studies to date.

In response, this research's central objective is to conduct a scoping review study that summarizes the current state of the literature on *communicative processes* in *organizational teams*. This review is novel because of its particularly high selective inclusion criteria that incorporates papers, uniquely focusing on 'objective' measures of the team communicative processes, including direct observations of communicative behavior. Notably, researchers found that while studying real-time communicative processes, teams produce patterns (often unconsciously), that are oftentimes invisible to the naked eye (e.g., Arrow et al., 2000; Oldeweme et al., 2021). Moreover, communicative patterns seem to manifest in various formats and while scholars continue to capture a variety of patterned behavior, it is currently more challenging to oversee this academic landscape. Thus, this review aims to answer which communicative patterns are investigated in organizational teams research and subsequently how these patterns are related to team and organizational-level outcomes. A key contribution of this review paper is the development of an overarching framework that summarizes three key aspects in studying communicative patterns. This framework will guide researchers and practitioners in capturing these patterns in a more comprehensive manner, thus advancing the team-level communicative process literature.

METHOD

As we aim to map the current body of literature regarding communicative patterns in organizational teams, we conducted a scoping review study (Munn et al., 2018; Pham et al., 2014). We first identified peer-reviewed journal articles that discuss communicative patterns in organizational teams. In the time period of November 2021 - January 2022, we conducted a literature search across several interdisciplinary academic databases, including psycINFO, EconLit and MEDLINE. Table 3.1 shows the Boolean operator keyword search, resulting in 8152 articles found for reviewal, after refining the search based on several inclusion and exclusion criteria.

Table 3.1
Search terms for scoping review: Boolean search

Search terms	OR	AND
Team	Multidisciplinary	Communication
Teamwork	Interdisciplinary	Interaction
Group	Interprofessional	Pattern
Meeting		Discussion
		Conversation

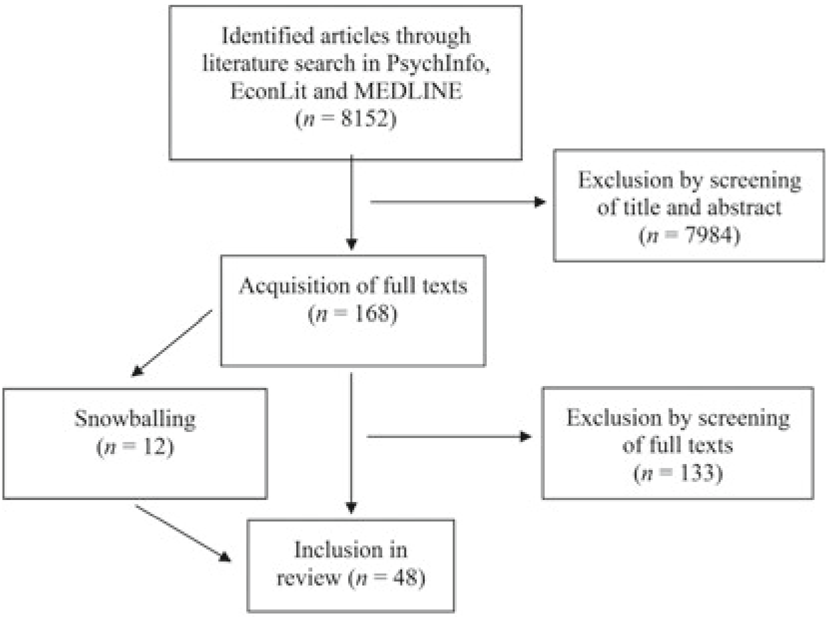
Table 3.2 summarizes these inclusion and exclusion criteria. First, empirical work had to be peer-reviewed and published in journals written in English published between 2007-2022. Second, the articles had to be empirical studying actual communicative patterns in a context aligned within an organization, in which a variety of disciplines (min 3) discuss a pre-defined goal. Although patterned communication suggests a quantitative approach (i.e., behaviors that co-occur above chance); a minority of the studies include qualitative methods for analyzing communicative patterns such as micro ethnographies (e.g. Liu & Maitlis, 2014) or interpretive approaches (e.g., van Oortmerssen et al., 2015). These papers were also integrated in this review, as these techniques microscopically analyze naturally occurring team communication and identify significant 'themes' out of verbal transcripts. Next, communication between two members does not resemble the team dynamics that are present in most organizational teams and therefore, studies around dyads were excluded (e.g., Lei et al., 2016; Zijlstra et al., 2012). As discussed in detail by Moreland (2010), dyads are qualitatively different than teams, as they represent simpler social structures and many team communication patterns are more complex compared to what dyads are able to show. In addition, empirical articles were only included if the sample consisted of organizational team settings, meaning student samples (e.g., Uitdewilligen et al., 2018) or ad hoc teams (e.g., Fischer et al., 2007) were excluded from this review.

Figure 3.1 shows that the multidisciplinary database search resulted in a selection of 35 primary studies. Snowballing techniques were used to include an additional 13 empirical articles, resulting in a total of 48 research papers.

Table 3.2
Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Time period	2007-2022	Studies outside these dates
Language	English	Non-English studies
Type of article	Original, empirical paper published in a peer-reviewed journal	Articles that were not peer reviewed or non-empirical
Study method	Observing/ analyzing actual communicative patterns	Cross-sectional designs, survey methods, interview studies
Sample	Multidisciplinary (min 3) organizational teams, adults	Student samples, ad hoc teams, dyads, childhood, adolescence, 65yrs & older
Study focus	Subject major heading search: incl e.g. work teams, group dynamics, interpersonal interaction	Subject major heading search excl group psychotherapy, major depression, age differences, drug therapy and other topics not related to communication patterns in organizational multidisciplinary teams

Figure 3.1
Flow diagram



RESULTS

Descriptives

Table 3.3 shows descriptive statistics regarding industry and research setting. Notably, the vast majority of communicative patterns were empirically investigated in *healthcare settings*, mostly in emergency surgery teams or decision-making boards. Next, the *automotive industry* as well as *public service and safety* industries were largely representing the organizational team samples. Other industries were less represented (e.g., aviation, ICT, construction, manufacturing).

Organizing framework for communicative patterns

Table 3.4 shows that the current investigation of communication patterns in organizational teams comprise three primary research foci: the *content* (i.e., meaning), *structure* (i.e., inter-member configurations), and the *temporality* (e.g., temporal sequencing, rhythm). Instead of focusing on multiple aspects, we find the current literature focusing on these elements separately in 67 percent[2] of all studies. As communicative patterns are defined as regular sets of communicative statements, repeated over time and, occurring more often than could be expected on a random basis (Hoogeboom & Wilderom, 2020; Stachowski et al., 2009; Zellmer-Bruhn et al., 2004), we posit that all communicative patterns inherently involve *content*, *structure* and *temporality*.

In this review, we first provide an overview of which communicative patterns manifest in organizational teams, classified into three categories*: content*, *structure*, and *temporality* and describe in each section how these patterns are related to team and organization-level outcomes. Furthermore, we summarize studies that incorporate more than one element, such as content and temporality, and highlight the advantages of investigating various aspects synergistically. Finally, we introduce the contingency layer and discuss how communicative patterns differ based on crucial contextual factors, such as task characteristics.

[2] 52% of all studies focus on one aspect of communicative pattern, however 15% focuses on two aspects, but treat them as distinct subjects in the research paper. The remaining 33% of articles investigate communicative patterns including various aspects

Table 3.3
Overview of the number of organizational teams embedded in various industries

Sector	Number of teams (% from total number of teams)	Authors
Healthcare		
Emergency/ surgery	442 (27.23%)	Abd El-Shafy et al., 2018; Barth et al., 2015; Davis et al., 2017; Gundrosen et al., 2016; Härgestam et al., 2013; Jacobsson et al., 2012; Kolbe et al., 2014; Santos et al., 2012; Schmutz et al., 2015; J. B. Schmutz et al., 2018; Schraagen, 2011; Siassakos et al., 2009, 2011; van den Oever & Schraagen, 2021; Walter et al., 2019; Parush et al., 2014)
Decision-making boards	403 (24.83%)	(Arber, 2008; Dew et al., 2015; Horlait et al., 2019; Schellenberger et al., 2021; Soukup, Lamb, Shah, et al., 2020; Soukup, Murtagh, Lamb, Bali, et al., 2021; Soukup, Murtagh, Lamb, Green, et al., 2021; Wallace et al., 2019; Wittenberg-Lyles et al., 2013)
Handoff team meetings	25 (1.54%)	(Parush et al., 2014)
Hospital wards	4 (0.25%)	(Nyoni et al., 2021)
Reflection meetings	8 (0.49%)	(Begemann et al., 2021)
Public service/safety		
Military, firefighter, navy	97 (5.98%)	(Espevik et al., 2011; Jouanne et al., 2017; Schecter et al., 2018)
Regular staff meetings	96 (5.91%)	(Hoogeboom & Wilderom, 2020)
Crisis management teams	29 (1.79%)	(Uitdewilligen & Waller, 2018a; van der Haar et al., 2017)
Nuclear power plant control rooms	26 (1.60%)	(Stachowski et al., 2009; D. Wang et al., 2020)
Automotive industry		
(Project) team meetings	185 (11.40%)	(Klonek et al., 2016; Lehmann-Willenbrock, Allen, et al., 2013; Lehmann-Willenbrock et al., 2017)

Table 3.3
Continued

Sector	Number of teams (% from total number of teams)	Authors
Mix team meetings automotive, electrical, chemical, metal and packaging industry	177 (10.91%)	(Kauffeld & Lehmann-Willenbrock, 2012; Kauffeld & Meyers, 2009; Sauer & Kauffeld, 2013)
Manufacturing		
Team meetings	54 (3.33%)	(Lehmann-Willenbrock & Allen, 2014)
Construction		
Live project meetings	36 (2.22%)	(Gorse & Emmitt, 2007)
Education		
Teacher teams	3 (0.18%)	(Zoethout et al., 2017)
Prereferral intervention teams	7 (0.43%)	(Bennett et al., 2012)
Aviation		
Airplane flight crews	2 (0.12%)	(David & Schraagen, 2018; van den Oever & Schraagen, 2021)
Accountancy		
Board meetings	2 (0.12%)	(Nicholson et al., 2017)
Gaming industry		
Top management teams	7 (0.43%)	(Liu & Maitlis, 2014)
ICT		
Board meetings	12 (0.74%)	*(van Oortmerssen et al., 2015)*
	Total: 1623	

3

Table 3.4
Organizing framework including three aspects of communicative patterns

Defining various *aspects* of communicative patterns	**Level of Analysis**	**Grouping of findings**	**Authors**
Content in communicative patterns			
'what is actually said' the ideas, opinions, meaning of information that we transmit through communicative statements	Communicative statement level	Procedural communication	*Kauffeld & Lehmann-Willenbrock, 2012; Lehmann-Willenbrock et al., 2013; Parush et al., 2014; Schmutz et al., 2015; Uitdewilligen & Waller, 2018; van der Haar et al., 2017; Wang et al., 2020)*
		Socio-emotional communication	*Begemann et al., 2021; Gorse & Emmitt, 2007; Jouanne et al., 2017; Kauffeld & Lehmann-Willenbrock, 2012; Klonek et al., 2016; Lehmann-Willenbrock et al., 2016, 2017; Lehmann-Willenbrock & Allen, 2014; Liu & Maitlis, 2014; Soukup, Lamb, Shah, et al., 2020)*
		Power, leadership and hierarchy	*Arber, 2008; Dew et al., 2015; Fox & Comeau-Vallée, 2020; Nyoni et al., 2021; Schellenberger et al., 2021; Wallace et al., 2019; Wittenberg-Lyles et al., 2013)*
		Reflexivity or monitoring	(Espevik et al., 2011; Kolbe et al., 2014; J. B. Schmutz et al., 2018; D. Wang et al., 2020).
	Team phase level	Activity or decision-making phase	*Dew et al., 2015; Gundrosen et al., 2016; Schellenberger et al., 2021; Soukup, Murtagh, Lamb, Green, et al., 2021*

Table 3.4
Continued

Defining various *aspects* of communicative patterns	**Level of Analysis**	**Grouping of findings**	**Authors**
Structure in communicative patterns			
'Relational aspects or features of social interaction that determines the flow of communication' Defines subgroup configurations of information flow between or amongst team members	Dyad-level pattern	Closed-loop communication, reciprocity	*(Abd El-Shafy et al., 2018; Barth et al., 2015; W. A. Davis et al., 2017; Härgestam et al., 2013; Jacobsson et al., 2012; Jouanne et al., 2017; Santos et al., 2012; Schecter et al., 2018; J. Schmutz et al., 2015; Schraagen, 2011; Siassakos et al., 2009, 2011; van den Oever & Schraagen, 2021)*
	Triad-level pattern	Handing off communication	*David & Schraagen, 2018; Schecter et al., 2018; van den Oever & Schraagen, 2021)*
	Team-level pattern	Length, complexity, centrality	Barth et al., 2015; Bennett et al., 2012; Hoogeboom & Wilderom, 2020; Horlait et al., 2019; Sauer & Kauffeld, 2013; Stachowski et al., 2009; Walter et al., 2019)
Temporality in communicative patterns			
'Temporal aspects of the pattern', meaning the timing, pace, rhythm or conversational rate of the communicative statements/patterns	Temporal ordering of communicative statements	Sequences	*Begemann et al., 2021; Kolbe et al., 2014; Lehmann-Willenbrock et al., 2017; Lehmann-Willenbrock & Allen, 2014)*
	Temporality as communicative rhythm	Bursts of conversational rate	*Barth et al., 2015; Gundrosen et al., 2016; Hoogeboom & Wilderom, 2020; Kolbe et al., 2014; Nicholson et al., 2017; Soukup, Murtagh, Lamb, Bali, et al., 2021; van Oortmerssen et al., 2015)*

Content in communicative patterns

The examination of communicative patterns involves the analysis of verbal exchanges among team members, which allows researchers to identify the *meaning* embedded in the messages conveyed during team discussions. Among the studies reviewed, 33 (69 percent) prioritized content aspects as a central phenomenon of interest. Scholars have examined communication content patterns at various levels of granularity, with the majority focusing on micro-level combinations of members communicative statements (i.e., communicative statement level). A smaller set of studies addressed larger segments of communication, such as the initial problem orientation phase in the decision-making process (i.e., team-level phases). Table 3.5 provides transcript examples regarding the meaning behind content embedded in communicative patterns. It is important to note that, depending on the theory underlying a coding scheme, similar content communicative statements may result in different labels.

Table 3.5
Example transcript of content communicative patterns

Content pattern	Team member	Example content/transcript
Procedural communication	Person A:	'I believe the police representative should give us first a risk assessment regarding the safety of entering the building'
	Person B:	'Ok, but next I want information regarding the exact location of the medical care unit'
Socio-emotional communication	Person A:	'It really nice of you, Sam, to have prepared the slides in advance, I am very happy to have you in our team'
	Person B:	'Thank you so much, I am also very grateful to be part of this group'
Authority	Person A:	'I have seen a patient recently with a similar condition and I believe **we** should hospitalize the patient, just to be sure'
	Person B:	'But do you think **we** sufficiently take into account the wishes of the patient, I believe he shared he did not wish any treatment?*' (= strategic question implying disagreement)*
Monitoring	Person A:	"I am checking whether you are using the appropriate size of the tube for that patients stomach"
	Person B:	"Let me assist you, first let's intubate the patient, then administer X before we then continue with Y,"

Communicative statement level

Procedural communication. A majority of studies focused on the content of communicative patterns aimed at organization of the teams discourse (Kauffeld & Lehmann-Willenbrock, 2012; Lehmann-Willenbrock et al., 2013; Parush et al., 2014; Schmutz et al., 2015; Uitdewilligen & Waller, 2018; van der Haar et al., 2017; Wang et al., 2020). For instance, team members communicate about agenda-setting, planning, or task distributions which subsequently facilitate goal accomplishment. In regular organizational team meetings, procedural communication helped to inhibit dysfunctional meetings behaviors, promoted proactive communication and is associated with team satisfaction and organizational success (Kauffeld & Lehmann-Willenbrock, 2012; Lehmann-Willenbrock, Allen, et al., 2013). Also in crisis management teams, procedural communication is associated with team performance and team effectiveness (Uitdewilligen & Waller, 2018a; van der Haar et al., 2017; Wang et al., 2020). Table 3.5 shows a short example of *procedural communication* in crisis management teams managing a fire outbreak.

Socio-emotional communication. An emerging line of research has specifically focused on positive or negative socio-emotional team communication[3] (Begemann et al., 2021; Gorse & Emmitt, 2007; Jouanne et al., 2017; Kauffeld & Lehmann-Willenbrock, 2012; Klonek et al., 2016; Lehmann-Willenbrock et al., 2016, 2017; Lehmann-Willenbrock & Allen, 2014; Liu & Maitlis, 2014; Soukup, Lamb, Shah, et al., 2020). Generally speaking, the more positive socio-emotional interactions, the quicker the team solved the task (Soukup, Lamb, Shah, et al., 2020), the more dysfunctional communication is inhibited (Klonek et al., 2016), the more collaborative strategizing occurred (Liu & Maitlis, 2014), the higher the managerial ratings of team performance (Lehmann-Willenbrock et al., 2017; Lehmann-Willenbrock & Allen, 2014) and the higher the team effectiveness (Jouanne et al., 2017). Correspondingly, negativity in teams conversations decreased team effectiveness (Jouanne et al., 2017), drove the team further apart and resulted in unreconciled strategizing (Liu & Maitlis, 2014), is associated with lower

[3] Positivity patterns are shown for example in terms of encouragement or support that improves the teams morale (Jouanne et al., 2017), showing solidarity, cooperation (Soukup, Lamb, Shah, et al., 2020), showing optimism and confidence (Lehmann-Willenbrock et al., 2017), energetic exchange, amused encounters (Liu & Maitlis, 2014) or behavior that tends to reduce tension such as laughter or jokes (Jouanne et al., 2017; Soukup, Lamb, Shah, et al., 2020). Negativity patterns are shown in teamwork for example in terms of swearing, expressions of antagonism (Jouanne et al., 2017), tension or passive rejection (Soukup, Lamb, Shah, et al., 2020), criticizing, disinterest (Kauffeld & Lehmann-Willenbrock, 2012), unempathetic interaction (Liu & Maitlis, 2014), gossip (Begemann et al., 2021) or complaining behavior (Lehmann-Willenbrock et al., 2016).

decision-making quality (Soukup, Lamb, Shah, et al., 2020) and reduced idea-longevity (Lehmann-Willenbrock et al., 2016). Table 3.5 shows a short sequence of socio-emotional communication content in project management teams.

Power, leadership and hierarchy. Several researchers have found that power, authority, or hierarchy gets negotiated or expressed through content communicative statements in the teams interaction, particularly in multidisciplinary healthcare teams (Dew et al., 2015; Fox & Comeau-Vallée, 2020; Nyoni et al., 2021; Schellenberger et al., 2021; Wittenberg-Lyles et al., 2013). More specifically, team members used various content strategies (possessive pronouns, authority from experience, strategic questions) in their communicative patterns to persuade others in their opinion/decision (Arber, 2008; Dew et al., 2015; Schellenberger et al., 2021; Wallace et al., 2019). Table 3.5 shows a short transcript of how power can be displayed in multidisciplinary healthcare teams.

Reflexivity or monitoring. Whereas one study explicitly focused on reflexivity capturing the team's conscious reflection on their objectives, strategies and processes (Schmutz et al., 2018), other studies focused on monitoring patterns in which the team identified mistakes and provided feedback (Espevik et al., 2011; Kolbe et al., 2014; Wang et al., 2020). Team reflexivity or monitoring behaviors were generally associated with higher team performance (Espevik et al., 2011; Kolbe et al., 2014; Schmutz et al., 2018; Wang et al., 2020). Table 3.5 shows an example of monitoring content in anesthesia teams.

Team-level phases

Activity or decision-making phases. Instead of focusing on communicative statements at the speaker level, researchers cluster communicative statements around overarching team activities (Gundrosen et al., 2016) or broader decision-making phases (Dew et al., 2015; Parush et al., 2014; Schellenberger et al., 2021; Soukup, Murtagh, Lamb, Green, et al., 2021; Uitdewilligen & Waller, 2018a). To illustrate, in multidisciplinary decision-making boards, medical specialists collectively decide on treatment plans for patients and move through the following decision-making phases: (1) the orientation phase (i.e., core problems/background information is presented), (2) discussion phase (i.e., all experts share expertise), and (3) decision-making phase (i.e., agreement towards treatment plan).

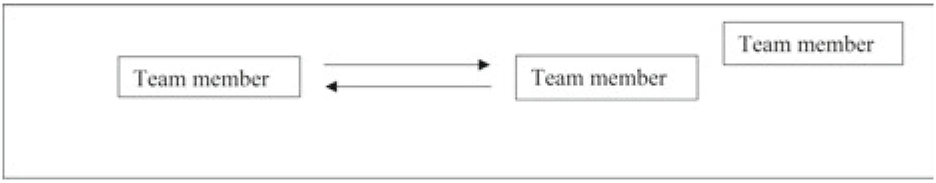
Structure in communicative patterns

While structural characteristics of communicative patterns mostly disregard the actual content information of communicative statements, they capture relational aspects of social interactions amongst team members and describe their compositional features.

These structural characteristics were one of the main phenomena of interest in 21 papers (44 percent) embedded in this review.

Structural dyad-level patterns. The communicative structure of dyad relationships was the most common approach to examine structural patterns in subgroups in the team's collaboration. The most often investigated dyad structure was closed-loop communication (CLC) involving a reciprocal loop of dyadic interaction (for a visual representation see Figure 3.2). While some papers focused on short loops: e.g., team member A directing the message to team member B and subsequently team member B that reciprocates member A (Barth et al., 2015; Schmutz et al., 2015; Schraagen, 2011; van den Oever & Schraagen, 2021), other papers stated the dyadic loop is only completed when team member A confirms the reciprocity from B (Abd El-Shafy et al., 2018; Davis et al., 2017; Härgestam et al., 2013; Santos et al., 2012). Although open loops[4] of structural patterns were more frequently observed in organizational teams compared to CLC patterns (Härgestam et al., 2013; Santos et al., 2012; van den Oever & Schraagen, 2021), CLC was generally associated with higher performance (Schmutz et al., 2015), and task efficiency across various medical emergency settings (Abd El-Shafy et al., 2018; Siassakos et al., 2011).

Figure 3.2
Structural dyad-level communicative pattern. The arrows present the sending of (directed) communicative statements between two members in a team composing of three members.

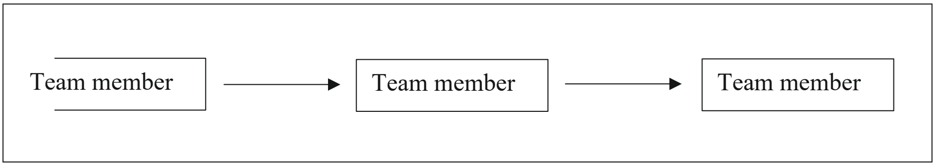


Structural triad-level patterns. A rather small set of studies investigated particular triadic structural relationships (David & Schraagen, 2018; Schecter et al., 2018; van den Oever & Schraagen, 2021). To illustrate, these studies found evidence for triadic

[4] Open loops are observed when the message is not received, interpreted or acknowledged by the intended receiver (Jouanne et al., 2017). CLC is widely used and part of evidence-based communication trainings (especially in emergency situations) because it reduces information loss, ambiguous situations or misunderstandings (Davis et al., 2017; Jacobsson et al., 2012; Jouanne et al., 2017). While prior studies describe CLC as the 'holy grail' of effective communicating, one paper put forward the idea that communication should be 'flexible' and cannot be simply described as rigid transmission models in line with closed-loop communication (Jacobsson et al., 2012).

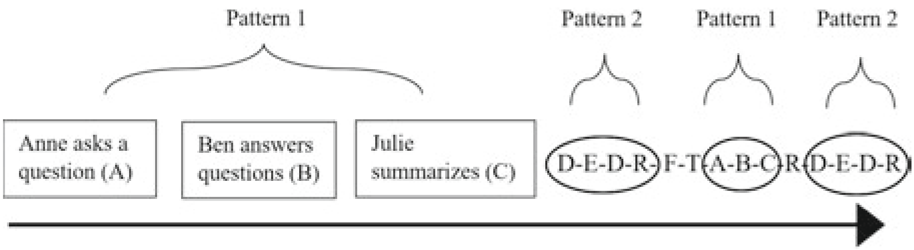
patterns in which e.g., team member A directs a message to team member B, followed by team member B contacting team member C (van den Oever & Schraagen, 2021; for a visual representation see Figure 3.3). These authors explain that this type of structural interaction may provide information regarding 'handing off' communication. For more information regarding various combinations of triadic structural patterns, we direct the reader to Van den Oever and Schraagen (2021).

Figure 3.3
Structural triad-level communicative pattern. The arrows present the sending of (directed) communicative statements



Structural team-level patterns. Several studies examined the overarching communicative network structures at the team level (Barth et al., 2015; Sauer & Kauffeld, 2013; Schecter et al., 2018). These studies investigate, for example, whether the information flow is more equally spread amongst team members (i.e., decentralized network) or more dominated by specific individual(s) (i.e., centralized conversational network; Barth et al., 2015; Schecter et al., 2018). More decentralized team interaction is associated with higher team performance (Sauer & Kauffeld, 2013) and more positive perceptions of the process quality (Schecter et al., 2018). In addition, this review found a tendency for specific individuals (e.g., medical physicians) to systematically dominate the teams conversation compared to other disciplines (e.g., nurses; Horlait et al., 2019; Walter et al., 2019). Two other studies looked at the overall number of (unique) patterned communication at the team level in crisis situations (Stachowski et al., 2009) as well as in regular organizational team meetings (Hoogeboom & Wilderom, 2020). The number of unique patterned communication informs whether the team is in a more stable mode (i.e., lower numbers reflect lower variety in patterns) or in a more flexible mode (i.e., higher numbers reflect higher variety of patterns). In crisis situations, a high number of unique patterned communication (i.e., flexibility) was associated with higher team performance (Stachowski et al., 2009), while that association was not found in regular organizational team meetings (Hoogeboom & Wilderom, 2020). Moreover, these authors zoomed in on abstract features of communicative patterns describing various levels of 'participation', 'pattern complexity' or 'pattern length' (i.e., single pairs of covarying behaviors involving few participants are lower in pattern length and complexity compared to patterns that involve behaviors from all team members; Hoogeboom & Wilderom, 2020; Stachowski et al., 2009). In crisis situations, higher performing teams showed patterns characterized as less complex and, shorter, thus encompassing fewer behaviors and involving fewer members (Stachowski et al., 2009), while higher participative patterns are related to higher team effectiveness in regular organizational team meetings (Hoogeboom & Wilderom, 2020). Figure 3.4 shows a visual example of two patterns embedded in a team conversation, with varying lengths and degrees of participation. Although the authors 'code' the content of each communicative statement, the interest does not lie in what is said, rather in the abstract features of the pattern (e.g., variety, complexity, length).

Figure 3.4
Abstract pattern features emerging at team level (i.e., degree of participation, pattern length)



Time in communicative patterns

Studying communicative patterns in a time sensitive manner is highly interesting because conversational rhythm, tempo or timing of communicative patterns are an inherent part of team communication. This review identified that 19 papers (40 percent) captured temporality in communicative patterns as their main topic of interest in the following ways:

Temporality as communication rhythm. One way researchers capture rhythm of team communication is in the repetition of cycles of communication behaviors, labeled as 'pattern recurrency', in other words, how often the team cycles e.g., through pattern 'A-B-C' as visualized in Figure 3.4 (Hoogeboom & Wilderom, 2020; Nicholson et al., 2017). It is beneficial to not show too much repetitiveness in cycling through similar communicative patterns because higher performing teams showed less standardization in terms of routine patterns (Hoogeboom & Wilderom, 2020). Another way in which researchers captured communicative rhythm is looking at the extent to which communicative statements slow down or speed up over time (Barth et al., 2015; Gundrosen et al., 2016; Kolbe et al., 2014; Soukup, Murtagh, Lamb, Bali, et al., 2021; van Oortmerssen et al., 2015). In particular, one study focused on the *number of seconds* it took for the next speaker to secure their turn (Soukup, Murtagh, Lamb, Bali, et al., 2021). Fast turn-taking (e.g., no overlap) indicates speaker competitiveness and results in highly interactive meeting environments (Gundrosen et al., 2016; Kolbe et al., 2014; Soukup, Murtagh, Lamb, Green, et al., 2021). As the conversational pace increases, positive effects emerged for team members attention and energy (van Oortmerssen et al., 2015). It is the combination between silence and higher bursts of interaction that naturally emerged (Barth et al., 2015). These fluctuations in pace and intensity of the interaction process provide energy and fuel attention (van Oortmerssen et al., 2015). That is important, as one study found evidence for higher pace interactive meeting environments that decreased as the meetings progressed, indicating fatigue effects (Soukup, Lamb, Morbi, et al., 2020).

Temporal ordering of communicative statements. Several papers focused on the temporal ordering of sequences of communicative statements, showcasing that specific communicative statements were either 'contagious' and thus tend to trigger more of the same over time (Begemann et al., 2021; Kolbe et al., 2014; Lehmann-Willenbrock et al., 2017; Lehmann-Willenbrock & Allen, 2014) or triggered particular other types of behaviors (Kauffeld & Meyers, 2009; Klonek et al., 2016; Kolbe et al., 2014; Lehmann-Willenbrock, Allen, et al., 2013; Lehmann-Willenbrock et al., 2017; Wang et al., 2020). However, this will be discussed more in depth in relation to the content in the section below.

Combinations of aspects of communicative patterns

While prior sections primarily focus on only a single aspect of the communicative pattern for parsimonious reasons, it is important to acknowledge that 16 papers (33 percent) study the communicative pattern combining various angles, adding interesting nuances towards the research findings.

Temporality as sequence-ordering and content. A popular approach in the literature is to investigate how content communicative statements were ordered in immediate temporal proximity. To illustrate, several papers found evidence for 'self-sustaining' communicative patterns': positivity patterns are 'contagious' and thus repeat themselves (Lehmann-Willenbrock et al., 2017; Lehmann-Willenbrock & Allen, 2014); negativity patterns tend to increase subsequent negativity (Kauffeld & Meyers, 2009) and various types of gossip (e.g., positive/negative) tend to trigger more of the same (Begemann et al., 2021). Other combinations of content patterns such as 'question-answer' in an immediate sequential temporal order were related to team performance (Schmutz et al., 2015; Soukup, Lamb, Shah, et al., 2020), while providing information without a prior request appears not to be related to team performance (Schmutz et al., 2015). Similarly, the total number of 'monitoring' statements and relevant information sharing such as 'giving instructions' aggregated over the performance episode seemed not to relate to team performance, while the sequence of 'monitoring statements' directly followed by e.g., 'giving instructions' in its temporal order does appear to be associated with higher team performance in medical anesthesia teams (Kolbe et al., 2014). These examples show that it is not the content communicative statement alone that benefits the team, rather the extent to which the content builds on what had been shared previously (see also; Uitdewilligen & Waller, 2018b; van Oortmerssen et al., 2015; Zoethout et al., 2017).

Temporality as team-level change and content/structure. Several studies found that specific content communicative patterns were more important at the beginning of the meeting (Siassakos et al., 2011; van der Haar et al., 2017), while others take more time to develop and showcase at a later point in time (Klonek et al., 2016; Schmutz et al., 2018). In crisis situations, it was important to verbally state the emergency early on for the team's efficiency (Siassakos et al., 2011) and to engage in procedural communication at the beginning of the meeting for higher team effectiveness (van der Haar et al., 2017). In addition, team reflexivity did not show at the beginning of the meeting, rather it emerged over time as it requires time to unfold (Schmutz et al., 2018). A similar mechanism for negativity holds empirically, which is observed more towards the second half of project team collaborations (Klonek et al., 2016). Regarding the structural elements, one study found that team-level network measures, such as density and reciprocity, increased as the team moved from one phase of the surgical procedure to the next (Barth et al., 2015[5]). Similarly, David and Schraagen (2018) found that the dyad and triad structures changed (i.e., more reliance on immediately preceding patterns) in response to emergency phases during airplane malfunctions. In multidisciplinary decision-making boards, specific combinations of disciplines tend to contribute more in various phases of the decision-making process (Soukup, Murtagh, Lamb, Green, et al., 2021). In sum, content and structural patterns are not 'static', rather they change over the course of the meeting and are more or less effective depending on the timing of the pattern throughout the broader team collaboration period.

[5] Although the authors also code the content of communicative statements, they do not analyze or describe how the content changes over time over the course of the performance episodes. Therefore, we categorize this pattern as a combination of structure and time. More specifically, density measurements compares the communicative links from one team member to all other team members and describes the level of interrelatedness between members.

Structure and content. One study found that more equally distributed procedural communication across team members is associated with higher team satisfaction (Lehmann-Willenbrock, Allen, et al., 2013). Implicitly, these authors focused on a structural pattern (i.e., centralization measure) that zooms in on one type of content communication. Similar other authors found that speaker switches (= structural pattern) reinforced content patterns including positivity (Lehmann-Willenbrock et al., 2017). Other researchers tend to focus on specific content combinations of dyad-level patterns (e.g., statement-confirmation; Schraagen, 2011) and found that cross-checking of information is important in cardiac surgery operations. Taken together, various combinations of content and structure exists, which are currently only marginally explored in organizational team research.

Contingencies in communicative patterns

So far, this review has summarized communicative patterns in organizational teams regardless of varying conditions under which the patterns are studied in the broader team context. Several studies explored how communicative patterns change in relation to varying task characteristics such as the urgency of the task (Barth et al., 2015; Schmutz et al., 2015; van den Oever & Schraagen, 2021), the complexity of the task (Schraagen, 2011; Soukup, Lamb, Shah, et al., 2020) or changes in workload conditions (Espevik et al., 2011; Soukup, Lamb, Shah, et al., 2020). There is sufficient evidence to conclude that teams *adapt* their communicative patterns depending on important characteristics of changing task demands. However, only few studies also focused on how the adaptiveness of patterns are related to important team outcomes. For example, one study found that the use of closed-loop communication (dyadic structural pattern) was related to team performance, especially when the emergency task or situation is driven by specific cues (e.g., abnormal peaks in patients heart rates; Schmutz et al., 2015). Another study focused on content and found that reflexivity fits nonroutine tasks best in medical emergency situations (Schmutz et al., 2018). The authors concluded that in order for reflective patterns to become relevant, the task must contain some degree of uncertainty (Schmutz et al., 2018). Monitoring patterns were also studied in relation to increased workload conditions (Espevik et al., 2011). These authors found that higher performing teams did not change monitoring communication as the workload increased, while lower performing teams decreased the monitoring. The same authors found that higher performing teams increased the conversational rhythm (especially the transfer of information) in higher workload conditions, while that was not the case for lower performing teams. In sum, these studies show that the effectiveness of the communicative pattern is contingent upon the task context.

Apart from task characteristics, one study focused on team-level job insecurity climate as a boundary condition for humor patterns to emerge (Lehmann-Willenbrock & Allen, 2014). Notably, these authors found that humor patterns were positively related to performance, however only in low job insecurity climates. In conditions where team members reported higher levels of job insecurity, humor patterns did not relate to team performance. Another study included team composition contingencies, and found that larger teams benefit more from reflexivity patterns compared to smaller teams (Schmutz et al., 2018). Thus, apart from the focusing on the adaptiveness of communicative patterns, these findings reveal that context factors such as team compositional factors or job perceptions serve as a prerequisite for specific content patterns to (1) emerge or (2) relate to specific outcomes. Taken together, this section hints towards including various contingency factors in the study of communicative patterns, which will be discussed in more in detail in the section below.

DISCUSSION

The central goal of this scoping review aimed to answer which communicative patterns have been investigated in organizational teams. We identified three central aspects of communicative patterns: *content* (e.g., procedural, reflexivity, socio-emotional talk), *structure* (e.g., dyad or triad interpersonal patterns) and *temporality* (e.g., conversational rhythm, sequence) and organized our results around these three categories. We put forward the idea that the combination of various aspects of communicative patterns uncovers interesting and nuanced findings of how the process impacts important outcomes (e.g., procedural communication as a *content* pattern is related to performance, however this only occurs early in meeting adding the *temporality* lens; van der Haar et al., 2017). We found in several studies that *content* and *structural* patterns are not 'static', rather change over the course of the meeting and are more or less effective depending on the timing of the pattern in the broader collaboration period (Klonek et al., 2016; Schmutz et al., 2018; Siassakos et al., 2011). Prior team process theories underline the importance to focus on *content* and *time* (Marks et al., 2001), or explain the importance of *structure* (Crawford & Lepine, 2013). Thus, this review contributes to bringing two seminal team process theories together in the study of communicative patterns in organizational teams. The following section explores how we can advance research on communicative patterns in more depth.

Advancing research on communicative patterns

In reviewing empirical organizational team research, we found three tendencies in the organizational team literature: (1) focus on different aspects of communicative patterns studied in isolation, (2) focus on contingency-free communicative patterns and (3) focus on within (specific types of) team boundaries. Based on these findings, we suggest avenues that are likely to advance communicative pattern research to come closer to understanding the complex patterned reality for modern-day organizational teams.

Advance synergy in combining multiple aspects of the pattern

While the datasets embedded in the majority of selected papers allow scholars to focus on content, structure as well as temporality, we identified a tendency in the organizational teams' field to focus on either a single aspect of the communicative pattern (e.g., solely focusing on content) or several aspects of the communicative pattern but studied in isolation. Yet, we argue that it is the integration of multiple aspects of communicative patterns that will advance the field towards a more holistic picture that may better explain important (team) outcomes. To illustrate, instead of uniquely coding persuasion strategies as *content* patterns, the combination with the *structural* side allows us to understand which (subgroups of) members exert disproportionate influence on the team process. In addition, the *temporality* aspect may reveal sequences of one member systematically supporting influence from a subordinate in its temporal order. Another interesting application of temporality may indicate that more towards the end of the meeting, as important decisions need to be taken, subsets of members tend to exert more influence compared to the beginning of the meeting. Instead of solely focusing on content (= persuasion strategies), adding structural components of subgrouping of members at particular points in time may add towards explaining why and when some members (systematically) are overruled in the 'shared decision-making' process, resulting in potentially less optimal outcomes. In sum, we believe that our communicative patterns framework will inspire scholars to think more holistically about the study of communicative patterns, with the result of explaining team functioning and important outcomes in a more integrative and complete way. Scholars can thus examine the effects of *content*, *structure* and *temporality* simultaneously, rather than in isolation, which currently dominates prior research.

Advance contingency thinking

Most studies interpret research findings in their broader team context (e.g., procedural patterns in emergency management teams), but tend to zoom in less on various types of other contingency factors that drive communicative patterns within this broader context. While varying task characteristics are covered to a slight greater extent in the current organizational team literature, other levels of contingency factors are far less explored. To illustrate, varying levels of psychological safety (e.g., team culture) may drive different patterns in emergency situations. Indeed, communicative patterns are not the only element that is variable over time, rather contingency factors such as perceived levels of psychological safety may also develop or decrease over time and steer patterned communication in various ways (Roussin et al., 2016). Thus, by explicitly considering the contingencies of communicative pattern and how the communication changes in relation to various varying conditions, we can gain a more complete understanding of why teams may succeed or fail.

Advance research across (various types of) team boundaries

This review finds that communicative patterns are mostly investigated in stable steams where the team boundary is clearly defined and fixed, meaning that communication is studied inside one team boundary. However, in most organizations nowadays, people are embedded in multiple teams and thus communicative patterns also emerge across teams, more outwardly focused in multi-team systems (MTS; Mathieu et al., 2002). As Luciano et al. (2018) states; 'MTSs are tightly coupled networks of teams that pursue at least one shared superordinate goal in addition to their component team goals (p. 1066). Thus, in multi-team system arrangements, communicative patterns matter within the team boundary, however they also emerge across teams as the MTS collectively works towards higher-order goals. To illustrate, research may focus on communicative patterns in MTS, e.g., zooming in on how boundary spanners change various aspects of communicative patterns when they represent sub component teams in discussions targeting systemwide responsibilities.

CONCLUSION

The exploration of real-time communicative patterns in organizational teams is a promising and intriguing road to understand in depth what actually happens during team collaboration episodes. Following a rigorous review selection process that uniquely includes empirical organizational team samples in combination with behavioral observation research designs, we advance the team process literature by developing a guiding framework that summarizes three aspects of communicative patterns inherently connected to understanding team functioning. In particular, we position *content*, *structure,* and *temporality* as synergetic aspects that connect team members in their patterned communication. As organizational teams oftentimes (unconsciously) produce communicative patterns, this review offers an integrative approach for scholars and practitioners to understand in depth what actually happens inside the team process. By simultaneously studying combinations of *content*, *structure* and *temporal* aspects of communicative patterns in relation to varying environmental conditions, we aim to challenge researchers to take a more varied and nuanced position in the study of communicative patterns that allows the explanation of relevant outcomes in real-life organizations.

REFERENCES

Abd El-Shafy, I., Delgado, J., Akerman, M., Bullaro, F., Christopherson, N. A., & Prince, J. M. (2018). Closed-loop communication improves task completion in pediatric trauma resuscitation. *Journal of Surgical Education*, *75*(1), 58–64.

Addas, S., & Pinsonneault, A. (2013). *IT Interruptions and Coordination Effectiveness in Software Development Groups: A Conceptual, Multilevel Model*. 6.

Addas, S., & Pinsonneault, A. (2018). E-mail interruptions and individual performance: Is there a silver lining? *MIS Quarterly*, *42*(2), 381–406. https://doi.org/10.25300/MISQ/2018/13157

Alexandersson, N., Rosell, L., Wihl, J., Ohlsson, B., Steen Carlsson, K., & Nilbert, M. (2018). Determinants of variable resource use for multidisciplinary team meetings in cancer care. *Acta Oncologica*, *57*(5), 675–680. https://doi.org/10.1080/0284186X.2017.1400682

Altmann, E. M., Trafton, J. G., & Hambrick, D. Z. (2014). Momentary interruptions can derail the train of thought. *Journal of Experimental Psychology: General*, *143*(1), 215–226. https://doi.org/10.1037/a0030986

Alvarez, G., & Coiera, E. (2006). Interdisciplinary communication: An uncharted source of medical error? *Journal of Critical Care*, *21*(3), 236–242.

Ancona, D. G., Goodman, P. S., Lawrence, B. S., & Tushman, M. L. (2001). Time: A new research lens. *Academy of Management Review*, *26*(4), 645–663.

Arber, A. (2008). Team Meetings in Specialist Palliative Care: Asking Questions as a Strategy Within Interprofessional Interaction. *Qualitative Health Research*, *18*(10), 1323–1335. https://doi.org/10.1177/1049732308322588

Arrow, H., McGrath, J. E., & Berdahl, J. L. (2000). *Small groups as complex systems: Formation, coordination, development, and adaptation*. Sage Publications.

Aubé, C., & Rousseau, V. (2016). Yes, we complain … so what? *Journal of Managerial Psychology*, *31*(7), 1137–1151. https://doi.org/10.1108/JMP-08-2015-0304

Ayoko, O. B., Konrad, A. M., & Boyle, M. V. (2012). Online work: Managing conflict and emotions for performance in virtual teams. *European Management Journal*, *30*(2), 156–174. https://doi.org/10.1016/j.emj.2011.10.001

Baethge, A., & Rigotti, T. (2013). Interruptions to workflow: Their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands. *Work & Stress*, *27*(1), 43–63. https://doi.org/10.1080/02678373.2013.761783

Baethge, A., Rigotti, T., & Roe, R. A. (2015). Just more of the same, or different? An integrative theoretical framework for the study of cumulative interruptions at work. *European Journal of Work and Organizational Psychology*, *24*(2), 308–323.

Bales, R. F. (1950). A set of categories for the analysis of small group interaction. *American Sociological Review*, *15*(2), 257–263.

Barsade, S. G. (2002). The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly*, *47*(4), 644–675.

Barsade, S. G., & Knight, A. P. (2015). Group affect. *Annual Review of Organizational Psychology and Organizational Behavior*, *2*(1), 21–46.

Barth, S., Schraagen, J. M., & Schmettow, M. (2015). Network measures for characterising team adaptation processes. *Ergonomics*, *58*(8), 1287–1302. https://doi.org/10.1080/00140139.2015.1009951

Begemann, V., Lübstorf, S., Meinecke, A. L., Steinicke, F., & Lehmann-Willenbrock, N. (2021). Capturing Workplace Gossip as Dynamic Conversational Events: First Insights From Care Team Meetings. *Frontiers in Psychology*, *12*. https://www.frontiersin.org/article/10.3389/fpsyg.2021.725720

Bennett, M. S., Erchul, W. P., Young, H. L., & Bartel, C. M. (2012). Exploring Relational Communication Patterns in Prereferral Intervention Teams. *Journal of Educational and Psychological Consultation*, *22*(3), 187–207. https://doi.org/10.1080/10474412.2012.706128

Bonito, J. A., & Keyton, J. (2018). Introduction to machine learning. *The Cambridge Handbook of Group Interaction Analysis*, 387–404.

Boos, M. (2018). CoCo: A category system for coding coherence in conversations. *The Cambridge Handbook of Group Interaction Analysis*, 502–509.

Bruine de Bruin, W., & Morgan, M. G. (2019). Reflections on an interdisciplinary collaboration to inform public understanding of climate change, mitigation, and impacts. *Proceedings of the National Academy of Sciences*, *116*(16), 7676–7683.

Burgoon, J. K., & Dunbar, N. E. (2018). *Coding nonverbal behavior.*

Carey, H. R., & Laughlin, P. R. (2012). Groups perform better than the best individuals on letters-to-numbers problems: Effects of induced strategies. *Group Processes & Intergroup Relations*, *15*(2), 231–242. https://doi.org/10.1177/1368430211419174

Cheshin, A., Rafaeli, A., & Bos, N. (2011). Anger and happiness in virtual teams: Emotional influences of text and behavior on others' affect in the absence of non-verbal cues. *Organizational Behavior and Human Decision Processes*, *116*(1), 2–16.

Cochran, A., & Elder, W. B. (2015). Effects of disruptive surgeon behavior in the operating room. *The American Journal of Surgery*, *209*(1), 65–70.

Cohen, M. D., & Bacdayan, P. (1994). Organizational routines are stored as procedural memory: Evidence from a laboratory study. *Organization Science*, *5*(4), 554–568.

Crawford, E. R., & Lepine, J. A. (2013). A configural theory of team processes: Accounting for the structure of taskwork and teamwork. *Academy of Management Review*, *38*(1), 32–48.

Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? *Academy of Management Annals*, *5*(1), 571–612.

David, L. Z., & Schraagen, J. M. (2018). Analysing communication dynamics at the transaction level: The case of Air France Flight 447. *Cognition, Technology & Work*, *20*(4), 637–649.

Davis, J., Burrows, J. F., Ben Khallouq, B., & Rosen, P. (2017). Predictors of patient satisfaction in pediatric oncology. *Journal of Pediatric Oncology Nursing*, *34*(6), 435–438. psyh. https://doi.org/10.1177/1043454217717239

Davis, W. A., Jones, S., Crowell-Kuhnberg, A. M., O'Keeffe, D., Boyle, K. M., Klainer, S. B., Smink, D. S., & Yule, S. (2017). Operative team communication during simulated emergencies: Too busy to respond? *Surgery*, *161*(5), 1348–1356. https://doi.org/10.1016/j.surg.2016.09.027

Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*, 19–43.

Devitt, B., Philip, J., & McLachlan, S.-A. (2010). Team dynamics, decision making, and attitudes toward multidisciplinary cancer meetings: Health professionals' perspectives. *Journal of Oncology Practice*, *6*(6), e17–e20.

Dew, K., Stubbe, M., Signal, L., Stairmand, J., Dennett, E., Koea, J., Simpson, A., Sarfati, D., Cunningham, C., & Batten, L. (2015). Cancer care decision making in multidisciplinary meetings. *Qualitative Health Research*, *25*(3), 397–407.

Dinh, J. V., Traylor, A. M., Kilcullen, M. P., Perez, J. A., Schweissing, E. J., Venkatesh, A., & Salas, E. (2020). Cross-Disciplinary Care: A Systematic Review on Teamwork Processes in Health Care. *Small Group Research*, *51*(1), 125–166. https://doi.org/10.1177/1046496419872002

Edney, L. C., Gray, J., & Karnon, J. (2020). A scoping review of the economics of multidisciplinary teams in oncology care. *Journal of Cancer Policy*, *26*, 100257. https://doi.org/10.1016/j.jcpo.2020.100257

Espevik, R., Johnsen, B. H., & Eid, J. (2011). Communication and Performance in Co-Located and Distributed Teams: An Issue of Shared Mental Models of Team Members? *Military Psychology*, *23*(6), 616–638. https://doi.org/10.1080/08995605.2011.616792

Feyerherm, A. E., & Rice, C. L. (2002). EMOTIONAL INTELLIGENCE AND TEAM PERFORMANCE: THE GOOD, THE BAD AND THE UGLY. *The International Journal of Organizational Analysis*, *10*(4), 343–362. https://doi.org/10.1108/eb028957

Fischer, U., McDonnell, L., & Orasanu, J. (2007). Linguistic correlates of team performance: Toward a tool for monitoring team functioning during space missions. *Aviation, Space, and Environmental Medicine*, *78*(5), B86–B95.

Fletcher, K. A., Potter, S. M., & Telford, B. N. (2018). Stress outcomes of four types of perceived interruptions. *Human Factors*, *60*(2), 222–235.

Forsyth, D. R. (2018). *Group dynamics*. Cengage Learning.

Fox, S., & Comeau-Vallée, M. (2020). The negotiation of sharing leadership in the context of professional hierarchy: Interactions on interprofessional teams. *Leadership*, *16*(5), 568–591. https://doi.org/10.1177/1742715020917817

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4), 331–362.

Galluch, P., Grover, V., & Thatcher, J. (2015). Interrupting the Workplace: Examining Stressors in an Information Technology Context. *Journal of the Association for Information Systems*, *16*(1). https://doi.org/10.17705/1jais.00387

Gerpott, F. H., Chiu, M. M., & Lehmann-Willenbrock, N. (2020). Multilevel antecedents of negativity in team meetings: The role of job attitudes and gender. *Managing Meetings in Organizations*.

Gersick, C. J., & Hackman, J. R. (1990). Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*, *47*(1), 65–97.

Gibbs, J. L., Sivunen, A., & Boyraz, M. (2017). Investigating the impacts of team type and design on virtual team processes. *Human Resource Management Review*, *27*(4), 590–603. https://doi.org/10.1016/j.hrmr.2016.12.006

Gillespie, B. M., Chaboyer, W., & Fairweather, N. (2012). Interruptions and Miscommunications in Surgery: An Observational Study. *AORN Journal*, *95*(5), 576–590. https://doi.org/10.1016/j.aorn.2012.02.012

Gorse, C. A., & Emmitt, S. (2007). Communication behaviour during management and design team meetings: A comparison of group interaction. *Construction Management and Economics*, *25*(11), 1197–1213. https://doi.org/10.1080/01446190701567413

3

Gundrosen, S., Andenæs, E., Aadahl, P., & Thomassen, G. (2016). Team talk and team activity in simulated medical emergencies: A discourse analytical approach. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *24*(1), 135. https://doi.org/10.1186/s13049-016-0325-1

Hackman, J. R. (1987). *The design of work teams. InHandbook of Organizational Behavior, ed. JW Lorsch*. Englewood Cliffs, NJ: Prentice-Hall.

Hareli, S., & Rafaeli, A. (2008). Emotion cycles: On the social influence of emotion in organizations. *Research in Organizational Behavior*, *28*, 35–59.

Härgestam, M., Lindkvist, M., Brulin, C., Jacobsson, M., & Hultin, M. (2013). Communication in interdisciplinary teams: Exploring closed-loop communication during in situ trauma team training. *BMJ Open*, *3*(10), e003525.

Higgins, L. E., & Smith, J. M. (2022). Documenting development of interdisciplinary collaboration among researchers by visualizing connections. *Research Evaluation*, *31*(1), 159–172.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin*, *121*(1), 43.

Hirokawa, R. Y., & Poole, M. S. (1996). *Communication and Group Decision Making*. SAGE Publications, Incorporated. http://ebookcentral.proquest.com/lib/uvtilburg-ebooks/detail.action?docID=996520

Hmieleski, K. M., & Cole, M. S. (2022). Laughing all the way to the bank: The joint roles of shared coping humor and entrepreneurial team-efficacy in new venture performance. *Entrepreneurship Theory and Practice*, *46*(6), 1782–1811.

Hohenstein, C., Fleischmann, T., Rupp, P., Hempel, D., Wilk, S., & Winning, J. (2016). German critical incident reporting system database of prehospital emergency medicine: Analysis of reported communication and medication errors between 2005-2015. *World Journal of Emergency Medicine*, *7*(2), 90. https://doi.org/10.5847/wjem.j.1920-8642.2016.02.002

Hoogeboom, M. A., & Wilderom, C. P. (2020). A complex adaptive systems approach to real-life team interaction patterns, task context, information sharing, and effectiveness. *Group & Organization Management*, *45*(1), 3–42.

Horlait, M., Baes, S., Dhaene, S., Van Belle, S., & Leys, M. (2019). How multidisciplinary are multidisciplinary team meetings in cancer care? An observational study in oncology departments in Flanders, Belgium. *Journal of Multidisciplinary Healthcare*, *12*, 159–167. https://doi.org/10.2147/JMDH.S196660

Humphrey, S. E., Hollenbeck, J. R., Meyer, C. J., & Ilgen, D. R. (2007). Trait configurations in self-managed teams: A conceptual examination of the use of seeding for maximizing and minimizing trait variance in teams. *Journal of Applied Psychology*, *92*(3), 885.

Hung, H., Murray, G., Varni, G., Lehmann-Willenbrock, N., Gerpott, F. H., & Oertel, C. (2020). Workshop on Interdisciplinary Insights into Group and Team Dynamics. *Proceedings of the 2020 International Conference on Multimodal Interaction*, 876–877.

Ibrahim, T., Flamini, E., Fabbri, L., Serra, P., Mercatali, L., Ricci, R., Sacanna, E., Falasconi, M. C., Casadei, R., & Galassi, R. (2009). Multidisciplinary approach to the treatment of bone metastases: Osteo-Oncology Center, a new organizational model. *Tumori Journal*, *95*(3), 291–297.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annu. Rev. Psychol.*, *56*, 517–543.

Jacobsson, M., Hargestam, M., Hultin, M., & Brulin, C. (2012). Flexible knowledge repertoires: Communication by leaders in trauma teams. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *20*(1), 44. https://doi.org/10.1186/1757-7241-20-44

Janssens, M., Meslec, N., & Leenders, R. (2022). Collective intelligence in teams: Contextualizing collective intelligent behavior over time. *Frontiers in Psychology*.

Jett, Q. R. (2003). Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life. *Academy of Management Review*, 14.

Johns, G. (2006). The essential impact of context on organizational behavior. *Academy of Management Review*, *31*(2), 386–408.

Jouanne, E., Charron, C., Chauvin, C., & Morel, G. (2017). Correlates of team effectiveness: An exploratory study of firefighter's operations during emergency situations. *Applied Ergonomics*, *61*, 69–77. https://doi.org/10.1016/j.apergo.2017.01.005

Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. *Small Group Research*, *43*(2), 130–158.

Kauffeld, S., & Meyers, R. A. (2009). Complaint and solution-oriented circles: Interaction patterns in work group discussions. *European Journal of Work and Organizational Psychology*, *18*(3), 267–294.

Ke, K. M., Blazeby, J. M., Strong, S., Carroll, F. E., Ness, A. R., & Hollingworth, W. (2013). Are multidisciplinary teams in secondary care cost-effective? A systematic review of the literature. *Cost Effectiveness and Resource Allocation*, *11*(1), 1–13.

Kesson, E. M., Allardice, G. M., George, W. D., Burns, H. J. G., & Morrison, D. S. (2012). Effects of multidisciplinary team working on breast cancer survival: Retrospective, comparative, interventional cohort study of 13 722 women. *BMJ*, *344*, e2718. https://doi.org/10.1136/bmj.e2718

Keyton, J. (2018). Interaction analysis: An introduction. *The Cambridge Handbook of Group Interaction Analysis*, *10*(9781316286302.002), 3–19.

Keyton, J., & Beck, S. J. (2009). The influential role of relational messages in group interaction. *Group Dynamics: Theory, Research, and Practice*, *13*(1), 14.

Klonek, F. E., Meinecke, A. L., Hay, G., & Parker, S. K. (2020). Capturing team dynamics in the wild: The communication analysis tool. *Small Group Research*, *51*(3), 303–341.

Klonek, F. E., Quera, V., Burba, M., & Kauffeld, S. (2016). Group interactions and time: Using sequential analysis to study group dynamics in project meetings. *Group Dynamics: Theory, Research, and Practice*, *20*(3), 209.

Koduru, A., Valiveti, H. B., & Budati, A. K. (2020). Feature extraction algorithms to improve the speech emotion recognition rate. *International Journal of Speech Technology*, *23*(1), 45–55.

Kolbe, M., Grote, G., Waller, M. J., Wacker, J., Grande, B., Burtscher, M. J., & Spahn, D. R. (2014). Monitoring and talking to the room: Autochthonous coordination patterns in team interaction and performance. *Journal of Applied Psychology*, *99*(6), 1254.

Kozlowski, S. W., & Chao, G. T. (2018). Unpacking team process dynamics and emergent phenomena: Challenges, conceptual advances, and innovative methods. *American Psychologist*, *73*(4), 576.

Kozlowski, S. W., & Klein, K. J. (2000). *A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes.*

Lee, A. H., Wang, K., Scott, J. A., Yau, K. K. W., & McLachlan, G. J. (2006). Multi-level zero-inflated Poisson regression modelling of correlated count data with excess zeros. *Statistical Methods in Medical Research*, *15*(1), 47–61. https://doi.org/10.1191/0962280206sm429oa

Leenders, R. T. A., Contractor, N. S., & DeChurch, L. A. (2016). Once upon a time: Understanding team processes as relational event networks. *Organizational Psychology Review*, *6*(1), 92–115.

Lehmann-Willenbrock, N., & Allen, J. A. (2014). How fun are your meetings? Investigating the relationship between humor patterns in team interactions and team performance. *Journal of Applied Psychology*, *99*(6), 1278–1287. https://doi.org/10.1037/a0038083

Lehmann-Willenbrock, N., & Allen, J. A. (2018a). Modeling temporal interaction dynamics in organizational settings. *Journal of Business and Psychology*, *33*(3), 325–344.

Lehmann-Willenbrock, N., & Allen, J. A. (2018b). Modeling Temporal Interaction Dynamics in Organizational Settings. *Journal of Business and Psychology*, *33*(3), 325–344. https://doi.org/10.1007/s10869-017-9506-9

Lehmann-Willenbrock, N., Allen, J. A., & Kauffeld, S. (2013). A sequential analysis of procedural meeting communication: How teams facilitate their meetings. *Journal of Applied Communication Research*, *41*(4), 365–388.

Lehmann-Willenbrock, N., Beck, S. J., & Kauffeld, S. (2016). Emergent team roles in organizational meetings: Identifying communication patterns via cluster analysis. *Communication Studies*, *67*(1), 37–57.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2013). *The upward spirals in team processes: Examining dynamic positivity in problem solving teams*.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2017). Understanding positivity within dynamic team interactions: A statistical discourse analysis. *Group & Organization Management*, *42*(1), 39–78.

Lei, Z., Waller, M. J., Hagen, J., & Kaplan, S. (2016). Team adaptiveness in dynamic contexts: Contextualizing the roles of interaction patterns and in-process planning. *Group & Organization Management*, *41*(4), 491–525.

Leroy, S., Schmidt, A. M., & Madjar, N. (2020). Interruptions and task transitions: Understanding their characteristics, processes, and consequences. *Academy of Management Annals*, *14*(2), 661–694.

Liu, F., & Maitlis, S. (2014). Emotional Dynamics and Strategizing Processes: A Study of Strategic Conversations in Top Team Meetings. *Journal of Management Studies*, *51*(2), 202–234. https://doi.org/10.1111/j.1467-6486.2012.01087.x

Luciano, M. M., DeChurch, L. A., & Mathieu, J. E. (2018). Multiteam systems: A structural framework and meso-theory of system functioning. *Journal of Management*, *44*(3), 1065–1096.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, *26*(3), 356–376.

Marlow, S. L., Lacerenza, C. N., Paoletti, J., Burke, C. S., & Salas, E. (2018). Does team communication represent a one-size-fits-all approach?: A meta-analysis of team communication and performance. *Organizational Behavior and Human Decision Processes*, *144*, 145–170. https://doi.org/10.1016/j.obhdp.2017.08.001

Mathieu, J. E., Gallagher, P. T., Domingo, M. A., & Klock, E. A. (2019). Embracing complexity: Reviewing the past decade of team effectiveness research. *Annual Review of Organizational Psychology and Organizational Behavior*, *6*, 17–46.

Mathieu, J. E., Hollenbeck, J. R., van Knippenberg, D., & Ilgen, D. R. (2017). A century of work teams in the Journal of Applied Psychology. *Journal of Applied Psychology*, *102*(3), 452.

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. (2002). *Multiteam systems.*

Maynard, M. T., Conroy, S., Lacerenza, C. N., & Barnes, L. Y. (2021). Teams in the wild are not extinct, but challenging to research: A guide for conducting impactful team field research with 10 recommendations and 10 best practices. *Organizational Psychology Review*, *11*(3), 274–318. https://doi.org/10.1177/2041386620986597

McComb, S., & Kennedy, D. (2020). *Computational methods to examine team communication*. Springer.

McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14). Prentice-Hall Englewood Cliffs, NJ.

Mehta, D., Siddiqui, M. F. H., & Javaid, A. Y. (2019). Recognition of emotion intensities using machine learning algorithms: A comparative study. *Sensors*, *19*(8), 1897.

Mitchell, A. J., Hussain, N., Grainger, L., & Symonds, P. (2011). Identification of patient-reported distress by clinical nurse specialists in routine oncology practice: A multicentre UK study. *Psycho-Oncology*, *20*(10), 1076–1083. psyh. https://doi.org/10.1002/pon.1815

Mohammed, S., & Dumville, B. C. (2001). Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *22*(2), 89–106.

Mohammed, S., Hamilton, K., & Lim, A. (2008). The incorporation of time in team research: Past, current, and future. *Team Effectiveness in Complex Organizations*, 355–382.

Moirano, R., Sánchez, M. A., & Štěpánek, L. (2020). Creative interdisciplinary collaboration: A systematic literature review. *Thinking Skills and Creativity*, *35*, 100626. https://doi.org/10.1016/j.tsc.2019.100626

Moreland, R. L. (2010). Are dyads really groups? *Small Group Research*, *41*(2), 251–267.

Mullan, B. J., Brown, J. S., Lowe, D., Rogers, S. N., & Shaw, R. J. (2014). Analysis of time taken to discuss new patients with head and neck cancer in multidisciplinary team meetings. *British Journal of Oral and Maxillofacial Surgery*, *52*(2), 128–133.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Murugappan, M., & Mutawa, A. (2021). Facial geometric feature extraction based emotional expression classification using machine learning algorithms. *Plos One*, *16*(2), e0247131.

Nancarrow, S. A., Booth, A., Ariss, S., Smith, T., Enderby, P., & Roots, A. (2013). Ten principles of good interdisciplinary team work. *Human Resources for Health*, *11*(1), 19. https://doi.org/10.1186/1478-4491-11-19

Nicholson, G., Pugliese, A., & Bezemer, P.-J. (2017). Habitual accountability routines in the boardroom: How boards balance control and collaboration. *Accounting, Auditing & Accountability Journal*, *30*(2), 222–246. https://doi.org/10.1108/AAAJ-07-2015-2143

Nyoni, C. N., Grobler, C., & Botma, Y. (2021). Towards Continuing Interprofessional Education: Interaction patterns of health professionals in a resource-limited setting. *PLOS ONE*, *16*(7), e0253491. https://doi.org/10.1371/journal.pone.0253491

Okhuysen, G. A., & Eisenhardt, K. M. (2002). Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility. *ORGANIZATION SCIENCE*, *13*(4), 18.

Oldeweme, M., Konradt, U., & Brede, M. (2021). The rhythm of teamwork: Discovering a complex temporal pattern of team processes. *Group Dynamics: Theory, Research, and Practice*. https://doi.org/10.1037/gdn0000175

Omilion-Hodges, L. M., Imes, R., & Hester, J. (2021). Editorial: Team and Leader Communication in the Healthcare Context: Building and Maintaining Optimal Transdisciplinary Teams. *Frontiers in Communication*, *6*. https://www.frontiersin.org/article/10.3389/fcomm.2021.669399

Parush, A., Kramer, C., Foster-Hunt, T., McMullan, A., & Momtahan, K. (2014). Exploring similarities and differences in teamwork across diverse healthcare contexts using communication analysis. *Cognition, Technology & Work*, *16*(1), 47–57. https://doi.org/10.1007/s10111-012-0242-7

Pavitt, C. (2014). An interactive input–process–output model of social influence in decision-making groups. *Small Group Research*, *45*(6), 704–730.

Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Research Synthesis Methods*, *5*(4), 371–385. https://doi.org/10.1002/jrsm.1123

Poole, M. S., & Baldwin, C. L. (1986). Developmental processes in group decision making. *Communication and Group Decision-Making*, 35–62.

Puranik, H., Koopman, J., & Vough, H. C. (2020). Pardon the Interruption: An Integrative Review and Future Research Agenda for Research on Work Interruptions. *Journal of Management*, *46*(6), 806–842. https://doi.org/10.1177/0149206319887428

Puranik, H., Koopman, J., & Vough, H. C. (2021). Excuse me, do you have a minute? An exploration of the dark-and bright-side effects of daily work interruptions for employee well-being. *Journal of Applied Psychology*.

Purvanova, R. K., & Kenda, R. (2021). The impact of virtuality on team effectiveness in organizational and non-organizational teams: A meta-analysis. *Applied Psychology*.

Raab, M., & Gigerenzer, G. (2005). Intelligence as smart heuristics. In *Cognition and intelligence: Identifying the mechanisms of the mind* (pp. 188–207). Oxford University Press.

Raes, E., Boon, A., Kyndt, E., & Dochy, F. (2015). Measuring team learning behaviours through observing verbal team interaction. *Journal of Workplace Learning*.

Ramos-Villagrasa, P. J., Marques-Quinteiro, P., Navarro, J., & Rico, R. (2018). Teams as complex adaptive systems: Reviewing 17 years of research. *Small Group Research*, *49*(2), 135–176.

Rezvani, A., Barrett, R., & Khosravi, P. (2018). Investigating the relationships among team emotional intelligence, trust, conflict and team performance. *Team Performance Management: An International Journal*, *25*(1/2), 120–137. https://doi.org/10.1108/TPM-03-2018-0019

Rivera-Rodriguez, A. J., & Karsh, B.-T. (2010). Interruptions and distractions in healthcare: Review and reappraisal. *BMJ Quality & Safety*, *19*(4), 304–312.

Rosell, L., Wihl, J., Hagberg, O., Ohlsson, B., & Nilbert, M. (2019). Function, information, and contributions: An evaluation of national multidisciplinary team meetings for rare cancers. *Rare Tumors*, *11*, 2036361319841696.

Roussin, C. J., MacLean, T. L., & Rudolph, J. W. (2016). The safety in unsafe teams: A multilevel approach to team psychological safety. *Journal of Management*, *42*(6), 1409–1433.

Ruhstaller, T., Roe, H., Thürlimann, B., & Nicoll, J. J. (2006). The multidisciplinary meeting: An indispensable aid to communication between different specialities. *European Journal of Cancer*, *42*(15), 2459–2462. https://doi.org/10.1016/j.ejca.2006.03.034

Saini, K. S., Taylor, C., Ramirez, A.-J., Palmieri, C., Gunnarsson, U., Schmoll, H.-J., Dolci, S. M., Ghenne, C., Metzger-Filho, O., & Skrzypski, M. (2012). Role of the multidisciplinary team in breast cancer management: Results from a large international survey involving 39 countries. *Annals of Oncology*, *23*(4), 853–859.

Santos, R., Bakero, L., Franco, P., Alves, C., Fragata, I., & Fragata, J. (2012). Characterization of non-technical skills in paediatric cardiac surgery: Communication patterns†. *European Journal of Cardio-Thoracic Surgery*, *41*(5), 1005–1012. https://doi.org/10.1093/ejcts/ezs068

Sauer, N. C., & Kauffeld, S. (2013). Meetings as Networks: Applying Social Network Analysis to Team Interaction. *Communication Methods and Measures*, *7*(1), 26–47. https://doi.org/10.1080/19312458.2012.760729

Schaink, A. K., Kuluski, K., Lyons, R. F., Fortin, M., Jadad, A. R., Upshur, R., & Wodchis, W. P. (2012). A scoping review and thematic classification of patient complexity: Offering a unifying framework. *Journal of Comorbidity*, *2*(1), 1–9.

Schecter, A., Pilny, A., Leung, A., Poole, M. S., & Contractor, N. (2018). Step by step: Capturing the dynamics of work team process through relational event sequences. *Journal of Organizational Behavior*, *39*(9), 1163–1181. https://doi.org/10.1002/job.2247

Schellenberger, B., Diekmann, A., Heuser, C., Gambashidze, N., Ernstmann, N., & Ansmann, L. (2021). Decision-Making in Multidisciplinary Tumor Boards in Breast Cancer Care – An Observational Study. *Journal of Multidisciplinary Healthcare*, *14*, 1275–1284. https://doi.org/10.2147/JMDH.S300061

Schippers, M. C., Edmondson, A. C., & West, M. A. (2014). Team reflexivity as an antidote to team information-processing failures. *Small Group Research*, *45*(6), 731–769.

Schmutz, J. B., Lei, Z., Eppich, W. J., & Manser, T. (2018). Reflection in the heat of the moment: The role of in-action team reflexivity in health care emergency teams. *Journal of Organizational Behavior*, *39*(6), 749–765. https://doi.org/10.1002/job.2299

Schmutz, J., Hoffmann, F., Heimberg, E., & Manser, T. (2015). Effective coordination in medical emergency teams: The moderating role of task type. *European Journal of Work and Organizational Psychology*, *24*(5), 761–776. https://doi.org/10.1080/1359432X.2015.1018184

Schraagen, J. M. (2011). Dealing with unforeseen complexity in the OR: The role of heedful interrelating in medical teams. *Theoretical Issues in Ergonomics Science*, *12*(3), 256–272. https://doi.org/10.1080/1464536X.2011.564481

Shen, W., Kiger, T. B., Davies, S. E., Rasch, R. L., Simon, K. M., & Ones, D. S. (2011). Samples in applied psychology: Over a decade of research in review. *Journal of Applied Psychology*, *96*(5), 1055.

Siassakos, D., Bristowe, K., Draycott, T. J., Angouri, J., Hambly, H., Winter, C., Crofts, J. F., Hunt, L. P., & Fox, R. (2011). Clinical efficiency in a simulated emergency and relationship to team behaviours: A multisite cross-sectional study. *BJOG*, *118*(5), 596–607. https://doi.org/10.1111/j.1471-0528.2010.02843.x

Siassakos, D., Draycott, T., Montague, I., & Harris, M. (2009). Content analysis of team communication in an obstetric emergency scenario. *Journal of Obstetrics and Gynaecology*, *29*(6), 499–503. https://doi.org/10.1080/01443610903039153

Sillars, A. L. (2018). *VTCS: Verbal Tactics Coding Scheme.*

Simon, H. A. (2013). *Administrative Behavior, 4th Edition*. Simon and Schuster.

Sniezek, J. A. (1989). An examination of group process in judgmental forecasting. *International Journal of Forecasting*, *5*(2), 171–178.

Soukup, T., Gandamihardja, T. A., McInerney, S., Green, J. S., & Sevdalis, N. (2019). Do multidisciplinary cancer care teams suffer decision-making fatigue: An observational, longitudinal team improvement study. *BMJ Open*, *9*(5), e027303.

Soukup, T., Lamb, B. W., Arora, S., Darzi, A., Sevdalis, N., & Green, J. S. (2018). Successful strategies in implementing a multidisciplinary team working in the care of patients with cancer: An overview and synthesis of the available literature. *Journal of Multidisciplinary Healthcare*, *11*, 49–61. https://doi.org/10.2147/JMDH.S117945

Soukup, T., Lamb, B. W., Morbi, A., Shah, N. J., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S., & Sevdalis, N. (2020). A multicentre cross-sectional observational study of cancer multidisciplinary teams: Analysis of team decision making. *Cancer Medicine*, *9*(19), 7083–7099. https://doi.org/10.1002/cam4.3366

Soukup, T., Lamb, B. W., Shah, N. J., Morbi, A., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S. A., & Sevdalis, N. (2020). Relationships Between Communication, Time Pressure, Workload, Task Complexity, Logistical Issues and Group Composition in Transdisciplinary Teams: A Prospective Observational Study Across 822 Cancer Cases. *Frontiers in Communication*, *5*, 101. https://doi.org/10.3389/fcomm.2020.583294

Soukup, T., Murtagh, G., Lamb, B. W., Green, J. S., & Sevdalis, N. (2021). Degrees of multidisciplinarity underpinning care planning for patients with cancer in weekly multidisciplinary team meetings: Conversation analysis. *Journal of Multidisciplinary Healthcare*, *14*, 411.

Soukup, T., Murtagh, G. M., Lamb, B. W., Bali, A., Gandamihardja, T., Darzi, A., Green, J. S. A., & Sevdalis, N. (2021). Gaps and Overlaps in Cancer Multidisciplinary Team Communication: Analysis of Speech. *Small Group Research*, *52*(2), 189–219. https://doi.org/10.1177/1046496420948498

Spates, S. A., Kingsley Westerman, C. Y., Laam, L. A., & Goke, R. (2020). Exploring Challenges of Hospital Chaplains in Transdisciplinary Teams. *Frontiers in Communication*, *5*. https://www.frontiersin.org/article/10.3389/fcomm.2020.582626

Stachowski, A. A., Kaplan, S. A., & Waller, M. J. (2009). The benefits of flexible team interaction during crises. *Journal of Applied Psychology*, *94*(6), 1536.

Sutcliffe, K. M., Lewton, E., & Rosenthal, M. M. (2004). Communication failures: An insidious contributor to medical mishaps. *Academic Medicine*, *79*(2), 186–194.

Taberna, M., Gil Moncayo, F., Jané-Salas, E., Antonio, M., Arribas, L., Vilajosana, E., Peralvez Torres, E., & Mesía, R. (2020). The multidisciplinary team (MDT) approach and quality of care. *Frontiers in Oncology*, *10*, 85.

Tamburini, N., Maniscalco, P., Mazzara, S., Maietti, E., Santini, A., Calia, N., Stefanelli, A., Frassoldati, A., Santi, I., & Rinaldi, R. (2018). Multidisciplinary management improves survival at 1 year after surgical treatment for non-small-cell lung cancer: A propensity score-matched study. *European Journal of Cardio-Thoracic Surgery*, *53*(6), 1199–1204.

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly*, 23–47.

Thenappan, A., Halaweish, I., Mody, R. J., Smith, E. A., Geiger, J. D., Ehrlich, P. F., Jasty Rao, R., Hutchinson, R., Yanik, G., & Rabah, R. M. (2017). Review at a multidisciplinary tumor board impacts critical management decisions of pediatric patients with cancer. *Pediatric Blood & Cancer*, *64*(2), 254–258.

Tiferes, J., & Bisantz, A. M. (2018). The impact of team characteristics and context on team communication: An integrative literature review. *Applied Ergonomics*, *68*, 146–159. https://doi.org/10.1016/j.apergo.2017.10.020

Tschan, F. (2002). Ideal cycles of communication (or cognitions) in triads, dyads, and individuals. *Small Group Research*, *33*(6), 615–643.

Tschan, F., Vetterli, M., Semmer, N. K., Hunziker, S., & Marsch, S. C. U. (2011). Activities during interruptions in cardiopulmonary resuscitation: A simulator study. *Resuscitation*, *82*(11), 1419–1423. https://doi.org/10.1016/j.resuscitation.2011.06.023

Uitdewilligen, S., Rico, R., & Waller, M. J. (2018). Fluid and stable: Dynamics of team action patterns and adaptive outcomes. *Journal of Organizational Behavior*, *39*(9), 1113–1128. https://doi.org/10.1002/job.2267

Uitdewilligen, S., & Waller, M. J. (2018a). Information sharing and decision-making in multidisciplinary crisis management teams. *Journal of Organizational Behavior*, *39*(6), 731–748. https://doi.org/10.1002/job.2301

Uitdewilligen, S., & Waller, M. J. (2018b). Information sharing and decision-making in multidisciplinary crisis management teams. *Journal of Organizational Behavior*, *39*(6), 731–748.

van den Oever, F., & Schraagen, J. M. (2021). Team Communication Patterns in Critical Situations. *Journal of Cognitive Engineering and Decision Making*, *15*(1), 28–51. https://doi.org/10.1177/1555343420986657

van der Haar, S., Koeslag-Kreunen, M., Euwe, E., & Segers, M. (2017). Team Leader Structuring for Team Effectiveness and Team Learning in Command-and-Control Teams. *Small Group Research*, *48*(2), 215–248. https://doi.org/10.1177/1046496417689897

van der Meer, S. A., Lehmann-Willenbrock, N., Delahaij, R., & Homan, A. C. (2022). The Influence of Intrusions on Team Interaction: An Explorative Field Study. *Small Group Research*, 10464964211073590.

Van Der Vegt, G. S., & Bunderson, J. S. (2005). Learning and performance in multidisciplinary teams: The importance of collective team identification. *Academy of Management Journal*, *48*(3), 532–547.

Van Knippenberg, D., De Dreu, C. K., & Homan, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology*, *89*(6), 1008.

van Oortmerssen, L. A., van Woerkum, C. M. J., & Aarts, N. (2015). When Interaction Flows: An Exploration of Collective Creative Processes on a Collaborative Governance Board. *Group & Organization Management*, *40*(4), 500–528. https://doi.org/10.1177/1059601114560586

van Swol, L. M., & Ahn, P. H. (2021). Inside the Black Box: Group Processes and the Role of Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 157–170). Emerald Publishing Limited.

Vollrath, D. A., Sheppard, B. H., Hinsz, V. B., & Davis, J. H. (1989). Memory performance by decision-making groups and individuals. *Organizational Behavior and Human Decision Processes*, *43*(3), 289–300.

Volmer, J., & Sonnentag, S. (2011). The role of star performers in software design teams. *Journal of Managerial Psychology*, *26*(3), 219–234. https://doi.org/10.1108/02683941111112659

Wallace, I., Barratt, H., Harvey, S., & Raine, R. (2019). The impact of Clinical Nurse Specialists on the decision making process in cancer multidisciplinary team meetings: A qualitative study. *European Journal of Oncology Nursing*, *43*. psyh. https://doi.org/10.1016/j.ejon.2019.101674

Waller, M. J., & Kaplan, S. A. (2018a). Systematic behavioral observation for emergent team phenomena: Key considerations for quantitative video-based approaches. *Organizational Research Methods*, *21*(2), 500–515. https://doi.org/10.1177/1094428116647785

Waller, M. J., & Kaplan, S. A. (2018b). Systematic Behavioral Observation for Emergent Team Phenomena: Key Considerations for Quantitative Video-Based Approaches. *Organizational Research Methods*, *21*(2), 500–515. https://doi.org/10.1177/1094428116647785

Waller, M. J., Uitdewilligen, S., Rico, R., & Thommes, M. S. (2021). Interaction Pattern and Trajectory Analysis for Studying Group Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 135–153). Emerald Publishing Limited.

Walraven, J. E., van der Hel, O. L., van der Hoeven, J. J. M., Lemmens, V. E., Verhoeven, R. H., & Desar, I. M. (2022). Factors influencing the quality and functioning of oncological multidisciplinary team meetings: Results of a systematic review. *BMC Health Services Research*, *22*(1), 1–27.

Walraven, J. E., van der Meulen, R., van der Hoeven, J. J., Lemmens, V. E., Verhoeven, R. H., Hesselink, G., & Desar, I. M. (2022). Preparing tomorrow's medical specialists for participating in oncological multidisciplinary team meetings: Perceived barriers, facilitators and training needs. *BMC Medical Education*, *22*(1), 502.

Walter, J. K., Schall, T. E., DeWitt, A. G., Faerber, J., Griffis, H., Galligan, M., Miller, V., Arnold, R. M., & Feudtner, C. (2019). Interprofessional team member communication patterns, teamwork, and collaboration in pre–family meeting huddles in a pediatric cardiac intensive care unit. *Journal of Pain and Symptom Management*, *58*(1), 11–18.

Wang, B., Liu, Y., & Parker, S. K. (2020). How does the use of information communication technology affect individuals? A work design perspective. *Academy of Management Annals*, *14*(2), 695–725.

Wang, D., Gao, Q., Tan, H., Liu, Z., Zhou, L., Jia, L., & Li, Z. (2020). Coordination breakdowns in nuclear power plant control rooms: Cause identification and behaviour-sequence analysis. *Ergonomics*, *63*(6), 660–681.

Weigl, M., Antoniadis, S., Chiapponi, C., Bruns, C., & Sevdalis, N. (2015). The impact of intra-operative interruptions on surgeons' perceived workload: An observational study in elective general and orthopedic surgery. *Surgical Endoscopy*, *29*(1), 145–153. https://doi.org/10.1007/s00464-014-3668-6

Weingart, L. R. (2012). Studying dynamics within groups. In *Looking back, moving forward: A review of group and team-based research* (Vol. 15, pp. 1–25). Emerald Group Publishing Limited.

Weiss, H. M., & Cropanzano, R. (1996). Affective events theory. *Research in Organizational Behavior*, *18*(1), 1–74.

Wiesche, M. (2021). Interruptions in Agile Software Development Teams. *Project Management Journal*, *52*(2), 210–222. https://doi.org/10.1177/8756972821991365

Wittenbaum, G. M., Hollingshead, A. B., Paulus, P. B., Hirokawa, R. Y., Ancona, D. G., Peterson, R. S., Jehn, K. A., & Yoon, K. (2004). The functional perspective as a lens for understanding groups. *Small Group Research*, *35*(1), 17–43.

Wittenberg-Lyles, E., Goldsmith, J., & Ferrell, B. (2013). Oncology nurse communication barriers to patient-centered care. *Clinical Journal of Oncology Nursing*, *17*(2), 152–158. psyh. https://doi.org/10.1188/13.CJON.152-158

Wright, F. C., De Vito, C., Langer, B., & Hunter, A. (2007). Multidisciplinary cancer conferences: A systematic review and development of practice standards. *European Journal of Cancer*, *43*(6), 1002–1010. https://doi.org/10.1016/j.ejca.2007.01.025

Xiao, Y., Hunter, W. A., Mackenzie, C. F., Jefferies, N. J., Horst, R. L., & Group, L. (1996). SPECIAL SECTION: Task Complexity in Emergency Medical Care and Its Implications for Team Coordination. *Human Factors*, *38*(4), 636–645. https://doi.org/10.1518/001872096778827206

Xie, L., Beyerlein, M., & Han, S. J. (2022). Revealing deep interaction patterns of team learning processes through video-based interactive analysis. *International Journal of Human Resources Development and Management*. https://www.inderscienceonline.com/doi/abs/10.1504/IJHRDM.2021.120307

Zajac, S., Woods, A., Tannenbaum, S., Salas, E., & Holladay, C. L. (2021). Overcoming challenges to teamwork in healthcare: A team effectiveness framework and evidence-based guidance. *Frontiers in Communication*, *6*, 606445.

Zellmer-Bruhn, M., Waller, M. J., & Ancona, D. (2004). THE EFFECT OF TEMPORAL ENTRAINMENT ON THE ABILITY OF TEAMS TO CHANGE THEIR ROUTINES. In S. Blount (Ed.), *Time in Groups* (Vol. 6, pp. 135–158). Emerald Group Publishing Limited. https://doi.org/10.1016/S1534-0856(03)06007-9

Zijlstra, F. R., Waller, M. J., & Phillips, S. I. (2012). Setting the tone: Early interaction patterns in swift-starting teams as a predictor of effectiveness. *European Journal of Work and Organizational Psychology*, *21*(5), 749–777.

Zoethout, H., Wesselink, R., Runhaar, P., & Mulder, M. (2017). Using transactivity to understand emergence of team learning. *Small Group Research*, *48*(2), 190–214.

CHAPTER 4

Utterance based analysis of Communicative Phases in Multidisciplinary Health Care Team Meetings

ABSTRACT

Multidisciplinary health-care teams consist of highly experienced and specialized medical professionals who combine discipline-specific expertise to collaboratively discuss and make decisions on treatment recommendations for patients. This study provides fine-grained insights into *how* medical professionals arrive at treatment plans for patients in 38 multidisciplinary team meetings (MDTMs) encompassing 565 patient cases, in two different types of oncological board meetings. Drawing from minute-to-second communicative data, we examine the extent to which the team adheres to two decision-making process models (i.e., *unitary* and *multiple sequence models*). Using a mixed-method approach, we find empirical evidence for more back-and-forth communicative switches (i.e., evidence for *multiple sequence models*) underlying the decision-making process, especially in highly complex patient case discussions. Furthermore, teams that devote more time on collectively building a shared representation of the patient's background exhibit subsequently less communicative shifts and more efficient decision-making. Additionally, qualitative analysis shows that insufficient orientation is one of the main reasons for back-and-forth communicative shifts. We contribute to providing objective and fine-grained empirical insights into the decision-making process of real-life MDTMs.

Keywords: Multidisciplinary teams, decision-making, phase shifts, communicative phases, healthcare

INTRODUCTION

Multidisciplinary Team Meetings (MDTMs) have been widely accepted and implemented in health care settings around the world (Dinh et al., 2020; Edney et al., 2020; Omilion-Hodges et al., 2021; Saini et al., 2012). In a MDTM, medical professionals consisting of a variety of disciplines meet to discuss and decide on treatment recommendations for patient care (Rosell et al., 2019). MDTMs are highly valued and described in the literature as the 'golden standard' because of their positive effects: improved patient' outcomes in terms of survival rates (Kesson et al., 2012; Tamburini et al., 2018), higher patient satisfaction (Ibrahim et al., 2009) and improved decisions in treatment plans (Thenappan et al., 2017; Wright et al., 2007).

Despite these positive effects, empirical research shows that multidisciplinary team discussions are not always as *effective* or as *efficient* as we might expect (Ke et al., 2013; Zajac et al., 2021). Research suggests that *interaction problems* and *poor communication* are the most frequent causes of adverse events, medical errors, staff distress and tensions, as well as suboptimal patient treatment (Alvarez & Coiera, 2006; Sutcliffe et al., 2004). To illustrate, scholars report a deficit in team communication as the cause of 27 percent of cases of patient harm (Hohenstein et al., 2016). Moreover, it is important to optimize the communicative processes for efficiency for two main reasons. First, MDTMs are costly: the costs per patient case discussion is — on average — estimated at 212 EUR (with a range of 91-595 EUR; Alexandersson et al., 2018). As the average discussion time per patient is estimated at two minutes and given that MDTMs can take up to two hours, the total costs of these meetings is thus high (Mullan et al., 2014; Walraven, van der Meulen, et al., 2022). Secondly, the physicians' work environment is known for its high time pressure, meaning that physicians may highly benefit from applying more efficient practices (e.g., Walraven et al., 2022; Zajac et al., 2021). Although the importance of the communicative processes in MDTMs is widely acknowledged (Ruhstaller et al., 2006; Soukup et al., 2018; Spates et al., 2020), less attention has been given to the actual unfolding team communicative practices in the decision-making processes within MDTMs and how we can organize them more efficiently.

In this research, we aim to gain a fine-grained understanding of how multidisciplinary team (MDT) members collectively process and integrate information by looking into the underlying communicative decision-making process in depth. As communication is an essential factor and prerequisite for decision-making in MDTMs (Devitt et al., 2010; Schellenberger et al., 2021), we aim to advance our understanding of the decision-making process by analyzing how the team moves through various underlying communicative phases, as they occur in their temporal context. As opposed to more static team snapshots, we include temporality by zooming in on the team interaction over time, using minute and seconds video-based coding of the communicative phases that unfold over the course of the meeting in each patient case reviewal. This translates into a detailed conversational analysis that allows for a more nuanced and comprehensive understanding of how MDT members make decisions in practice. This approach answers various calls to study team processes in terms of observing real unfolding communicative behaviors over the collaboration period (Cronin et al., 2011; Waller & Kaplan, 2018a). Based on the group decision-making literature (Forsyth, 2018), we identify and apply distinct communicative phases (i.e., periods of time that enhance particular communicative focus) and investigate (1) how the MDT granularly moves through the decision-making process and (2) which ways of movements are more *efficient* ways of organizing.

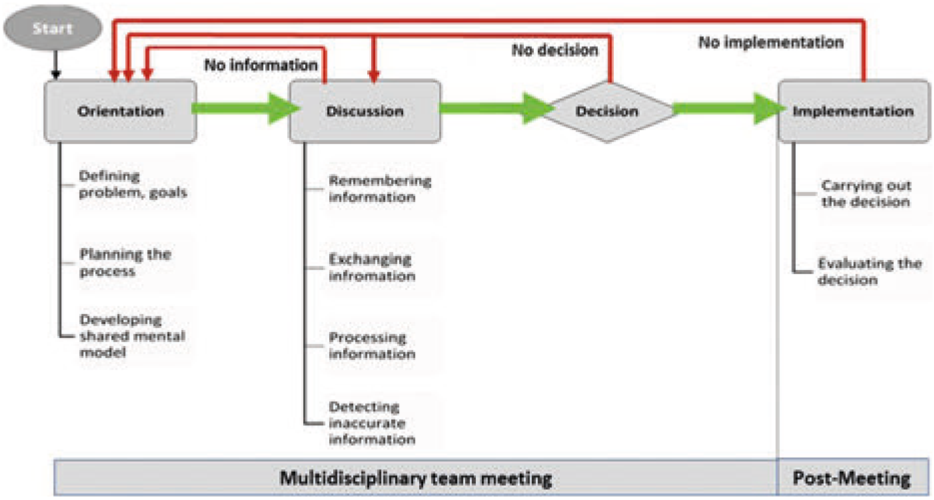
With this research, we advance knowledge about medical team decision-making in three important ways. Firstly, by investigating the specific communicative phases MDTs engage in, we gain detailed insight into the collective decision-making process that is central to the teams functioning. We contribute to the collective decision-making literature by describing in depth *why* and *when* the actual decision-making process exhibit either (1) more linear decision-making pathways or (2) more multiple sequences that shift across communicative phases, comparing two known theoretical angles in team science (Poole & Baldwin, 1986). Secondly, we adopt a more temporal approach looking at the occurrence of time-based decision-making phases and their sequential order, that have been found in the literature to be important for understanding team functioning (Cronin et al., 2011; Poole & Baldwin, 1986). Finally, we contribute to the medical field by translating the fine-grained communicative structural insights into recommendations for practice. Combined, our findings serve as a sound foundation to reflect on (in)efficient communicative practices in MDTMs.

In the following sections, we review the collective decision-making model (i.e., ODDI process model) that identifies fundamental underlying communicative phases that have been shown to apply well in the context of medical MDTMs (Forsyth, 2018; Soukup, Murtagh, Lamb, Green, et al., 2021). Thereafter, we summarize two main theoretical lenses (i.e. *unitary* and *multiple sequence models*) that researchers apply to process models of group decision-making (Poole & Baldwin, 1986).

THE ODDI PROCESS MODEL FOR COLLECTIVE DECISION-MAKING

Team researchers have used the Orientation-Discussion-Decision-Implementation (ODDI) model to understand, evaluate and improve decision-making in organizational teams (Forsyth, 2018). This model offers a conceptual analysis for the communicative phases that teams generally tend to follow when making a decision, based on the intended purpose of each phase in the overall decision-making process. A phase is defined as a period of coherent activity that serves some decision-related function (Poole & Baldwin, 1986). The four phases identified in the ODDI process model shown in Figure 4.1 (i.e., Orientation, Discussion, Decision and Implementation) are the core building blocks for team decision-making and problem solving (Simon, 2013). To explicate, the core problem or questions are presented and explored in the *orientation phase*. Thereafter, team members discuss, share and evaluate the information in the *discussion phase*. Subsequently, all inputs are combined into a solution in the *decision-making* phase, followed by the *implementation phase* in which the decision is put into action.

Figure 4.1
Orientation-Discussion-Decision-making framework of group decision-making. Adapted from Soukup et al. (2021)



Importantly, in their study on MDT meetings, Soukup et al. (2021) demonstrate the suitability of the ODDI model in medical group decision-making when MDT members collectively decide on treatment plans for patients. The underlying communicative decision-making phases fits this setting well, as each patient case reviewal starts with a summary of (1) the core problems, (2) a history of treatment and (3) other relevant patient information (i.e., *orientation phase*). Next, the MDTs exchange opinions and expertise, examine strengths and weaknesses of various treatment plan options in the *discussion phase*. For each patient case, a proposal (i.e., decision) is articulated, which can be an active treatment plan(e.g., surgery, radiotherapy or medication); but can also be to wait and do nothing (i.e., *decision-making phase*). During the patient case discussions in MDTMs, a conclusion must be formulated. After the patient discussion within the MDTM, the treatment proposal is carried out post-meeting to communicate and apply to the patient in the implementation phase.

COMPARISON OF TWO TEMPORAL PERSPECTIVES ON ODDI APPLICATION

The literature on MDTMs offer two temporal perspectives to account for the underlying ODDI decision-making pathways in the development of treatment plans for patients in MDTMs: (1) *unitary sequence models*; and (2) *multiple sequence models*.

The *'unitary sequence models'* perspective posits that a single set of sequential phases lead to a decision (Poole and Baldwin, 1986). Here, the underlying premise is that teams follow a linear pathway of ordered phases to build a decision. More specifically, MDTs first start with the orientation phase, subsequently head into the discussion phase and end with the decision-making phase. Proponents of this perspective argue that adherence to the ODDI model in a sequential order (i.e., orientation-discussion-decision) leads to more effective performance, better quality in decision-making and improved task efficiency (Soukup, Murtagh, Lamb, Green, et al., 2021; Tschan, 2002). As the team moves through these decision-making phases, communicative routines are established that describe to follow each phase in a sequential order (Cohen & Bacdayan, 1994; Tschan, 2002). These routines are important for the meetings' efficiency, so that the MDT does not need to re-invent ways on how to collectively decide on treatment plans.

Another theoretical perspective on these phase models argues that teams follow different developmental sequences, called '*multiple sequence models'* (Poole & Baldwin, 1986). These models do not neglect the occurrence of the set of sequences posited by the unitary sequence models, but argue that this is only one of many decision-making paths to follow. MDTs may also follow more complicated paths in which phases repeat themselves, meaning that the MDTs cycles back to previously completed phases as they re-discover problems or encounter difficulties (as indicated by the red arrows in Figure 4.1). As the decision-making process evolves as members attempt to fulfill what they see as requisites for qualitative decision-making, evidence has been found in the literature that teams loop back into previous communicative phases (Hirokawa & Poole, 1996).

Summarizing, the two perspectives (i.e. *unitary* and *multiple sequence models*) suggest different patterns of movement through the ODDI group decision-making framework. The first perspective (*unitary sequence models*) argues to follow a linear pathway, indicating moving from orientation to discussion, and from discussion to decision. The second perspective (*multiple sequence models*) argues that the team might deviate from unitary sequences to cycle back into previous phases. Thus, the number of '*phase shifts'* is indicative towards the underlying structure of the decision-making process and will be the focal variable in this study.

Using an exploratory research approach, our central goal is to unravel which model (unitary vs multiple sequence) holds best in the context of medical MDTMs. If the team moves from orientation to discussion (shift 1) and subsequently from discussion to decision-making (shift 2), we would have empirical evidence for unitary sequence models and linear decision-making pathways. On the other hand, more than two phase shifts indicates more back-and-forth communication, as the team jumps more often from one communicative phase to the other and hence provides support for the multiple sequence models. The exploration of these decision-making pathways is an important research topic, as it uncovers temporal patterns that govern collective decision-making. This, in turn, facilitates a better understanding of how MDTMs arrive at treatment plans, which serves as an evidence-based foundation to reflect on qualitative and efficient collaborative practices.

SHARED MENTAL MODEL LITERATURE AND TASK COMPLEXITY

Additionally, this exploratory research paper further aims to zoom in on the role of the orientation phase and the extent to which time spent in this initial orientation phase relates to how the meeting unfolds (in terms of *phase shifts* and *efficiency* of decision-making). According to the shared mental model literature, it is crucial to build a collective understanding of the patient's background and symptoms during the initial orientation phase (Maynard & Gilson, 2014; Mohammed & Dumville, 2001). Hence, investing sufficient time in this phase is crucial to develop a comprehensive understanding of the patient's problem and to ensure that subsequent conversations are productive (Orlitzky

& Hirokawa, 2001). Consequently, the time spent in the orientation phase can therefore be considered a critical input that shapes the subsequent decision-making process.

Finally, we look at the role of task complexity and how it effects the relation between time spent in the initial orientation phase and the subsequent decision-making process. It is important to consider that some patient cases are more routine, while others are more complex in nature. Thus, we consider the complexity of the patient case as a key contingency variable in this study (Mathieu et al., 2017; Xiao et al., 1996).

METHOD

Study context

The data collection took place between July 2021 – January 2022 in a non-academic European hospital. We audio and video recorded 38 weekly MDTMs in two different types of oncology departments (Sample 1; N_1 = 14, Sample 2; N_2 = 24). The hospital is organized in various types of oncology departments, such as neuro-oncology, immune-oncology, gynae-oncology, with each of these types having their own MDTM on a weekly basis. Due to privacy concerns and non-disclosure agreements, we removed all sample information that can be traced back to the specific type of the oncological MDTMs. The data was collected during the COVID-19 pandemic, meaning that the maximum number of people that were allowed within the meeting hospital room was limited. Therefore, some MDT members took part via an online videoconferencing tool, resulting in less members being physically present (especially interns/residents, which are doctors in training in order to become specialists). Each MDTM room was equipped with a videoconferencing system, allowing us to record audio and video of members in the meeting room as well as members present at other locations via videoconferencing stream. The study was granted ethical approval by a mid-western European Ethics Committee (complying with the national law on Medical Research in Humans) and informed consent was obtained from all MDT members.

Transcription and coding process

We captured the entire verbal communication flow during 38 MDTMs. The audio and video recordings were transcribed into time-stamped sequences of ‘who says what at what point in time’. The unit of analysis for the coding process is a verbal contribution that expresses or implies a complete thought of verbal speech (Bales, 1950). Table 4.1 shows an example of one patient case discussion, which illustrates all sequences of

Table 4.1
Conversational dataset example of 1 patient case discussion

Sender	Content	Coding decision-making process	Time
Physician 1	*'We start with number 6, which is ***, ** years old, is inserted through ***, has a lesion left cerebellar with a history of non-small cell lung carcinoma, would like your opinion and feedback. In September last year a non-small cell lung carcinoma left upper lobe, with on the MRI brain leptomeningeal extension not ruled out, but then she later gets another MRI after chemoradiation and it looks otherwise more normal. So there it does seem like something is there and in the meantime she is being treated with Daratumumap and so now she had a fall recurrence, long story short, 'n fall recurrence, further investigation initiated and dexamethasone started.'*	Exploration	0:09:05.5
Physician 2	*'And can you show the T2'*	Exploration	0:09:09.6
Physician 3	*'T2 shows air liquid level, clear, but little sediment?'*	Exploration	0:09:17.5
Physician 1	*'What do you see?'*	Exploration	0:09:19.2
Physician 3	*'Solitary abnormality, cerebellar, suspicious for metastases'*	**Exploration**	0:09:23.5
Physician 1	*'And do you have any evidence of leptomeningeal states on this MRI?'*	**Discussion**	0:09:28.9
Physician 3	*'No, no evidence of leptomeningeal'*	Discussion	0:09:30.2
Physician 1	*'Ok'*	Discussion	0:09:31.2
Physician 4	*'Puncture and ?'*	Discussion	0:09:32.7
Physician 1	*'Yes'*	Discussion	0:09:34.0
Physician 2	*'Yes, puncture and stereotactic radio-surgery?'*	Discussion	0:09:35.8

Table 4.1
Continued

Sender	Content	Coding decision-making process	Time
Physician 4	*'Yes'*	Discussion	0:09:36.4
Physician 1	*'Yes, that is a good proposal'*	**Conclusion**	0:09:39.7
Physician 4	*'Yes, if that goes well that's fine treatment right'*	**Conclusion**	0:09:42.4
Physician 2	*'If you look at T2 we see few partitions, I think a air liquid level*	**Discussion**	0:09:45.7
Physician 6	*'You can puncture this do you think?'*	Discussion	0:09:47.6
Physician 2	*'I think so'*	Discussion	0:09:49.7
Physician 6	*'Yes'*	**Discussion**	0:09:50.2
Physician 1	*'Biopsy and stereotactic radio-surgery, biopsy to relieve pressure is perhaps better'*	**Conclusion**	0:09:58.2
Physician 6	*'Agreed ***? '*	Conclusion	0:09:59.4
Physician 7	*'Yes yes yes, with subsequent gammaknife he'*	Conclusion	0:10:01.6
Physician 2	*'Yes'*	Conclusion	0:10:02.3

verbal contributions. Subsequently, each verbal contribution was coded into the three decision-making phases (i.e., orientation, discussion and decision-making phase; based on the ODDI group decision-making model from Forsyth, 2018) using a qualitative coding software program MAXQDA (Kuckartz & Rädiker, 2019; see Table 4.1 for an example). In total, 15568 verbal contributions were manually labeled each as either orientation, discussion or decision (N_1 = 12494 for the sample 1; and N_2 = 3056 for sample 2). One meeting was double coded to determine the inter-rater reliability between two independent coders (one social scientist and one medical physician), resulting in substantial agreement (κ = .748).

Measures

To understand how the decision-making process in patient case discussion across phases actually takes place, the number of times the team shifts from one communicative phase to the other is counted per patient case discussion (i.e., *phase shifts*). Table 4.1 shows an example of a patient case discussion and the bold transitions highlight phase shifts. Next, *team efficiency* is measured in terms of total amount of time (in seconds) it takes for the team to discuss the patient case in full (for similar approaches see; Abd El-Shafy et al., 2018; Siassakos et al., 2011). The *time in exploration* is calculated by the number of seconds that are devoted to building a collective representation regarding the patient background information and symptoms, before the first phase shift. Subsequently, several additional task characteristics are measured. One medical physician rated the *task complexity* for each patient case, independent of the conversations that took place, based on the electronic patient records (ranging from 1 = routine, low complex patient cases that mostly follow protocolar advice, to 7 = very rare, high complex patient cases; Schaink et al., 2012). Next, we added several control variables. First, we calculate whether the patient case was discussed in prior MDTMs (i.e., *repeating case*), as well as whether the case was discussed at the beginning or the end of the meeting (i.e., *order of discussion*). Next, the composition of different medical disciplines present in the teams is captured through *meeting compositional diversity.* Additionally, we captured the ratio of the number of people that are present in the core hospital face-to-face subgroup, compared to the number of people that call in virtually (i.e., *team virtuality*). Finally, we include *team size*, which reflects the total number of members present.

Data analysis

This paper adopts a mixed-method design, using both (1) quantitative and (2) qualitative approaches. For the quantitative part we make use of multi-level Poisson regression models in order to estimate how *time spent in the orientation phase* influences the underlying decision-making processes (i.e., *phase shifts*, *efficiency*). A Poisson distribution was deemed suitable for the data structure because we aim to predict count variables and because we need to account for the multilevel structure of the data, as patient case discussions are embedded in team meetings that occur on a weekly basis. Qualitative data analysis was rendered through a qualitative ethnographic analysis about the content of the transcript in order to understand why MDTs exhibit particular (deviating) decision-making pathways.

Sample characteristics

Table 4.2 includes the sample characteristics of two types of oncological MDTMs and show different characteristics. First, sample 1, as shown on the left side of Table 4.2, was found to be longer on average (*Mean* = 1h and 16min, *SD* = 15min) and discuss a greater number of patient cases per meeting (*Mean* = 31.79, *SD* = 5.39) in contrast to sample 2 (*Mean* = 18min, *SD* = 9min) and the number of patients that are discussed (*Mean* = 5.12, *SD* = 2.12). Moreover, we found in sample 1 a higher average number of attendees (*Mean* = 15.5, *SD* = 2.71), compared to sample 2 (*Mean* = 6.25, *SD* = 1.72). No notable differences in age or work experience were observed between the participants in the two MDTM types.

RESULTS

In the first part of the result section, we start by describing why some patient cases are excluded from further analysis. Next, we explore and describe the decision-making process in sample 1. Subsequently, we look into whether similar communicative patterns hold in sample 2, because one important part of testing the robustness of findings is to replicate the effect in another type of MDTM. In the second part of this study, we explore how the initial orientation phase relates to the collective decision-making process quantitatively in terms of decision-making movement (i.e., *phase shifts*) and *efficiency*. We conclude this result section with a more qualitative approach, to give meaning towards our quantitative findings.

First, looking at sample 1, we explore the interaction process of 431 patient case reviews embedded in the 14 MDTMs. However, we find that 32 patient case discussions end with the initial orientation phase and thus did not proceed into the full decision-making process (e.g., due to insufficient available information and late registrations;

Table 4.2
Comparison of descriptive characteristics of sample 1 and sample 2

	Sample 1 (*N* = 14 MDTMs)					**Sample 2** (*N* = 24 MDTMs)				
Meeting characteristics	*Min.*	*Max*	*Mean*	*SD*	*Total*	*Min.*	*Max*	*Mean*	*SD*	*Total*
Meeting duration (HH:MM:SS)	00:41:17	01:32:32	01:16:44	00:15:18	17:54:15	00:04:36	00:42:34	00:18:32	00:09:15	07:25:00
Number of cases discussed per meeting	21	40	31.79	5.39	431	2	9	5.12	2.12	134
Individual characteristics										
Age	27	59	41.24	8.3	/	26	60	41.13	9.54	/
Work experience	0	25	8.22	6.23	/	0	29	8	9.28	/

4

see Table 4.3 for transcript examples). The time spent in introducing these patient cases is a first indicator of inefficiency in MDTMs, which will be discussed more in depth in the practical implications section.

Figure 4.2 illustrates how the MDTs move through the orientation-discussion-decision-making pathways, looking at patient case discussions that went through the full decision-making process (N = 399). Each horizontal line represents the decision-making process for one patient case discussions displayed in seconds. Patient case discussions are visually ordered by time, meaning that patient cases solved more quickly are shown in the top lines of the figure, while patient cases that take longer are shown more at the bottom of Figure 4.2. The empty spaces in between the decision-making process reflect side conversations or interruptions, which represents content not related to the development of the patient's treatment plan. In the sample zoom-in in Figure 4.2, we can microscopically see how four patient case discussions unfold over time in terms of content of communicative phases. In the first two lines, we see that the patient cases follow a 'routine' sequence of first orientation, followed by discussion and ending with the decision-making phase (i.e., two phase shifts), which provides us with empirical evidence for unitary sequence models. However, from the third patient case onwards, we see more deviation from this linear pathway, which is evidence for the MDTs following multiple sequence models. To illustrate, in patient case 3 in Figure 4.2, we can see the MDT briefly shifting towards the discussion after orientation, to quickly head back into the orientation. Subsequently, the MDT seems to alternate between discussion and decision-making phases multiple times. Right before the final decision, we see an additional shift heading back into the orientation phase (total count of nine phase shifts in patient case three). The fourth patient case example visualizes how the team heads back multiple times into the orientation phase after starting the discussion, resulting in a similar count of nine phase shifts, however highlighting different patterns of shifting. In sum, Figure 4.2 provides us with first empirical evidence for high variation in terms of (1) how often the team shifts from one phase to the other and (2) how 'efficient' the decision is reached in terms of time. We see on the top of Figure 4.2 that several patient cases are solved rather quickly, while others at the bottom of Figure 4.2 take more time.

Table 4.3
Reasons why patient cases do not proceed to full decision-making review

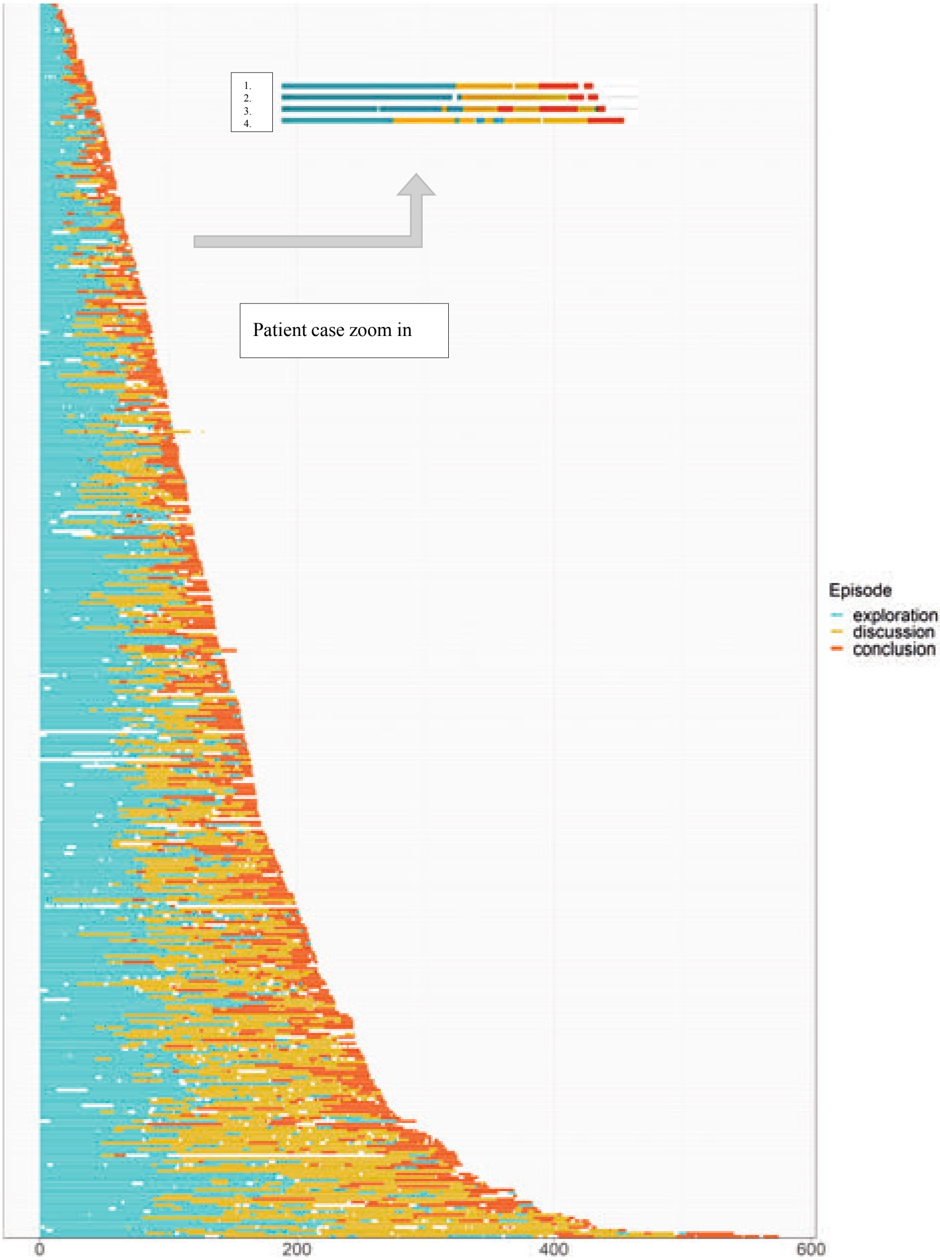
	Description reason	Amount of cases	Amount of time in HH:MM:SS	Transcript examples
Insufficient information / preparation	Due to incomplete biopsy results, the discussion cannot proceed to full review. A biopsy is a procedure to remove a sample of abnormal tissue for examination under a microscope to show whether the present tumor is (not) cancerous. If the pathologist suspects certain types of cancer, additional molecular testing may determine subtype.	27	00:25:25	… *'number 2 is Mrs. ***'* *'there is still material from decalcification. I don't have yet* *''okay, will come back next week'* … *' Mrs. ***, biopsy of an intra axial lesion right parietal/occipital, uhm yes'* *' it now requires supplementary molecular'* *'waiting for that analysis, and come back next week?* *'Yes'* …
	Patient case is registered last minute for MDTM reviewal, resulting in the e.g., radiologist not being able to review imaging.	3	00:05:43	… *'shall we skip those given the time '* *'cause you just didn't get any image or '* *'very late again so not being able to watch XXX did you put these patients on the list '* *'yes so we just haven't been able to look at the images yet they came in very late so if he just doesn't uh if the case is not urgent then we actually want to not to discuss that '* *'but it's a radiological question so I guess if you guys look at this tomorrow then '* …

Table 4.3
Continued

	Description reason	Amount of cases	Amount of time in HH:MM:SS	Transcript examples
Feedback	MDT member may give feedback regarding the current state of a patient, without the need for the patient case going for full decision-making review (e.g., sharing information that the patient revived).	2	00:02:08	… *' I know that one, she came out of XXX in an acute setting, completely constricted, with wide light stiff pupils and deformed, she works in the hospital herself, and yes with the CT , then surgery, it was clearly a tumor during the surgery, and after the surgery she is completely well recovered, she is going home today'* *'oh super'* … *'then we go to Mrs. oh yes I just put that on there purely for informing you about a patient who was earlier on the MDO, Mrs. XXX who was supposed to get a biopsy today for a glioblastoma suspected lesion, but XXX called me last night that that Mrs. was much worse, she was known to us in the MDO, and that is indeed true. I saw that lady today together with XXX and that lady is hemiparalytic in bed, dazed and we decided not to proceed with biopsy. And she is back to XXX and will be receiving palliative care."* *'That is severe'* …

Figure 4.2

Sequences of how MDTs cycle through communicative phases in patient case discussions



* The x-axis represents the number of seconds for each patient case discussion. Each horizontal line represents one patient case discussion

Quantitative analysis

To investigate these two topics more in detail, Table 4.4 shows the descriptive statistics including (1) number of *phase shifts* per patient case discussion and (2) *team efficiency* in terms of total amount of time spent per patient case.

Firstly, the data in Table 4.4 (from sample 1) shows that the MDTs shift across decision-making phases on average approximately four times (*Mean* = 4.34, *SD* = 3.25) per patient case, which is in contrast to what is described in the unitary sequence models as an efficient way of communicating (Poole & Baldwin, 1986; Soukup, Murtagh, Lamb, Green, et al., 2021; Tschan, 2002). Additionally, the maximum number of phase shifts adds up to twenty, which provides us with empirical evidence for multiple sequence models that illustrate more back-and-forth communicative patterns. Secondly, Table 4.4 showcases high variation in terms of how efficient the MDT reaches decisions regarding treatment plans, ranging from thirteen seconds to up to almost nine minutes and 45 seconds (*Mean* = 2 min 34 sec, *SD* = 1 min 35 sec).

Next, we are interested whether these findings hold in sample 2. One important part of testing the robustness of findings is to replicate the effects in another type of MDTM, with different team compositional features (as described in the method section). We explored the interaction process of 119 patient case reviews embedded in 24 MDTM (this final sample excluded fifteen patient cases that did not go through full review). The research findings were similar to that of sample 1 as it was found, that the MDT on average shifts four times (*Mean* = 4.15, *SD* = 3.39). The number of phase shifts increases again up to nineteen times, resulting in empirical evidence for the multiple sequence models. Thus, we see a similar communicative phase shifting trend in both samples.

Additionally, we investigated whether the duration of the initial orientation phase relates to subsequent decision-making pathways. The correlation Table 4.4 reveals a negative correlation between the duration of the initial orientation phase and the number of subsequent phase shifts (r = -.55, $p < .01$) and with the time it takes the team to reach a decision (r = -.50, $p < .01$). In the second sample, we see a similar tendency meaning that the more time the MDTM spends in the orientation phase, the less the MDT shifts subsequently (r = - 46, $p < .01$); and the faster the team reaches a decision (r = -.41, $p <$ .01). Taken together, the results provide sound evidence of the importance of investing sufficient time in the initial orientation phase, which facilitates efficient decision-making and reduce the tendency and need for frequent phase shifts.

Table 4.4
Means, standard deviations, minimum and maximum scores and correlation of all variables in neuro-oncology sample (N= 399)

	M	*SD*	Min	Max	1.	2.	3.	4.	5.	6.	7.	8.
Patient case variables												
1. Phase shifts	4.34	3.25	1	20								
2. Team efficiency *(in HH:MM:SS)*	00:02:34	00:01:35	00:00:13	00:09:35	**.65**** [.59, .71]							
3. Time in Orientation [a]	0.51	0.20	0.05	0.96	**-.55**** [-.61, -.48]	**-.50**** [-.57, -.43]						
4. Complexity [b]	3.27	1.49	1	7	**.33**** [.24, .42]	**.47**** [.39, .55]	**-.27**** [-.36, -.18]					
5. Repeating case [c]	0.81	0.82	0	2	**-.10*** [-.20, -.00]	-.06 [-.16, .04]	.02 [-.08, .11]	.08 [-.02, .18]				
6. Order of discussion [d]	0.53	0.29	0.025	1	**.18**** [.09, .28]	**.31**** [.22, .40]	-.06 [-.16, .03]	**.23**** [.13, .32]	.05 [-.05, .15]			
Meeting characteristics												
7. Meeting composition diversity [e]	1.00	0.21	0.44	1.27	.04 [-.06, .14]	-.09 [-.18, .01]	.06 [-.04, .15]	.05 [-.04, .15]	-.08 [-.18, .02]	.00 [-.10, .10]		
8. Team size	15.52	2.28	11	19	-.04 [-.14, .06]	-.09 [-.18, .01]	.05 [-.05, .14]	.00 [-.09, .10]	-.06 [-.16, .04]	.00 [-.09, .10]	**.63**** [.56, .68]	

4

Table 4.4
Continued

	M	*SD*	Min	Max	1.	2.	3.	4.	5.	6.	7.	8.
9. Ratio Face-to-face vs virtual [f]	0.63	0.11	.43	0.88	.08 [-.02, .18]	.06 [-.04, .15]	**-.16**** [-.26, -.07	.04 [-.06, .14]	0.00 [-.10, .10]	.02 [-.08, .12]	**-.38**** [-.46, -.29]	.03 [-.07, .13]

Notes.
[a] Time in orientation is a ratio variable of the number of absolute time in seconds that is spent in the initial orientation phase (before the first shift), divided by the total number of patient case discussion time
[b] Complexity is calculated by a 7 point Likert scale (1= not complex at all, rather routine patient, 7= very rare, complex patient case. The coding is performed by a physician in training for internal medicine, based on medical experience
[c] The repeated case is represented as an ordinal variable (0= first time the patient is discussed in the MDT, 1 = the patient has been reviewed in the MDTM once before, 2= the patient has been reviewed more than once).
[d] The order of the discussion is calculated by the order in which the meeting follows; the 5th patient out of 25 total number of patients per meeting reflects a progression score of 0.2.
[e] The meeting composition diversity is calculated by taking the standard deviation from the number of unique disciplines present per meeting. The lower the number, the more equal disciplines are present, the higher the number, the more one discipline is dominating the meeting.
[f] The ratio face-to-face vs virtual is calculated by taking the total number of team members present in the core hospital group face-to-face, divided by the total number of people present (including via videoconferencing). A number of .57 indicates that the majority is present face-to-face.
* = $p < .05$; ** = $p < .001$

These findings were further explored through a multilevel Poisson regression model to predict the number of times the MDT shifts from one phase to the other, based on the time that was spent in the initial orientation phase (see left side of Table 4.5). We were only able to run the multilevel Poisson Regression model for sample 1 because of the rather low patient case sample in the sample 2. The model in Table 4.5 shows that the relative time spent in the orientation phase was a significant negative predictor of the incidence rate for the number of times the team shifts subsequently (b = -0.14, *s.e.* = 0.03, $p < .001$). The Incidence Rate Ratio (IRR) suggests that for every 10% extra time spent in the initial orientation phase, the number of time the team shifts phases changes by a factor of 0.80. That means that the more time is spent in the initial orientation phase, the number of phase shifts decrease exponentially. Similarly, relative time spent in the orientation phase was a significant negative predictor for the total case discussion time (b = -0.12, *s.e.* = 0.01, $p < .001$). The IRR suggests that for every 10% extra time spent in the initial orientation phase, the amount of time it takes to reach a decision changes by a factor of 0.84. That means that the more time is spent in the initial orientation phase, the more 'efficient' the team reaches a decision (i.e., time drops exponentially).

We also consider the role of task complexity, as patient cases vary in their complexity. Our analysis reveals that the complexity of the patient case is positively associated with the number of phase shifts ($r = .33$, $p < .01$) and with the time taken to reach a decision ($r = .47$, $p < .01$). Interestingly, we find that the more complex the case, the less time is spent by the team in the initial orientation phase ($r = -.27$, $p < .01$), opposing the expectation that the team would spend more time exploring the patient's core problems for complex cases.

To control for potential confounding variables, we included several control variables in our analysis. Firstly, we investigated whether the patient case had been discussed before (i.e., whether it is a repeating case) and found only a slight decrease in the number of phase shifts during the MDTM when a case had been discussed previously ($r = -.10$, $p < .05$). Secondly, we explored the order of discussion (i.e., whether the patient case was discussed at the beginning or towards the end of the meeting). As the meeting progressed, the MDT shifted more between phases ($r = .18$, $p < .01$) and required more time to make treatment decisions ($r = .31$, $p < .01$). However, patient case complexity increases over the course of the meeting ($r = .23$, $p < .01$), which may affect the increase in phase shifts and decision-making time.

Table 4.5
Multilevel Poisson Regression Model for sample 1

	Multilevel Poisson regression model							
Predictors	Only predictor				Including complexity and controls			
	Outcome: Phase shifts		Outcome: team efficiency		Outcome: Phase shifts		Outcome: team efficiency	
	Incidence Rate Ratios [CI]	*p*	*Incidence Rate Ratios[CI]*	*p*	*Incidence Rate Ratios[CI]*	*p*	*Incidence Rate Ratios [CI]*	*p*
Intercept	12.07 [10.44 – 13.97]	**< .001**	349.51 [327.23 – 373.30]	**< .001**	4.99 [2.15 – 11.57]	**< .001**	236.72 [122.24 – 458.38]	**< .001**
Time in orientation	0.80 [0.78 – 0.82]	**< .001**	0.84	**< .001**				
Meeting composition diversity					1.63 [0.93 – 2.87]	0.090	0.78 [0.49 – 1.25]	0.300
Team size					0.96 [0.91 – 1.00]	0.065	0.98 [0.95 – 1.02]	0.382
Team virtuality					1.60 [0.70 – 3.66]	0.266	0.82 [0.41 – 1.63]	0.563
Repeating case					0.90 [0.85 – 0.95]	**< .001**	0.92 [0.91 – 0.93]	**< .001**
Order of discussion					1.41 [1.18 – 1.68]	**< .001**	1.68 [1.63 – 1.73]	**< .001**
Complexity					1.19 [1.09 – 1.28]	**< .001**	1.20 [1.19 – 1.22]	**< .001**

Table 4.5
Continued

	Multilevel Poisson regression model							
Predictors	Only predictor				Including complexity and controls			
	Outcome: Phase shifts		Outcome: team efficiency		Outcome: Phase shifts		Outcome: team efficiency	
	Incidence Rate Ratios [CI]	*p*	*Incidence Rate Ratios[CI]*	*p*	*Incidence Rate Ratios[CI]*	*p*	*Incidence Rate Ratios [CI]*	*p*
Time in orientation					0.87 [0.82 – 0.92]	**< .001**	0.89 [0.88 – 0.90]	**< .001**
Time in orientation * Complexity					0.98 [0.96 – 1.00]	**0.027**	0.99 [0.99 – 1.00]	**< .001**
Random Effects								
σ^2	0.21		0.01		0.21		0.01	
τ00	0.02 MDT		0.01 MDT		0.01 MDT		0.02 MDT	
ICC	0.09		0.68		0.06		0.71	
N	14 MDT							
Observations	399		399		399		399	
Marginal R^2 / Conditional R^2	0.465 / 0.511		0.855 / 0.954		0.514 / 0.545		0.902 / 0.972	

We re-ran the multilevel Poisson regression model with all variables described above to investigate whether the effects of time spent in the initial orientation phase still holds for predicting (1) the phase shifts and (2) team efficiency when taking these characteristics into account. The effects remain similar: the more time spent in the initial orientation phase, the less teams shift subsequently and the quicker the task is solved. Given that task complexity is known in the literature as an important moderating factor, we explored whether the effect of time spent in the orientation phase on the decision-making process holds across task complexity levels. The findings indicate that the effect of more time spent in the initial orientation phase reduces phase shifts and increases efficiency consistently occurred in both simple and complex patient cases. (see moderation effect of patient complexity in Figure 4.3 and 4.4).

Qualitative analysis

The quantitative analyses showed that MDTMs shift frequently between decision-making phases, but they do not show *why* this happens. Especially the more 'extreme' phase shifting (up to twenty times) are unexpected and appear to reflect an unstructured and inefficient way of discussing patient cases. 'Extreme' phase shifting is defined as discussions that cycle ten or more times back-and-forth through the orientation-discussion-'decision-making' phases, operationalized as two standard deviations from the mean number of phase shifts. To explore *why* MDTs shift many times, this section employs a qualitative micro-ethnography, which generally aims to microscopically analyze naturally occurring human interaction (Streeck & Mehus, 2005). This approach allows us a more detailed examination of transcripts of patient case discussions with intense shifting patterns and reflect on reasons why these shifts take place.

The following stages describe our analytical process. Firstly, we identified all patient case discussions that showcase 'extreme' phase shifts in both type of oncological MDTMs (defined as ten or more phase shifts per patient case discussion). In sample 1, fourteen patient cases qualified for additional analysis and sample 2 added six patient cases. Secondly, we read through the transcripts and highlighted when 'unusual' shifts took place. We define unusual shifts as shift that go against the linear pathway of unitary sequence models. For example, the move from orientation to discussion is a logical linear shift, however the move from discussion back to orientation is 'unusual.' Subsequently, we read through the whole transcript context and identified general themes to give insight into why the team initiates extra shifts. Through a process of repeated comparison across patient case conversations, we identified various reasons for unusual shifts, that will be discussed more in detail below.

Figure 4.3

Prediction of phase shifts based on time in orientation phase

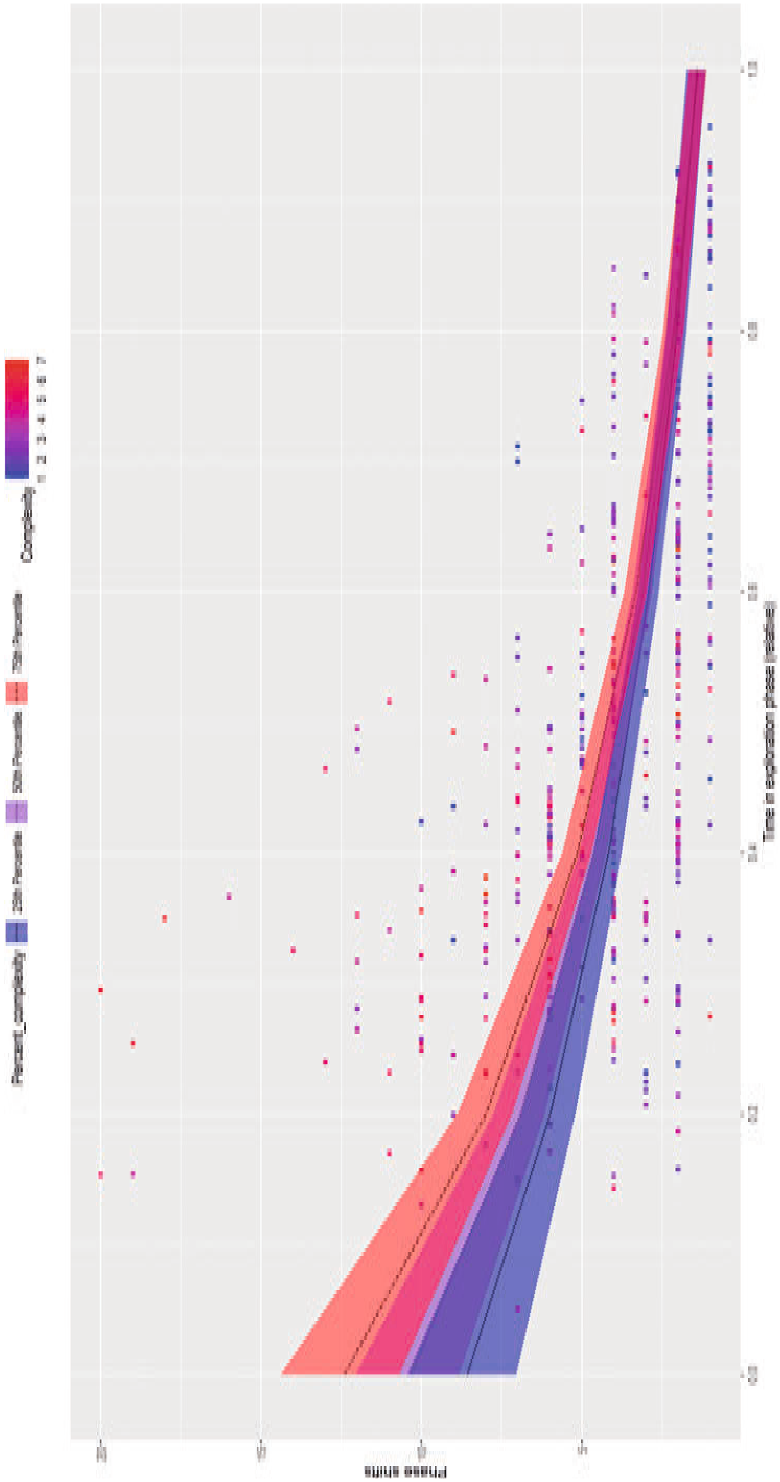


Figure 4.4
Prediction of team efficiency based on time in orientation phase

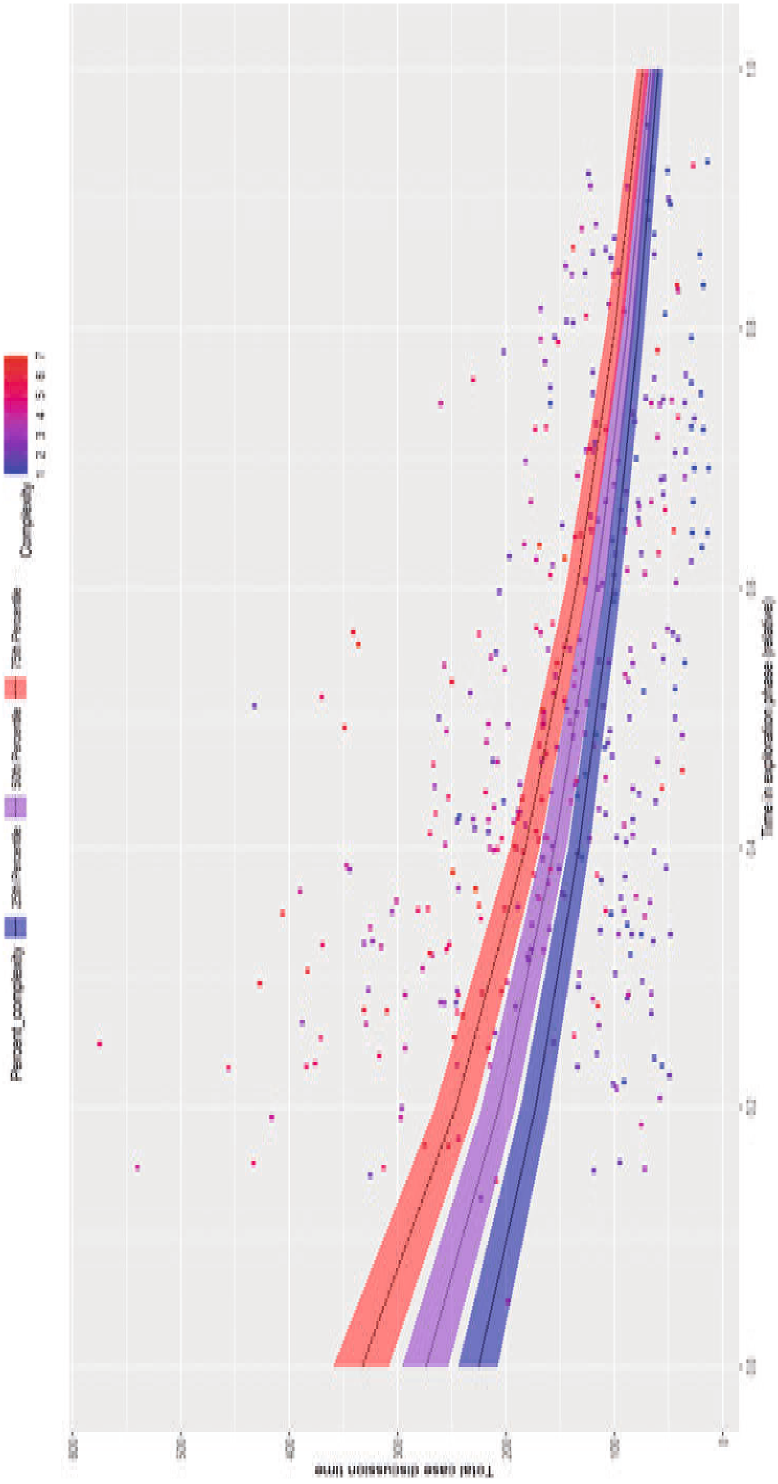


Table 4.6
Transcripts examples from reasoning why MDTs showcase 'unusual' shifts

	Example transcript	Code phase
Shift from discussion back into orientation	… Physician 1: 'I think that we should maybe do a lumbar puncture'	Discussion
	Physician 2: '*yes I think that too'*	Discussion
	Physician 3: 'That is already done, it is listed'	Orientation
	Physician 4: 'Yes you should look in here'	Orientation
	Physician 3: 'There has been done so much in terms of diagnostics' …	Orientation
Shift from decision back into discussion	… Physician 1: 'wait and see policy, control radiological as well as clinical, …'	Decision
	Physician 2: 'I try to get clear where we are actually going, you can also wait and see and if the lesion changes and if the staining disappears, that it would suit a demyelinating lesion'	Discussion
	Physician 3: '*Sure'*	Discussion
	Physician 2: 'you can consider the LP, and add pro momori, yes'	Decision
	Physician 3:'I didn't think it was such a problem to do this with LP, but I'm trying to get a clear picture of what we really want to achieve with that, and I don't think you really get any real certainty with it'…	Discussion

Shift from decision/discussion back into orientation

The majority of unusual shifts back into the orientation phase 'signals' that the initial orientation phase was *cut off too early* or was *not well-prepared*, meaning that important information is lacking, that should have been mentioned prior (see Table 4.6 for transcript examples). For example, we see discussions among physicians after initial orientation suggesting potential treatments, in which one physician interrupts to shift back into the orientation phase to share that these treatment suggestions are not feasible due to patient's medical history or because the proposed treatments have already been attempted. We put forward that this 'new' orientation information steers the content of the discussion into different directions. The time spent discussing these treatment options could have been saved if explicitly mentioned in the initial orientation phase. We notice discussions heading back into the orientation phase multiple times, in which additional patient case information steers the discussion phase into different directions. Such findings affirm the quantitative data analysis which suggests that the initial orientation phase was insufficiently addressed.

Another reason why the MDT shifts back to the orientation stage is because clarification is sought about content that has been shared previously. We generally observe these type of MDTMs as highly interruptive (i.e., members leaving entering the room, beepers that go off), which may result in information getting lost and thus not forming into a shared collective representation within the orientation phase. This leads to clarification statements and questions during the discussion phase, that have been mentioned before in the orientation phase. Another reason why the MDT shifts back into the orientation phase — in contrast to less efficient reasons for 'phase shifts' described prior — entails a small number of shifts where attentive physicians ask for crucial, very specific additional information pieces regarding prior treatments (i.e., orientation statement) during a discussion phase (e.g., 'and which doses has been administered exactly?'). While such information is not expected to be a 'logical' part of the initial orientation phase, it can be considered crucial to this particular case and necessary to develop a suitable treatment plan.

Shift from decision back into discussion.

Another decision pathway that is 'unusual' reflects heading back into the discussion phase, after a decision has been put forward. Team members repeatedly open up prior discussion phases after a decision has been shared because we notice a dissatisfaction or hesitation with the treatment plan that has been put forward. We see team members reopening the discussion phase to give a deeper understanding of the suitability of treatment plan and potential change. In the conversational transcripts in Table 4.6, we observe physician 2 and 3 questioning the decision, and thus shifting back into the discussion phase. Another major reason for shifting back into the discussion phase occurs when physicians want to add towards the decision that has been rendered by suggesting a contingency plan. If the situation changes in the meantime or if additional diagnostics showcase deviation from the current state, the advice is contingent on changing additional information. Although it may require more time discussing the patient case upfront, it may save time in the long run as changes in the patient's condition occurs.

In sum, while we conclude that unusual phase shifting is not necessarily a maladaptive practice that reflects inherently unstructured conversations, we do find evidence that the majority of extreme unusual shifts, — especially those back into the orientation phase — suggests that the initial orientation phase was incomplete. That is, a scattered and fast initial orientation phase may lead the team to cycle back into the orientation phase, after conducting discussions that were not aligned with the core needs of the patient. This is time that could be used more efficiently and may distract discussion from the actual problem of the patient.

A final remark that caught our attention in this qualitative analysis is that eleven patient cases did go through full review and decision-making, even though the radiologist could not prepare the imaging due to late patient registrations. The conversation transcript highlighted in Table 4.7 showcases this recurrent pattern.

Table 4.7
Dispute regarding unprepared patient reviewal with radiologist

Sender	Content
	…
Radiologist	*'Those images were really really late so I didn't prepare these, uh I don't really want to discuss the patient either as we agreed'*
Physician 1	*'Yes'*
Radiologist	*'No I don't think that is acceptable'*
Physician 1	*'Show it to me XXX, come on'*
Radiologist	*'No I'm not going to do it, I'm not going to do it'*
Physician 1	*'But we want to see it'*
Radiologist	*'Yes you can see it but I'm not going to say anything about it'*
Physician 1	*'We're not going to wait a week for it, right '*
Radiologist	*'No but you also understand if there are 40 patients on such a list then'*
Physician 1	*'I get it, I get it'*
Radiologist	*'And yes who wants that, this is just bad patient care'*
Physician 1	*'May we see the imaging then'*
Radiologist	*'You may see those'*
Physician 2	*'Yes so we have to ask if XXX wants this a little earlier from now on'*
Radiologist	*'And that also applies to Mr. XXX and another patient XXX'*
Physician 2	*'Yes no we understand you very well XXX and it is very difficult, despite trying to communicate that as clearly as possible'*
Physician 3	*'XXX is also in her right, because we agreed to not discuss the late patient registrations'*
Physician 2	*'Yes you are right too'*
Radiologist	*'I find it, especially it's for the patient not quite uh neat'*
	…

DISCUSSION

The results of our analysis provides granular empirical evidence for the way in which MDTs cycle through the collective decision-making process in varying patient case discussions. First, we observed high numbers of phase shifts in the decision-making process between the orientation, discussion, and decision-making phases, which can be an indicator for a fairly unstructured decision-making process. That is surprising, as prior literature describes lower number of phase shifts (congruent with unitary sequence models) as a more efficient way of organizing (Soukup, Murtagh, Lamb, Green, et al., 2021; Tschan, 2002). Importantly, we showed that the more time spent in the orientation phase, the number of phase shifts decreases exponentially, in simple as well as complex patient cases. This means that the more time the MDT spends to build a collective representation of the patient case, the more focused and structured the subsequent discussion is likely to be. Furthermore, we observed that the longer the team spends in the orientation phase, the faster the MDT decides on treatment plans for patients. The latter provides insights regarding how the orientation phase may trigger a more efficient subsequent problem-solving conversation. These findings are in line with prior empirical papers that find that insufficient problem analysis (i.e., orientation phase) diminishing the team's success (Wittenbaum et al., 2004).

Additional qualitative analysis allows us to further nuance our quantitative findings. It is important to note that 'unusual' phase shifts are not necessarily maladaptive practice, instead, it serves various functions that benefit the natural flow of information exchange. Nevertheless, our quantitative insights in combination with qualitative insights around reasoning for 'extreme' shifting, suggests that inefficient discussions are mostly rooted in insufficient orientation, in which we see great potential for improvement. We believe specialists are unaware of this communicative pattern, which this research highlights to be key for understanding and subsequently finding alternative ways of organizing MDTMs.

Theoretical implications

Our results provide several key implications for theory concerning group decision-making in multidisciplinary health care teams. Firstly, our study sheds light on the conversational structure underlying the decision-making process in MDTM, a previous more unexplored phenomenon in such micro-level behavioral way. Therefore, this study extends previous research on group decision-making interaction studying team behavior in a more granular way (Soukup et al., 2021). While earlier research studies principally provide descriptive thematic qualitative analysis of the decision-making process (Frykholm & Groth, 2011; Wallace et al., 2019), we go beyond this mere description by providing fine grained unfolding minutes-to-seconds footage of how MDTs reach decisions. These findings underscore the need to study granular interactional analysis as it provides insights in actual team patterns, as we are currently unaware of their existence (i.e., especially the 'extreme' shifting discussions). We provide empirical evidence for linear decision-making pathways as routine behaviors (i.e., evidence for unitary sequence models), but also for more back-and-forth communicative structures that are more in line with multiple sequence models.

Additionally, we looked into explanatory variables and found that the orientation phase serves as a foundation to have a structured and efficient discussion subsequently. We contribute to the shared mental model literature by showcasing how the initial orientation phase positively influences the subsequent decision-making process. These effects are consistent under conditions of high or low task complexity. Initially, we would assume the effect would only hold in high complex case discussions, however the findings further demonstrate that in less complex cases it is similarly important to spend sufficient time in the orientation phase. In sum, our study answers recent calls for a more temporal, fine-grained perspective on studying actual behavior in teams (Kolbe & Boos, 2019; Lehmann-Willenbrock & Allen, 2018b).

Practical implications

This paper combines insights from social science and fine-grained observations in order to facilitate the communicative processes in cancer care. We propose practical directions for improving the way in which MDT members discus patient cases. Firstly, we find a substantial portion of patient cases that are initiated in the MDTM, but cannot proceed to full review, because information is lacking or due to insufficient preparation. The time spent sharing the initial orientation phase when the patient cannot be fully discussed is unnecessary time spent. Thus, we propose that if an individual MDT member prepares the meeting in more depth (i.e., patient case 'gatekeeper'), focusing on selecting only patients that include complete information, this can result in more efficient and less lengthy MDTMs. Next, we observe high number of phase shifts as a recurrent interaction pattern in MDTM. We believe specialists are unaware of this pattern and by shedding light on what is not visible with the unaided eye, we believe this is the key for understanding and subsequently finding alternative ways of organizing MDTMs. Specifically, we advise the team to spend sufficient time in the initial orientation phase in order to understand the key information pieces regarding the patient case, because that facilitates the discussion subsequently in terms of focus and efficiency. If team members initiate shifts early in the patient case discussions, a meeting chair could facilitate the discussion back into the orientation phase. In our qualitative analysis, we find that the MDT mostly cycles back into the orientation phase because crucial information regarding the patient case was not present in the initial orientation phase. This again provides us with evidence that there is room for improvement in that initial orientation, that steers the discussion in either a focused or more chaotic back-and-forward communicative structure.

Limitations

These contributions should be viewed in light of the study's limitations. Primarily, the variable 'team efficiency' is operationalized in terms of how fast the task is solved: when we work efficiently, we use less time in order to solve the task. However, we do not include effectiveness measures, meaning we keep away from any value judgements that align with evaluating the conversations' effectiveness. Moreover, although we were able to replicate the findings in another type of MDTM, the two samples are embedded in the same hospital. That is important to consider as, because prior research — using survey methods design — found that there is substantial variation in the decision-making process across 39 different countries around the world (Saini et al., 2012). That means we need to be careful with the generalizability of our findings. Finally, the explorative nature of the research design warrants further replication to confirm how various contingency variables influence the decision-making process.

Future research

As such there are various future research opportunities. First, the implementation phase described in the ODDI group decision-making model is not part of the scope of current study, however an important element to further examine. Particularly, we are interested in exploring if treatment recommendations (i.e., decisions that are put forward within the MDTM) are implemented and if not, explore the reasons for (1) non-implementation or (2) change in the actual administration to patients. Additionally, future research might find features within the decision-making process that contributes to proposals within the MDTMs being more or less likely to be implemented in practice.

Next, the visualization shown in Figure 4.2 indicates that the MDTM environment is highly interruptive (e.g., beepers that go off, people leaving entering the room, side-conversations). Our data allows us to gain initial (visual) insights into how often patient case discussions are interrupted. Future research might explore more in depth how often and the reasons why patient case discussions are interrupted and subsequently how it influences the decision-making process. Recent literature provides us with a first indication that interruptions impact the way in which teams communicate (van der Meer et al., 2022), which is an intriguing and interesting road to explore more in depth.

CONCLUSION

Taking into account that multidisciplinary teams follow a decision-making process in which they flow through sequences respectively of the orientation, discussion and decision-making phase, our findings show that teams seem to deviate from this overall communication pattern. That is, higher number of phase shifts provides us with evidence for a more back-and-forth decision-making process, especially in complex patient case discussions. This paper further finds that the time spent in the initial orientation phase plays a significant role for the structure and efficiency subsequently. The longer the team spends in the initial orientation phase, the more structured and focused the conversation subsequently. As Albert Einstein is quoted as having said: "If I had an hour to solve a problem, I'd spend 55 minutes thinking about the problem and five minutes thinking about solutions."

Given the increasing financial pressures on healthcare (Wakefield et al., 2020), costly practices of MDTMs (Alexandersson et al., 2018), staff shortage (Slotman et al., 2020), high workloads resulting in time pressure (Zajac et al., 2021) and lengthy MDTM adding to these pressures, it seems important to reflect on efficient ways of organizing. A first step into this direction is provided by gaining insight into the communicative structures of patient case discussions in which fine-grained communication structures of MDT members are explored.

REFERENCES

Abd El-Shafy, I., Delgado, J., Akerman, M., Bullaro, F., Christopherson, N. A., & Prince, J. M. (2018). Closed-loop communication improves task completion in pediatric trauma resuscitation. *Journal of Surgical Education*, *75*(1), 58–64.

Addas, S., & Pinsonneault, A. (2013). *IT Interruptions and Coordination Effectiveness in Software Development Groups: A Conceptual, Multilevel Model*. 6.

Addas, S., & Pinsonneault, A. (2018). E-mail interruptions and individual performance: Is there a silver lining? *MIS Quarterly*, *42*(2), 381–406. https://doi.org/10.25300/MISQ/2018/13157

Alexandersson, N., Rosell, L., Wihl, J., Ohlsson, B., Steen Carlsson, K., & Nilbert, M. (2018). Determinants of variable resource use for multidisciplinary team meetings in cancer care. *Acta Oncologica*, *57*(5), 675–680. https://doi.org/10.1080/0284186X.2017.1400682

Altmann, E. M., Trafton, J. G., & Hambrick, D. Z. (2014). Momentary interruptions can derail the train of thought. *Journal of Experimental Psychology: General*, *143*(1), 215–226. https://doi.org/10.1037/a0030986

Alvarez, G., & Coiera, E. (2006). Interdisciplinary communication: An uncharted source of medical error? *Journal of Critical Care*, *21*(3), 236–242.

Ancona, D. G., Goodman, P. S., Lawrence, B. S., & Tushman, M. L. (2001). Time: A new research lens. *Academy of Management Review*, *26*(4), 645–663.

Arber, A. (2008). Team Meetings in Specialist Palliative Care: Asking Questions as a Strategy Within Interprofessional Interaction. *Qualitative Health Research*, *18*(10), 1323–1335. https://doi.org/10.1177/1049732308322588

Arrow, H., McGrath, J. E., & Berdahl, J. L. (2000). *Small groups as complex systems: Formation, coordination, development, and adaptation*. Sage Publications.

Aubé, C., & Rousseau, V. (2016). Yes, we complain … so what? *Journal of Managerial Psychology*, *31*(7), 1137–1151. https://doi.org/10.1108/JMP-08-2015-0304

Ayoko, O. B., Konrad, A. M., & Boyle, M. V. (2012). Online work: Managing conflict and emotions for performance in virtual teams. *European Management Journal*, *30*(2), 156–174. https://doi.org/10.1016/j.emj.2011.10.001

Baethge, A., & Rigotti, T. (2013). Interruptions to workflow: Their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands. *Work & Stress*, *27*(1), 43–63. https://doi.org/10.1080/02678373.2013.761783

Baethge, A., Rigotti, T., & Roe, R. A. (2015). Just more of the same, or different? An integrative theoretical framework for the study of cumulative interruptions at work. *European Journal of Work and Organizational Psychology*, *24*(2), 308–323.

Bales, R. F. (1950). A set of categories for the analysis of small group interaction. *American Sociological Review*, *15*(2), 257–263.

Barsade, S. G. (2002). The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly*, *47*(4), 644–675.

Barsade, S. G., & Knight, A. P. (2015). Group affect. *Annual Review of Organizational Psychology and Organizational Behavior*, *2*(1), 21–46.

Barth, S., Schraagen, J. M., & Schmettow, M. (2015). Network measures for characterising team adaptation processes. *Ergonomics*, *58*(8), 1287–1302. https://doi.org/10.1080/00140139.2015.1009951

Begemann, V., Lübstorf, S., Meinecke, A. L., Steinicke, F., & Lehmann-Willenbrock, N. (2021). Capturing Workplace Gossip as Dynamic Conversational Events: First Insights From Care Team Meetings. *Frontiers in Psychology*, *12*. https://www.frontiersin.org/article/10.3389/fpsyg.2021.725720

Bennett, M. S., Erchul, W. P., Young, H. L., & Bartel, C. M. (2012). Exploring Relational Communication Patterns in Prereferral Intervention Teams. *Journal of Educational and Psychological Consultation*, *22*(3), 187–207. https://doi.org/10.1080/10474412.2012.706128

Bonito, J. A., & Keyton, J. (2018). Introduction to machine learning. *The Cambridge Handbook of Group Interaction Analysis*, 387–404.

Boos, M. (2018). CoCo: A category system for coding coherence in conversations. *The Cambridge Handbook of Group Interaction Analysis*, 502–509.

Bruine de Bruin, W., & Morgan, M. G. (2019). Reflections on an interdisciplinary collaboration to inform public understanding of climate change, mitigation, and impacts. *Proceedings of the National Academy of Sciences*, *116*(16), 7676–7683.

Burgoon, J. K., & Dunbar, N. E. (2018). *Coding nonverbal behavior*.

Carey, H. R., & Laughlin, P. R. (2012). Groups perform better than the best individuals on letters-to-numbers problems: Effects of induced strategies. *Group Processes & Intergroup Relations*, *15*(2), 231–242. https://doi.org/10.1177/1368430211419174

Cheshin, A., Rafaeli, A., & Bos, N. (2011). Anger and happiness in virtual teams: Emotional influences of text and behavior on others' affect in the absence of non-verbal cues. *Organizational Behavior and Human Decision Processes*, *116*(1), 2–16.

Cochran, A., & Elder, W. B. (2015). Effects of disruptive surgeon behavior in the operating room. *The American Journal of Surgery*, *209*(1), 65–70.

Cohen, M. D., & Bacdayan, P. (1994). Organizational routines are stored as procedural memory: Evidence from a laboratory study. *Organization Science*, *5*(4), 554–568.

Crawford, E. R., & Lepine, J. A. (2013). A configural theory of team processes: Accounting for the structure of taskwork and teamwork. *Academy of Management Review*, *38*(1), 32–48.

Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? *Academy of Management Annals*, *5*(1), 571–612.

David, L. Z., & Schraagen, J. M. (2018). Analysing communication dynamics at the transaction level: The case of Air France Flight 447. *Cognition, Technology & Work*, *20*(4), 637–649.

Davis, J., Burrows, J. F., Ben Khallouq, B., & Rosen, P. (2017). Predictors of patient satisfaction in pediatric oncology. *Journal of Pediatric Oncology Nursing*, *34*(6), 435–438. psyh. https://doi.org/10.1177/1043454217717239

Davis, W. A., Jones, S., Crowell-Kuhnberg, A. M., O'Keeffe, D., Boyle, K. M., Klainer, S. B., Smink, D. S., & Yule, S. (2017). Operative team communication during simulated emergencies: Too busy to respond? *Surgery*, *161*(5), 1348–1356. https://doi.org/10.1016/j.surg.2016.09.027

Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*, 19–43.

Devitt, B., Philip, J., & McLachlan, S.-A. (2010). Team dynamics, decision making, and attitudes toward multidisciplinary cancer meetings: Health professionals' perspectives. *Journal of Oncology Practice*, *6*(6), e17–e20.

Dew, K., Stubbe, M., Signal, L., Stairmand, J., Dennett, E., Koea, J., Simpson, A., Sarfati, D., Cunningham, C., & Batten, L. (2015). Cancer care decision making in multidisciplinary meetings. *Qualitative Health Research*, *25*(3), 397–407.

Dinh, J. V., Traylor, A. M., Kilcullen, M. P., Perez, J. A., Schweissing, E. J., Venkatesh, A., & Salas, E. (2020). Cross-Disciplinary Care: A Systematic Review on Teamwork Processes in Health Care. *Small Group Research*, *51*(1), 125–166. https://doi.org/10.1177/1046496419872002

Edney, L. C., Gray, J., & Karnon, J. (2020). A scoping review of the economics of multidisciplinary teams in oncology care. *Journal of Cancer Policy*, *26*, 100257. https://doi.org/10.1016/j.jcpo.2020.100257

Espevik, R., Johnsen, B. H., & Eid, J. (2011). Communication and Performance in Co-Located and Distributed Teams: An Issue of Shared Mental Models of Team Members? *Military Psychology*, *23*(6), 616–638. https://doi.org/10.1080/08995605.2011.616792

Feyerherm, A. E., & Rice, C. L. (2002). EMOTIONAL INTELLIGENCE AND TEAM PERFORMANCE: THE GOOD, THE BAD AND THE UGLY. *The International Journal of Organizational Analysis*, *10*(4), 343–362. https://doi.org/10.1108/eb028957

Fischer, U., McDonnell, L., & Orasanu, J. (2007). Linguistic correlates of team performance: Toward a tool for monitoring team functioning during space missions. *Aviation, Space, and Environmental Medicine*, *78*(5), B86–B95.

Fletcher, K. A., Potter, S. M., & Telford, B. N. (2018). Stress outcomes of four types of perceived interruptions. *Human Factors*, *60*(2), 222–235.

Forsyth, D. R. (2018). *Group dynamics*. Cengage Learning.

Fox, S., & Comeau-Vallée, M. (2020). The negotiation of sharing leadership in the context of professional hierarchy: Interactions on interprofessional teams. *Leadership*, *16*(5), 568–591. https://doi.org/10.1177/1742715020917817

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4), 331–362.

Galluch, P., Grover, V., & Thatcher, J. (2015). Interrupting the Workplace: Examining Stressors in an Information Technology Context. *Journal of the Association for Information Systems*, *16*(1). https://doi.org/10.17705/1jais.00387

Gerpott, F. H., Chiu, M. M., & Lehmann-Willenbrock, N. (2020). Multilevel antecedents of negativity in team meetings: The role of job attitudes and gender. *Managing Meetings in Organizations*.

Gersick, C. J., & Hackman, J. R. (1990). Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*, *47*(1), 65–97.

Gibbs, J. L., Sivunen, A., & Boyraz, M. (2017). Investigating the impacts of team type and design on virtual team processes. *Human Resource Management Review*, *27*(4), 590–603. https://doi.org/10.1016/j.hrmr.2016.12.006

Gillespie, B. M., Chaboyer, W., & Fairweather, N. (2012). Interruptions and Miscommunications in Surgery: An Observational Study. *AORN Journal*, *95*(5), 576–590. https://doi.org/10.1016/j.aorn.2012.02.012

Gorse, C. A., & Emmitt, S. (2007). Communication behaviour during management and design team meetings: A comparison of group interaction. *Construction Management and Economics*, *25*(11), 1197–1213. https://doi.org/10.1080/01446190701567413

Gundrosen, S., Andenæs, E., Aadahl, P., & Thomassen, G. (2016). Team talk and team activity in simulated medical emergencies: A discourse analytical approach. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *24*(1), 135. https://doi.org/10.1186/s13049-016-0325-1

Hackman, J. R. (1987). *The design of work teams. InHandbook of Organizational Behavior, ed. JW Lorsch*. Englewood Cliffs, NJ: Prentice-Hall.

Hareli, S., & Rafaeli, A. (2008). Emotion cycles: On the social influence of emotion in organizations. *Research in Organizational Behavior*, *28*, 35–59.

Härgestam, M., Lindkvist, M., Brulin, C., Jacobsson, M., & Hultin, M. (2013). Communication in interdisciplinary teams: Exploring closed-loop communication during in situ trauma team training. *BMJ Open*, *3*(10), e003525.

Higgins, L. E., & Smith, J. M. (2022). Documenting development of interdisciplinary collaboration among researchers by visualizing connections. *Research Evaluation*, *31*(1), 159–172.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin*, *121*(1), 43.

Hirokawa, R. Y., & Poole, M. S. (1996). *Communication and Group Decision Making*. SAGE Publications, Incorporated. http://ebookcentral.proquest.com/lib/uvtilburg-ebooks/detail.action?docID=996520

Hmieleski, K. M., & Cole, M. S. (2022). Laughing all the way to the bank: The joint roles of shared coping humor and entrepreneurial team-efficacy in new venture performance. *Entrepreneurship Theory and Practice*, *46*(6), 1782–1811.

Hohenstein, C., Fleischmann, T., Rupp, P., Hempel, D., Wilk, S., & Winning, J. (2016). German critical incident reporting system database of prehospital emergency medicine: Analysis of reported communication and medication errors between 2005-2015. *World Journal of Emergency Medicine*, *7*(2), 90. https://doi.org/10.5847/wjem.j.1920-8642.2016.02.002

Hoogeboom, M. A., & Wilderom, C. P. (2020). A complex adaptive systems approach to real-life team interaction patterns, task context, information sharing, and effectiveness. *Group & Organization Management*, *45*(1), 3–42.

Horlait, M., Baes, S., Dhaene, S., Van Belle, S., & Leys, M. (2019). How multidisciplinary are multidisciplinary team meetings in cancer care? An observational study in oncology departments in Flanders, Belgium. *Journal of Multidisciplinary Healthcare*, *12*, 159–167. https://doi.org/10.2147/JMDH.S196660

Humphrey, S. E., Hollenbeck, J. R., Meyer, C. J., & Ilgen, D. R. (2007). Trait configurations in self-managed teams: A conceptual examination of the use of seeding for maximizing and minimizing trait variance in teams. *Journal of Applied Psychology*, *92*(3), 885.

Hung, H., Murray, G., Varni, G., Lehmann-Willenbrock, N., Gerpott, F. H., & Oertel, C. (2020). Workshop on Interdisciplinary Insights into Group and Team Dynamics. *Proceedings of the 2020 International Conference on Multimodal Interaction*, 876–877.

Ibrahim, T., Flamini, E., Fabbri, L., Serra, P., Mercatali, L., Ricci, R., Sacanna, E., Falasconi, M. C., Casadei, R., & Galassi, R. (2009). Multidisciplinary approach to the treatment of bone metastases: Osteo-Oncology Center, a new organizational model. *Tumori Journal*, *95*(3), 291–297.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annu. Rev. Psychol.*, *56*, 517–543.

Jacobsson, M., Hargestam, M., Hultin, M., & Brulin, C. (2012). Flexible knowledge repertoires: Communication by leaders in trauma teams. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *20*(1), 44. https://doi.org/10.1186/1757-7241-20-44

Janssens, M., Meslec, N., & Leenders, R. (2022). Collective intelligence in teams: Contextualizing collective intelligent behavior over time. *Frontiers in Psychology*.

Jett, Q. R. (2003). Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life. *Academy of Management Review*, 14.

Johns, G. (2006). The essential impact of context on organizational behavior. *Academy of Management Review*, *31*(2), 386–408.

Jouanne, E., Charron, C., Chauvin, C., & Morel, G. (2017). Correlates of team effectiveness: An exploratory study of firefighter's operations during emergency situations. *Applied Ergonomics*, *61*, 69–77. https://doi.org/10.1016/j.apergo.2017.01.005

Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. *Small Group Research*, *43*(2), 130–158.

Kauffeld, S., & Meyers, R. A. (2009). Complaint and solution-oriented circles: Interaction patterns in work group discussions. *European Journal of Work and Organizational Psychology*, *18*(3), 267–294.

Ke, K. M., Blazeby, J. M., Strong, S., Carroll, F. E., Ness, A. R., & Hollingworth, W. (2013). Are multidisciplinary teams in secondary care cost-effective? A systematic review of the literature. *Cost Effectiveness and Resource Allocation*, *11*(1), 1–13.

Kesson, E. M., Allardice, G. M., George, W. D., Burns, H. J. G., & Morrison, D. S. (2012). Effects of multidisciplinary team working on breast cancer survival: Retrospective, comparative, interventional cohort study of 13 722 women. *BMJ*, *344*, e2718. https://doi.org/10.1136/bmj.e2718

Keyton, J. (2018). Interaction analysis: An introduction. *The Cambridge Handbook of Group Interaction Analysis*, *10*(9781316286302.002), 3–19.

Keyton, J., & Beck, S. J. (2009). The influential role of relational messages in group interaction. *Group Dynamics: Theory, Research, and Practice*, *13*(1), 14.

Klonek, F. E., Meinecke, A. L., Hay, G., & Parker, S. K. (2020). Capturing team dynamics in the wild: The communication analysis tool. *Small Group Research*, *51*(3), 303–341.

Klonek, F. E., Quera, V., Burba, M., & Kauffeld, S. (2016). Group interactions and time: Using sequential analysis to study group dynamics in project meetings. *Group Dynamics: Theory, Research, and Practice*, *20*(3), 209.

Koduru, A., Valiveti, H. B., & Budati, A. K. (2020). Feature extraction algorithms to improve the speech emotion recognition rate. *International Journal of Speech Technology*, *23*(1), 45–55.

Kolbe, M., Grote, G., Waller, M. J., Wacker, J., Grande, B., Burtscher, M. J., & Spahn, D. R. (2014). Monitoring and talking to the room: Autochthonous coordination patterns in team interaction and performance. *Journal of Applied Psychology*, *99*(6), 1254.

Kozlowski, S. W., & Chao, G. T. (2018). Unpacking team process dynamics and emergent phenomena: Challenges, conceptual advances, and innovative methods. *American Psychologist*, *73*(4), 576.

Kozlowski, S. W., & Klein, K. J. (2000). *A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes.*

Lee, A. H., Wang, K., Scott, J. A., Yau, K. K. W., & McLachlan, G. J. (2006). Multi-level zero-inflated Poisson regression modelling of correlated count data with excess zeros. *Statistical Methods in Medical Research*, *15*(1), 47–61. https://doi.org/10.1191/0962280206sm429oa

Leenders, R. T. A., Contractor, N. S., & DeChurch, L. A. (2016). Once upon a time: Understanding team processes as relational event networks. *Organizational Psychology Review*, *6*(1), 92–115.

Lehmann-Willenbrock, N., & Allen, J. A. (2014). How fun are your meetings? Investigating the relationship between humor patterns in team interactions and team performance. *Journal of Applied Psychology*, *99*(6), 1278–1287. https://doi.org/10.1037/a0038083

Lehmann-Willenbrock, N., & Allen, J. A. (2018a). Modeling temporal interaction dynamics in organizational settings. *Journal of Business and Psychology*, *33*(3), 325–344.

Lehmann-Willenbrock, N., & Allen, J. A. (2018b). Modeling Temporal Interaction Dynamics in Organizational Settings. *Journal of Business and Psychology*, *33*(3), 325–344. https://doi.org/10.1007/s10869-017-9506-9

Lehmann-Willenbrock, N., Allen, J. A., & Kauffeld, S. (2013). A sequential analysis of procedural meeting communication: How teams facilitate their meetings. *Journal of Applied Communication Research*, *41*(4), 365–388.

Lehmann-Willenbrock, N., Beck, S. J., & Kauffeld, S. (2016). Emergent team roles in organizational meetings: Identifying communication patterns via cluster analysis. *Communication Studies*, *67*(1), 37–57.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2013). *The upward spirals in team processes: Examining dynamic positivity in problem solving teams*.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2017). Understanding positivity within dynamic team interactions: A statistical discourse analysis. *Group & Organization Management*, *42*(1), 39–78.

Lei, Z., Waller, M. J., Hagen, J., & Kaplan, S. (2016). Team adaptiveness in dynamic contexts: Contextualizing the roles of interaction patterns and in-process planning. *Group & Organization Management*, *41*(4), 491–525.

Leroy, S., Schmidt, A. M., & Madjar, N. (2020). Interruptions and task transitions: Understanding their characteristics, processes, and consequences. *Academy of Management Annals*, *14*(2), 661–694.

Liu, F., & Maitlis, S. (2014). Emotional Dynamics and Strategizing Processes: A Study of Strategic Conversations in Top Team Meetings. *Journal of Management Studies*, *51*(2), 202–234. https://doi.org/10.1111/j.1467-6486.2012.01087.x

Luciano, M. M., DeChurch, L. A., & Mathieu, J. E. (2018). Multiteam systems: A structural framework and meso-theory of system functioning. *Journal of Management*, *44*(3), 1065–1096.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, *26*(3), 356–376.

Marlow, S. L., Lacerenza, C. N., Paoletti, J., Burke, C. S., & Salas, E. (2018). Does team communication represent a one-size-fits-all approach?: A meta-analysis of team communication and performance. *Organizational Behavior and Human Decision Processes*, *144*, 145–170. https://doi.org/10.1016/j.obhdp.2017.08.001

Mathieu, J. E., Gallagher, P. T., Domingo, M. A., & Klock, E. A. (2019). Embracing complexity: Reviewing the past decade of team effectiveness research. *Annual Review of Organizational Psychology and Organizational Behavior*, *6*, 17–46.

Mathieu, J. E., Hollenbeck, J. R., van Knippenberg, D., & Ilgen, D. R. (2017). A century of work teams in the Journal of Applied Psychology. *Journal of Applied Psychology*, *102*(3), 452.

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. (2002). *Multiteam systems*.

Maynard, M. T., Conroy, S., Lacerenza, C. N., & Barnes, L. Y. (2021). Teams in the wild are not extinct, but challenging to research: A guide for conducting impactful team field research with 10 recommendations and 10 best practices. *Organizational Psychology Review*, *11*(3), 274–318. https://doi.org/10.1177/2041386620986597

McComb, S., & Kennedy, D. (2020). *Computational methods to examine team communication*. Springer.

McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14). Prentice-Hall Englewood Cliffs, NJ.

Mehta, D., Siddiqui, M. F. H., & Javaid, A. Y. (2019). Recognition of emotion intensities using machine learning algorithms: A comparative study. *Sensors*, *19*(8), 1897.

Mitchell, A. J., Hussain, N., Grainger, L., & Symonds, P. (2011). Identification of patient-reported distress by clinical nurse specialists in routine oncology practice: A multicentre UK study. *Psycho-Oncology*, *20*(10), 1076–1083. psyh. https://doi.org/10.1002/pon.1815

Mohammed, S., & Dumville, B. C. (2001). Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *22*(2), 89–106.

Mohammed, S., Hamilton, K., & Lim, A. (2008). The incorporation of time in team research: Past, current, and future. *Team Effectiveness in Complex Organizations*, 355–382.

Moirano, R., Sánchez, M. A., & Štěpánek, L. (2020). Creative interdisciplinary collaboration: A systematic literature review. *Thinking Skills and Creativity*, *35*, 100626. https://doi.org/10.1016/j.tsc.2019.100626

Moreland, R. L. (2010). Are dyads really groups? *Small Group Research*, *41*(2), 251–267.

Mullan, B. J., Brown, J. S., Lowe, D., Rogers, S. N., & Shaw, R. J. (2014). Analysis of time taken to discuss new patients with head and neck cancer in multidisciplinary team meetings. *British Journal of Oral and Maxillofacial Surgery*, *52*(2), 128–133.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Murugappan, M., & Mutawa, A. (2021). Facial geometric feature extraction based emotional expression classification using machine learning algorithms. *Plos One*, *16*(2), e0247131.

Nancarrow, S. A., Booth, A., Ariss, S., Smith, T., Enderby, P., & Roots, A. (2013). Ten principles of good interdisciplinary team work. *Human Resources for Health*, *11*(1), 19. https://doi.org/10.1186/1478-4491-11-19

Nicholson, G., Pugliese, A., & Bezemer, P.-J. (2017). Habitual accountability routines in the boardroom: How boards balance control and collaboration. *Accounting, Auditing & Accountability Journal*, *30*(2), 222–246. https://doi.org/10.1108/AAAJ-07-2015-2143

Nyoni, C. N., Grobler, C., & Botma, Y. (2021). Towards Continuing Interprofessional Education: Interaction patterns of health professionals in a resource-limited setting. *PLOS ONE*, *16*(7), e0253491. https://doi.org/10.1371/journal.pone.0253491

Okhuysen, G. A., & Eisenhardt, K. M. (2002). Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility. *ORGANIZATION SCIENCE*, *13*(4), 18.

Oldeweme, M., Konradt, U., & Brede, M. (2021). The rhythm of teamwork: Discovering a complex temporal pattern of team processes. *Group Dynamics: Theory, Research, and Practice*. https://doi.org/10.1037/gdn0000175

Omilion-Hodges, L. M., Imes, R., & Hester, J. (2021). Editorial: Team and Leader Communication in the Healthcare Context: Building and Maintaining Optimal Transdisciplinary Teams. *Frontiers in Communication*, *6*. https://www.frontiersin.org/article/10.3389/fcomm.2021.669399

Parush, A., Kramer, C., Foster-Hunt, T., McMullan, A., & Momtahan, K. (2014). Exploring similarities and differences in teamwork across diverse healthcare contexts using communication analysis. *Cognition, Technology & Work*, *16*(1), 47–57. https://doi.org/10.1007/s10111-012-0242-7

Pavitt, C. (2014). An interactive input–process–output model of social influence in decision-making groups. *Small Group Research*, *45*(6), 704–730.

Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Research Synthesis Methods*, *5*(4), 371–385. https://doi.org/10.1002/jrsm.1123

Poole, M. S., & Baldwin, C. L. (1986). Developmental processes in group decision making. *Communication and Group Decision-Making*, 35–62.

Puranik, H., Koopman, J., & Vough, H. C. (2020). Pardon the Interruption: An Integrative Review and Future Research Agenda for Research on Work Interruptions. *Journal of Management*, *46*(6), 806–842. https://doi.org/10.1177/0149206319887428

Puranik, H., Koopman, J., & Vough, H. C. (2021). Excuse me, do you have a minute? An exploration of the dark-and bright-side effects of daily work interruptions for employee well-being. *Journal of Applied Psychology*.

Purvanova, R. K., & Kenda, R. (2021). The impact of virtuality on team effectiveness in organizational and non-organizational teams: A meta-analysis. *Applied Psychology*.

Raab, M., & Gigerenzer, G. (2005). Intelligence as smart heuristics. In *Cognition and intelligence: Identifying the mechanisms of the mind* (pp. 188–207). Oxford University Press.

Raes, E., Boon, A., Kyndt, E., & Dochy, F. (2015). Measuring team learning behaviours through observing verbal team interaction. *Journal of Workplace Learning*.

Ramos-Villagrasa, P. J., Marques-Quinteiro, P., Navarro, J., & Rico, R. (2018). Teams as complex adaptive systems: Reviewing 17 years of research. *Small Group Research*, *49*(2), 135–176.

Rezvani, A., Barrett, R., & Khosravi, P. (2018). Investigating the relationships among team emotional intelligence, trust, conflict and team performance. *Team Performance Management: An International Journal*, *25*(1/2), 120–137. https://doi.org/10.1108/TPM-03-2018-0019

Rivera-Rodriguez, A. J., & Karsh, B.-T. (2010). Interruptions and distractions in healthcare: Review and reappraisal. *BMJ Quality & Safety*, *19*(4), 304–312.

Rosell, L., Wihl, J., Hagberg, O., Ohlsson, B., & Nilbert, M. (2019). Function, information, and contributions: An evaluation of national multidisciplinary team meetings for rare cancers. *Rare Tumors*, *11*, 2036361319841696.

Ruhstaller, T., Roe, H., Thürlimann, B., & Nicoll, J. J. (2006). The multidisciplinary meeting: An indispensable aid to communication between different specialities. *European Journal of Cancer*, *42*(15), 2459–2462. https://doi.org/10.1016/j.ejca.2006.03.034

Saini, K. S., Taylor, C., Ramirez, A.-J., Palmieri, C., Gunnarsson, U., Schmoll, H.-J., Dolci, S. M., Ghenne, C., Metzger-Filho, O., & Skrzypski, M. (2012). Role of the multidisciplinary team in breast cancer management: Results from a large international survey involving 39 countries. *Annals of Oncology*, *23*(4), 853–859.

Santos, R., Bakero, L., Franco, P., Alves, C., Fragata, I., & Fragata, J. (2012). Characterization of non-technical skills in paediatric cardiac surgery: Communication patterns†. *European Journal of Cardio-Thoracic Surgery*, *41*(5), 1005–1012. https://doi.org/10.1093/ejcts/ezs068

Sauer, N. C., & Kauffeld, S. (2013). Meetings as Networks: Applying Social Network Analysis to Team Interaction. *Communication Methods and Measures*, *7*(1), 26–47. https://doi.org/10.1080/19312458.2012.760729

Schaink, A. K., Kuluski, K., Lyons, R. F., Fortin, M., Jadad, A. R., Upshur, R., & Wodchis, W. P. (2012). A scoping review and thematic classification of patient complexity: Offering a unifying framework. *Journal of Comorbidity*, *2*(1), 1–9.

Schecter, A., Pilny, A., Leung, A., Poole, M. S., & Contractor, N. (2018). Step by step: Capturing the dynamics of work team process through relational event sequences. *Journal of Organizational Behavior*, *39*(9), 1163–1181. https://doi.org/10.1002/job.2247

Schellenberger, B., Diekmann, A., Heuser, C., Gambashidze, N., Ernstmann, N., & Ansmann, L. (2021). Decision-Making in Multidisciplinary Tumor Boards in Breast Cancer Care – An Observational Study. *Journal of Multidisciplinary Healthcare*, *14*, 1275–1284. https://doi.org/10.2147/JMDH.S300061

Schippers, M. C., Edmondson, A. C., & West, M. A. (2014). Team reflexivity as an antidote to team information-processing failures. *Small Group Research*, *45*(6), 731–769.

Schmutz, J. B., Lei, Z., Eppich, W. J., & Manser, T. (2018). Reflection in the heat of the moment: The role of in-action team reflexivity in health care emergency teams. *Journal of Organizational Behavior*, *39*(6), 749–765. https://doi.org/10.1002/job.2299

Schmutz, J., Hoffmann, F., Heimberg, E., & Manser, T. (2015). Effective coordination in medical emergency teams: The moderating role of task type. *European Journal of Work and Organizational Psychology*, *24*(5), 761–776. https://doi.org/10.1080/1359432X.2015.1018184

Schraagen, J. M. (2011). Dealing with unforeseen complexity in the OR: The role of heedful interrelating in medical teams. *Theoretical Issues in Ergonomics Science*, *12*(3), 256–272. https://doi.org/10.1080/1464536X.2011.564481

Shen, W., Kiger, T. B., Davies, S. E., Rasch, R. L., Simon, K. M., & Ones, D. S. (2011). Samples in applied psychology: Over a decade of research in review. *Journal of Applied Psychology*, *96*(5), 1055.

Siassakos, D., Bristowe, K., Draycott, T. J., Angouri, J., Hambly, H., Winter, C., Crofts, J. F., Hunt, L. P., & Fox, R. (2011). Clinical efficiency in a simulated emergency and relationship to team behaviours: A multisite cross-sectional study. *BJOG*, *118*(5), 596–607. https://doi.org/10.1111/j.1471-0528.2010.02843.x

Siassakos, D., Draycott, T., Montague, I., & Harris, M. (2009). Content analysis of team communication in an obstetric emergency scenario. *Journal of Obstetrics and Gynaecology*, *29*(6), 499–503. https://doi.org/10.1080/01443610903039153

Sillars, A. L. (2018). *VTCS: Verbal Tactics Coding Scheme*.

Simon, H. A. (2013). *Administrative Behavior, 4th Edition*. Simon and Schuster.

Sniezek, J. A. (1989). An examination of group process in judgmental forecasting. *International Journal of Forecasting*, *5*(2), 171–178.

Soukup, T., Gandamihardja, T. A., McInerney, S., Green, J. S., & Sevdalis, N. (2019). Do multidisciplinary cancer care teams suffer decision-making fatigue: An observational, longitudinal team improvement study. *BMJ Open*, *9*(5), e027303.

Soukup, T., Lamb, B. W., Arora, S., Darzi, A., Sevdalis, N., & Green, J. S. (2018). Successful strategies in implementing a multidisciplinary team working in the care of patients with cancer: An overview and synthesis of the available literature. *Journal of Multidisciplinary Healthcare*, *11*, 49–61. https://doi.org/10.2147/JMDH.S117945

Soukup, T., Lamb, B. W., Morbi, A., Shah, N. J., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S., & Sevdalis, N. (2020). A multicentre cross-sectional observational study of cancer multidisciplinary teams: Analysis of team decision making. *Cancer Medicine*, *9*(19), 7083–7099. https://doi.org/10.1002/cam4.3366

Soukup, T., Lamb, B. W., Shah, N. J., Morbi, A., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S. A., & Sevdalis, N. (2020). Relationships Between Communication, Time Pressure, Workload, Task Complexity, Logistical Issues and Group Composition in Transdisciplinary Teams: A Prospective Observational Study Across 822 Cancer Cases. *Frontiers in Communication*, *5*, 101. https://doi.org/10.3389/fcomm.2020.583294

Soukup, T., Murtagh, G., Lamb, B. W., Green, J. S., & Sevdalis, N. (2021). Degrees of multidisciplinarity underpinning care planning for patients with cancer in weekly multidisciplinary team meetings: Conversation analysis. *Journal of Multidisciplinary Healthcare*, *14*, 411.

Soukup, T., Murtagh, G. M., Lamb, B. W., Bali, A., Gandamihardja, T., Darzi, A., Green, J. S. A., & Sevdalis, N. (2021). Gaps and Overlaps in Cancer Multidisciplinary Team Communication: Analysis of Speech. *Small Group Research*, *52*(2), 189–219. https://doi.org/10.1177/1046496420948498

Spates, S. A., Kingsley Westerman, C. Y., Laam, L. A., & Goke, R. (2020). Exploring Challenges of Hospital Chaplains in Transdisciplinary Teams. *Frontiers in Communication*, *5*. https://www.frontiersin.org/article/10.3389/fcomm.2020.582626

Stachowski, A. A., Kaplan, S. A., & Waller, M. J. (2009). The benefits of flexible team interaction during crises. *Journal of Applied Psychology*, *94*(6), 1536.

Sutcliffe, K. M., Lewton, E., & Rosenthal, M. M. (2004). Communication failures: An insidious contributor to medical mishaps. *Academic Medicine*, *79*(2), 186–194.

Taberna, M., Gil Moncayo, F., Jané-Salas, E., Antonio, M., Arribas, L., Vilajosana, E., Peralvez Torres, E., & Mesía, R. (2020). The multidisciplinary team (MDT) approach and quality of care. *Frontiers in Oncology*, *10*, 85.

Tamburini, N., Maniscalco, P., Mazzara, S., Maietti, E., Santini, A., Calia, N., Stefanelli, A., Frassoldati, A., Santi, I., & Rinaldi, R. (2018). Multidisciplinary management improves survival at 1 year after surgical treatment for non-small-cell lung cancer: A propensity score-matched study. *European Journal of Cardio-Thoracic Surgery*, *53*(6), 1199–1204.

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly*, 23–47.

Thenappan, A., Halaweish, I., Mody, R. J., Smith, E. A., Geiger, J. D., Ehrlich, P. F., Jasty Rao, R., Hutchinson, R., Yanik, G., & Rabah, R. M. (2017). Review at a multidisciplinary tumor board impacts critical management decisions of pediatric patients with cancer. *Pediatric Blood & Cancer*, *64*(2), 254–258.

Tiferes, J., & Bisantz, A. M. (2018). The impact of team characteristics and context on team communication: An integrative literature review. *Applied Ergonomics*, *68*, 146–159. https://doi.org/10.1016/j.apergo.2017.10.020

Tschan, F. (2002). Ideal cycles of communication (or cognitions) in triads, dyads, and individuals. *Small Group Research*, *33*(6), 615–643.

Tschan, F., Vetterli, M., Semmer, N. K., Hunziker, S., & Marsch, S. C. U. (2011). Activities during interruptions in cardiopulmonary resuscitation: A simulator study. *Resuscitation*, *82*(11), 1419–1423. https://doi.org/10.1016/j.resuscitation.2011.06.023

Uitdewilligen, S., Rico, R., & Waller, M. J. (2018). Fluid and stable: Dynamics of team action patterns and adaptive outcomes. *Journal of Organizational Behavior*, *39*(9), 1113–1128. https://doi.org/10.1002/job.2267

Uitdewilligen, S., & Waller, M. J. (2018a). Information sharing and decision-making in multidisciplinary crisis management teams. *Journal of Organizational Behavior*, *39*(6), 731–748. https://doi.org/10.1002/job.2301

Uitdewilligen, S., & Waller, M. J. (2018b). Information sharing and decision-making in multidisciplinary crisis management teams. *Journal of Organizational Behavior*, *39*(6), 731–748.

van den Oever, F., & Schraagen, J. M. (2021). Team Communication Patterns in Critical Situations. *Journal of Cognitive Engineering and Decision Making*, *15*(1), 28–51. https://doi.org/10.1177/1555343420986657

van der Haar, S., Koeslag-Kreunen, M., Euwe, E., & Segers, M. (2017). Team Leader Structuring for Team Effectiveness and Team Learning in Command-and-Control Teams. *Small Group Research*, *48*(2), 215–248. https://doi.org/10.1177/1046496417689897

van der Meer, S. A., Lehmann-Willenbrock, N., Delahaij, R., & Homan, A. C. (2022). The Influence of Intrusions on Team Interaction: An Explorative Field Study. *Small Group Research*, 10464964211073590.

Van Der Vegt, G. S., & Bunderson, J. S. (2005). Learning and performance in multidisciplinary teams: The importance of collective team identification. *Academy of Management Journal*, *48*(3), 532–547.

Van Knippenberg, D., De Dreu, C. K., & Homan, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology*, *89*(6), 1008.

van Oortmerssen, L. A., van Woerkum, C. M. J., & Aarts, N. (2015). When Interaction Flows: An Exploration of Collective Creative Processes on a Collaborative Governance Board. *Group & Organization Management*, *40*(4), 500–528. https://doi.org/10.1177/1059601114560586

van Swol, L. M., & Ahn, P. H. (2021). Inside the Black Box: Group Processes and the Role of Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 157–170). Emerald Publishing Limited.

Vollrath, D. A., Sheppard, B. H., Hinsz, V. B., & Davis, J. H. (1989). Memory performance by decision-making groups and individuals. *Organizational Behavior and Human Decision Processes*, *43*(3), 289–300.

Volmer, J., & Sonnentag, S. (2011). The role of star performers in software design teams. *Journal of Managerial Psychology*, *26*(3), 219–234. https://doi.org/10.1108/02683941111112659

Wallace, I., Barratt, H., Harvey, S., & Raine, R. (2019). The impact of Clinical Nurse Specialists on the decision making process in cancer multidisciplinary team meetings: A qualitative study. *European Journal of Oncology Nursing*, *43*. psyh. https://doi.org/10.1016/j.ejon.2019.101674

Waller, M. J., & Kaplan, S. A. (2018a). Systematic behavioral observation for emergent team phenomena: Key considerations for quantitative video-based approaches. *Organizational Research Methods*, *21*(2), 500–515. https://doi.org/10.1177/1094428116647785

Waller, M. J., & Kaplan, S. A. (2018b). Systematic Behavioral Observation for Emergent Team Phenomena: Key Considerations for Quantitative Video-Based Approaches. *Organizational Research Methods*, *21*(2), 500–515. https://doi.org/10.1177/1094428116647785

Waller, M. J., Uitdewilligen, S., Rico, R., & Thommes, M. S. (2021). Interaction Pattern and Trajectory Analysis for Studying Group Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 135–153). Emerald Publishing Limited.

Walraven, J. E., van der Hel, O. L., van der Hoeven, J. J. M., Lemmens, V. E., Verhoeven, R. H., & Desar, I. M. (2022). Factors influencing the quality and functioning of oncological multidisciplinary team meetings: Results of a systematic review. *BMC Health Services Research*, *22*(1), 1–27.

Walraven, J. E., van der Meulen, R., van der Hoeven, J. J., Lemmens, V. E., Verhoeven, R. H., Hesselink, G., & Desar, I. M. (2022). Preparing tomorrow's medical specialists for participating in oncological multidisciplinary team meetings: Perceived barriers, facilitators and training needs. *BMC Medical Education*, *22*(1), 502.

Walter, J. K., Schall, T. E., DeWitt, A. G., Faerber, J., Griffis, H., Galligan, M., Miller, V., Arnold, R. M., & Feudtner, C. (2019). Interprofessional team member communication patterns, teamwork, and collaboration in pre–family meeting huddles in a pediatric cardiac intensive care unit. *Journal of Pain and Symptom Management*, *58*(1), 11–18.

Wang, B., Liu, Y., & Parker, S. K. (2020). How does the use of information communication technology affect individuals? A work design perspective. *Academy of Management Annals*, *14*(2), 695–725.

Wang, D., Gao, Q., Tan, H., Liu, Z., Zhou, L., Jia, L., & Li, Z. (2020). Coordination breakdowns in nuclear power plant control rooms: Cause identification and behaviour-sequence analysis. *Ergonomics*, *63*(6), 660–681.

Weigl, M., Antoniadis, S., Chiapponi, C., Bruns, C., & Sevdalis, N. (2015). The impact of intra-operative interruptions on surgeons' perceived workload: An observational study in elective general and orthopedic surgery. *Surgical Endoscopy*, *29*(1), 145–153. https://doi.org/10.1007/s00464-014-3668-6

Weingart, L. R. (2012). Studying dynamics within groups. In *Looking back, moving forward: A review of group and team-based research* (Vol. 15, pp. 1–25). Emerald Group Publishing Limited.

Weiss, H. M., & Cropanzano, R. (1996). Affective events theory. *Research in Organizational Behavior*, *18*(1), 1–74.

Wiesche, M. (2021). Interruptions in Agile Software Development Teams. *Project Management Journal*, *52*(2), 210–222. https://doi.org/10.1177/8756972821991365

Wittenbaum, G. M., Hollingshead, A. B., Paulus, P. B., Hirokawa, R. Y., Ancona, D. G., Peterson, R. S., Jehn, K. A., & Yoon, K. (2004). The functional perspective as a lens for understanding groups. *Small Group Research*, *35*(1), 17–43.

Wittenberg-Lyles, E., Goldsmith, J., & Ferrell, B. (2013). Oncology nurse communication barriers to patient-centered care. *Clinical Journal of Oncology Nursing*, *17*(2), 152–158. psyh. https://doi.org/10.1188/13.CJON.152-158

Wright, F. C., De Vito, C., Langer, B., & Hunter, A. (2007). Multidisciplinary cancer conferences: A systematic review and development of practice standards. *European Journal of Cancer*, *43*(6), 1002–1010. https://doi.org/10.1016/j.ejca.2007.01.025

Xiao, Y., Hunter, W. A., Mackenzie, C. F., Jefferies, N. J., Horst, R. L., & Group, L. (1996). SPECIAL SECTION: Task Complexity in Emergency Medical Care and Its Implications for Team Coordination. *Human Factors*, *38*(4), 636–645. https://doi.org/10.1518/001872096778827206

Xie, L., Beyerlein, M., & Han, S. J. (2022). Revealing deep interaction patterns of team learning processes through video-based interactive analysis. *International Journal of Human Resources Development and Management*. https://www.inderscienceonline.com/doi/abs/10.1504/IJHRDM.2021.120307

Zajac, S., Woods, A., Tannenbaum, S., Salas, E., & Holladay, C. L. (2021). Overcoming challenges to teamwork in healthcare: A team effectiveness framework and evidence-based guidance. *Frontiers in Communication*, *6*, 606445.

Zellmer-Bruhn, M., Waller, M. J., & Ancona, D. (2004). THE EFFECT OF TEMPORAL ENTRAINMENT ON THE ABILITY OF TEAMS TO CHANGE THEIR ROUTINES. In S. Blount (Ed.), *Time in Groups* (Vol. 6, pp. 135–158). Emerald Group Publishing Limited. https://doi.org/10.1016/S1534-0856(03)06007-9

Zijlstra, F. R., Waller, M. J., & Phillips, S. I. (2012). Setting the tone: Early interaction patterns in swift-starting teams as a predictor of effectiveness. *European Journal of Work and Organizational Psychology*, *21*(5), 749–777.

Zoethout, H., Wesselink, R., Runhaar, P., & Mulder, M. (2017). Using transactivity to understand emergence of team learning. *Small Group Research*, *48*(2), 190–214.

CHAPTER 5

The Impact of Workflow Interruptions on Multidisciplinary Team Communication in Hybrid Healthcare Settings

ABSTRACT

Workflow interruptions are skyrocketing in the contemporary workplace, especially in collaborative team environments. The reliance on (communication) technologies and accessibility through e-mail and phone creates increasing avenues for frequent teamwork interruptions. Importantly, interruptions not only affect team members individually, but spill over and affect team functioning as a whole. In this study, we investigate in fourteen multidisciplinary team meetings in hybrid healthcare settings (1) which workflow interruptions naturally emerge and (2) how these interruptions influence the *communication valence* as well as *communication clarification*. We find evidence for a highly interruptive meeting environment, characterized by videoconferencing issues, disruptive beepers/phones that go off, and people leaving and entering the meeting room during patient discussions. Contrary to what was expected, team members initially respond to the interruption with positive statements (i.e., humor) as a coping mechanism, which decreases significantly in the minutes after the interruptive event. After the interruptive episode, significantly more negative statements, as well as conversational repetitiveness occurs. This research contributes to understanding naturally occurring workflow interruptions in actual organizational healthcare teams, by providing objective and fine-grained empirical insights into how workflow interruptions affect changes in the teams' communication.

Keywords: Multidisciplinary teams, interruptions, behavior, interaction analysis, healthcare

INTRODUCTION

Multidisciplinary Team Meetings (MDTMs) have been widely accepted and implemented in healthcare settings around the world (Dinh et al., 2020; Edney et al., 2020; Omilion-Hodges et al., 2021). In a MDTM, medical professionals from a variety of disciplines meet to discuss and advise upon treatment recommendations for patient care (Rosell et al., 2019). Given that these MDTMs are described as the 'golden standard' of healthcare organizing, more attention has been given towards what actually happens within these team meetings (Nancarrow et al., 2013; Soukup, Lamb, Shah, et al., 2020; Soukup, Murtagh, Lamb, Bali, et al., 2021). More specifically, recent literature describes that team meetings are heavily subject to various *workflow interruptions* that influence the team functioning, such as external telephone calls (Wiesche, 2021), technological failures (Gillespie et al., 2012) or physical meeting room interruptions (van der Meer et al., 2022).

Such work interruptions are part of our everyday professional work environment and are defined as 'an unexpected suspension of the behavioral performance or the attentional focus from an ongoing work task' (Puranik et al., 2020, p. 817). Although research primarily focusses on workflow interruptions at the individual-level (Altmann et al., 2014; Baethge & Rigotti, 2013; Gillespie et al., 2012), organizational teams are likewise prone to various interruptions during team meetings (van der Meer et al., 2022; Wiesche, 2021). Team members mutually impact one another, meaning that workflow interruptions not only impact team members individually, but spill over and affect how teams function overall (Addas & Pinsonneault, 2013).

Prior research has shown that interruptions have a primarily negative impact on the team functioning. That is, interruptions are related to more miscommunications (Gillespie et al., 2012), discontent, stress, delay, distraction (Wiesche, 2021) as well as issues in task distribution and task finalization (Tschan et al., 2011; Wiesche, 2021). The general premise of these papers suggests that work interruptions in teams are viewed as stressors which organizations should eliminate or minimize as much as possible to improve the teams' functioning. In the context of multidisciplinary healthcare teams, workflow interruptions may be especially harmful because of the high information processing demands and focus that is needed to formulate qualitative suitable treatment plans for patients (Humphrey et al., 2007; Schippers et al., 2014). Additionally, this work environment is known for its intense time pressure (Walraven, van der Hel, et al., 2022; Zajac et al., 2021). Thus, when the information processing demands are high and time pressure is present, workflow interruptions may be especially disruptive for the team functioning, resulting in changes in the way in which the conversation is carried out, and, ultimately may influence the quality of important outcomes.

Workflow interruptions can affect team communication in two ways: it can influence what is said (‘*communication content*’) or how it is said (‘*communication valence*[1] ’). As both types of communication are intertwined in conversations and should be considered in unison (Keyton & Beck, 2009), thus both are included in this study. As communication content and communication valence are not isolated elements that occur at singular points in time, we need a more temporal perspective to study changes in moment-to-moment communication (Ancona et al., 2001; Lehmann-Willenbrock et al., 2017). A temporal perspective is important because workflow interruptions inherently involve subsequent changes in focus and thus change how conversational time is used after the occurrence of an interruption (i.e., shifting focus to something else). Thus, we investigate how *communication content* as well as *communication valence* changes in response to naturally emerging workflow interruptions.

To date, most studies have dealt with interruptions at the individual level (e.g., Wang et al., 2020), using self-report measures in order to capture this phenomenon (e.g., Addas & Pinsonneault, 2018), leaving unexplored territory for understanding *actual real-time occurring interruptions* in teams and how that relates to the team’s communication processes. To our knowledge, only one study has explored the effect of workflow interruptions on the teams’ communication to date (van der Meer et al., 2022). This study used confederates to initiate one type of disruption (i.e., change of meeting room) and investigated how communication changed before and after. Building on the ideas of van der Meer et al. (2022), we focus on *naturally occurring interruptions* that are more heterogeneous in terms of type, levels of intensity, timing and occurrence rate. To illustrate, taking a phone call during a meeting is an internal type of interruption, that is rather high in intrusiveness, and that may happen (multiple times) at any time during the meeting. Additionally, studying the communicative reactions by team members to such naturally occurring interruptions is important as they are *ecological valid* (Leroy et al., 2020; Puranik et al., 2020). With these insights, we are able to take evidence-based effective measures against potentially harmful effects. Furthermore, given the rate at which interruptions may continue to grow in team-based collaborative settings, this is an important topic to focus on (Baethge et al., 2015).

Taken together, the contribution of this paper is two-fold. First, we shed light on naturally occurring workflow interruptions in high information processing and time

[1] Valence in emotion research is either relatively positive or negative in nature

pressured work environments in healthcare. Especially, since MDTMs in this research context are expected work activities on top of regular work activities (i.e., patient treatment) and thus not formally scheduled separately in the employees' work package, the research setting results in naturally high interruptive work environments. Second, this research adds to theory on both team dynamics and workflow interruptions by investigating how workflow interruptions impact changes in *content communication* as well as *valence communication*.

THEORETICAL BACKGROUND

Workflow interruptions

Interruptions within organizational teams may cause a temporary pause in the team's behavioral performance and results in teams shifting attention away from a primary task they are currently engaged in (Puranik et al., 2020). We focus particularly on (external) stimuli or secondary activities that interrupt focused concentration on a primary team task[2] (Jett, 2003). This type of interruption is generally initiated by competing activities or environmental stimuli that are irrelevant to the team task at hand.

Such interruptions naturally manifest themselves in a variety of ways during team meetings (Puranik et al., 2020). To exemplify, interruptions vary with regard to 'type,' meaning the interruption can be initiated from an *internal* source (i.e., a team member; Weigl et al., 2015) or from an *external* source (i.e., technological issues; Galluch et al., 2015). Secondly, the levels of intensity may vary in regards to, for example, quietly sending a personal text message (i.e., low in intensity) compared to team members taking phone calls during meetings (i.e., high in intensity). Thirdly, the rate at which interruptions occur vary from only a few per meeting to more highly interruptive meeting environments. Finally, interruptions may vary in timing or length as interruptions may occur at any time throughout the meeting, and can range from a few seconds to up to minutes.

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[2] Other type of interruptions, such as cutting somebody off in a conversation are not the focus of this research paper. Conversational interruptions may still be related to the primary team task and thus not suspend performance, which does not follow Puranik et al.'s (2020) definition. Similarly, individual distractions (such as disruptive trains of thoughts) is not shared within the team, thus not included in this study

Communication valence

Following the conceptualization of Lehmann-Willenbrock et al. (2013), we define valence as an observable, behavior-manifested process embedded in the teams' interaction, which goes beyond the notion of individual internal affective states. Thus, we do not focus on static features or affective states in individuals. Rather, we focus on a more dynamic team interaction context, because – especially in teams – individuals are subject to social influence (Hareli & Rafaeli, 2008). Communication valence in organizational teams may be either relatively positive or negative in nature. Based on emotion research, we define positivity as an individual's observable verbal statement that expresses or implies optimism or enthusiasm and that are constructive, supportive and affirmative in intention and attitude (Lehmann-Willenbrock, Chiu, et al., 2013; Lehmann-Willenbrock et al., 2017). Opposingly, negativity in team interactions is defined as the verbal expressions of disaffirmation that emphasizes the negative status quo and does not advance the team meeting (Gerpott et al., 2020).

We state that negativity or positivity statements are not isolated statements, but are formed and constrained by the buildup of moment-to-moment communication in teams (Lehmann-Willenbrock et al., 2017). According to these theoretical assumptions, positive and negative behavior in teams emerges and disappears, meaning that team valence can both undergo upward and downward changes over time (Barsade & Knight, 2015; Lehmann-Willenbrock, Chiu, et al., 2013). One of the factors that may impact valence in teams are interruptive events. In the ensuing discussion, we describe how interruptions may trigger valence responses in teams.

Interruptions and negative valence

Interruptions are inherently emotional and relational in nature, especially as they occur in a team's collaboration context and cause emotional responses (Fletcher et al., 2018; van der Meer et al., 2022). Interruptions can elicit negative emotions, because team members shift their attention to the disruption, resulting in a decrease of attentional resources for the primary task (Cochran & Elder, 2015; Weiss & Cropanzano, 1996). The negative affect and frustration felt in response to the interruption may result in negative communicative statements as team members that experience frustration are likely to immediately express it verbally (Ayoko et al., 2012). This negative affect and frustration perspective is explored in a study by van der Meer et al. (2022) who showed that the extent to which organizational project teams use negative communication differs significantly before and after the interruption. Although the overall frequency of negative communication did not change significantly before or after the interruption, specific task statements triggered more negativity after the interruption, compared to before the interruption. Taking these insights into account, we posit that in healthcare MDTMs that are characterized by high information processing demands and time pressure, the frustration perspective is especially salient, because medical specialists need focus to process important and densely formulated information and need to come up with treatment plans for patients in a timely, adequate and uniform manner. Thus, workflow interruptions put cognitive strain on the information processing flow, resulting in emerging negativity statements directly after the interruption. Moreover, we hypothesize that initial negative responses further triggers more negativity, drawing from the emotional cycles theory of Hareli and Rafaeli (2008). Expressed negativity by one member socially influences others. Prior studies have already shown that individual team members' visible emotions influence other members emotions (Barsade, 2002; Cheshin et al., 2011), resulting in the expectation that observed negativity during the interruptions transcends towards more negativity directly after the interruption. Therefore, we propose the following hypothesis:

H1: Team members respond initially with more negativity during the interruption than during uninterrupted conversational time[3]

H2: The initial negative response to the interruption displays more negativity in the subsequent five-minute time window after the interruptive event than during uninterrupted conversational time.

Interruptions and positive valence

We posit that interruptions not only trigger negativity, but inhibit positivity in the team's conversation as well. Interruptions in teams create a different momentary conversational context, with implications for the likelihood of positivity following that conversational moment. As the attention switches to the interruption, Van der Meer et al. (2022) found that teams use positive communication differently before and after the interruption. Specific statements (such as solution-oriented statements) triggered positivity before the interruptions, but this was not the case after the intrusion. Based on these findings, we posit that during naturally occurring interruptions, positivity in healthcare MDTMs is also inhibited. That is because, similarly to the frustration perspective described above, the attentional focus requires deviation from the primary task, which does not

[3] Uninterrupted conversational time is operationalized by selecting time periods of conversations that do not include any type of interruptions. In the methodology section the baseline model is explained more in depth based on Figure 1.

spark positivity, especially in task environments with high information processing requirements and time pressure. When focusing on moment-to-moment shifts in teams conversations, we consider that interruptions inhibit positivity statements, which carries on in the conversation after the workflow interruption that has taken place.

H3: Team members make fewer positive communicative statements during the interruptive events than during uninterrupted conversational time

H4: The inhibited positivity as a reaction towards the interruption transcends towards the subsequent conversation, meaning that positivity is also inhibited in the five-minute time window after the interruptive event, compared to uninterrupted conversational time.

Communication content

Communication content describes verbal messages that are shared within the team that are associated to the task at hand. Communication content from one team member triggers other team members to add to the discussion and therefore shape co-construction (Zoethout et al., 2017). Thus, individual team members process verbally shared content communication from others and use previously shared information to construct their own contribution. In the literature, this phenomenon is described as 'transactivity' or 'co-construction,' or as the extent to which team members act on each other's reasoning (Raes et al., 2015; Zoethout et al., 2017). However, the occurrence of workflow interruptions makes it more difficult to build on what was said previously, because it disrupts the team members' information processing system (Hinsz et al., 1997). Instead, team members take one step back to *repeat* or *clarify* what has been shared previously, which may potentially restore information processing failures caused by workflow interruptions (Schippers et al., 2014). Given that the healthcare work environment is known for its time pressure, the shift back into the primary task after an interruption is thus costly because team members may not remember which part of the primary task was last shared (Rivera-Rodriguez & Karsh, 2010). Therefore, we posit that the team showcases significantly more clarification behavior during meeting interruptive episodes. Consequently, drawing from premise the that behavior tend to repeat itself (Kolbe et al., 2014), we posit that the presence of clarification statements transcends towards the minutes after the interruptive event.

H5: Team members express more clarification statements during the interruptive event than during uninterrupted conversational time

H6: The team expresses more clarification statements in the five minute time window after the interruptive event, compared to uninterrupted conversational time

METHOD

Sample characteristics

The sample consists of team meetings in an oncology health care settings in a non-academic European hospital. During these multidisciplinary oncological decision-making boards, physicians gather on a weekly basis to discuss treatment plans for patients who are diagnosed with cancer. This research setting is highly fitting for studying workflow interruptions, as it includes physicians who are required to share their expertise in order to develop treatment plans for patients during the meeting, but who simultaneously need to be accessible through their work phones in case urgencies emerge with their patients. In addition to work phone interruptions, we also notice interruptions that are related to people walking into and out of the room and interruptions related to videoconferencing issues (i.e., audio problems, screen sharing issues). This environment is thus known and described as interruptive despite national quality guidelines explicitly recommending that ‘disruptive elements such as beepers or telephones need to be kept to a minimum’ (Westerhuis, 2016, p. 8). The data collection took place between July - September 2021, consisting of a sample of 44 unique physicians embedded in fourteen sequential multidisciplinary team meetings. The team composition varied but typically included neurologists, medical oncologists, pathologists, radiologists, radiotherapist-oncologists, neuro-surgeons, nurse specialists and, occasionally interns/ residents (doctors in training in order to become specialists), ranging from 12 to 21 uniquely contributing members in each meeting ($M = 15.5$, $SD = 2.71$). The number of work experience in current function varied from 0 to 25 years ($M = 8.22$, $SD = 6.23$). Team members were between 27 and 59 years old ($M = 41.23$, $SD = 8.3$). Due to COVID-19 restrictions there was a maximum in terms of the number of people who were allowed in the room, thus space was limited. Therefore, some MDT participants took part digitally via an online video conferencing tool, resulting in the hybrid research setting. The study was granted ethical approval by a mid-western European Ethics Committee (complying with the national law on Medical Research in Humans) and informed consent was obtained from all MDT members.

Transcription and coding process

We captured the entire communication flow in audio and video material from 14 oncological MDTMs. Each MDTM room was equipped with a videoconferencing system, allowing us to record audio and video of participants in the meeting room as well as participants present at other locations via videoconferencing stream. The audio and video recordings were transcribed into time-stamped sequences of ‘who says what at what point in time.' The unit of analysis for the coding process is a verbal contribution that expresses or implies a complete thought of verbal speech (Bales, 1950). Subsequently, 12512 verbal contributions were coded for *communication content* (i.e., clarification statements) and *communication valence* (i.e., positivity vs negativity) using a qualitative coding software program MAXQDA (Kuckartz and Rädiker, 2019). One meeting was double coded to determine inter-rater reliability between two independent coders (one medical physician and one social scientist). There was almost perfect agreement between the two coders' judgements, $\kappa = .897$. Next, we labeled the conversational dataset into three main categories: (1) conversations during interruptive episodes, (2) conversations five minutes after the interruptive episode and (3) uninterrupted conversational time that does not overlap the five minutes after the interruptive event. The selection of conversational time and examples for each category are visually shown in Figure 5.1. For each category, we calculated the frequencies of clarification statements, positivity statements and negativity statements.

Data Analysis

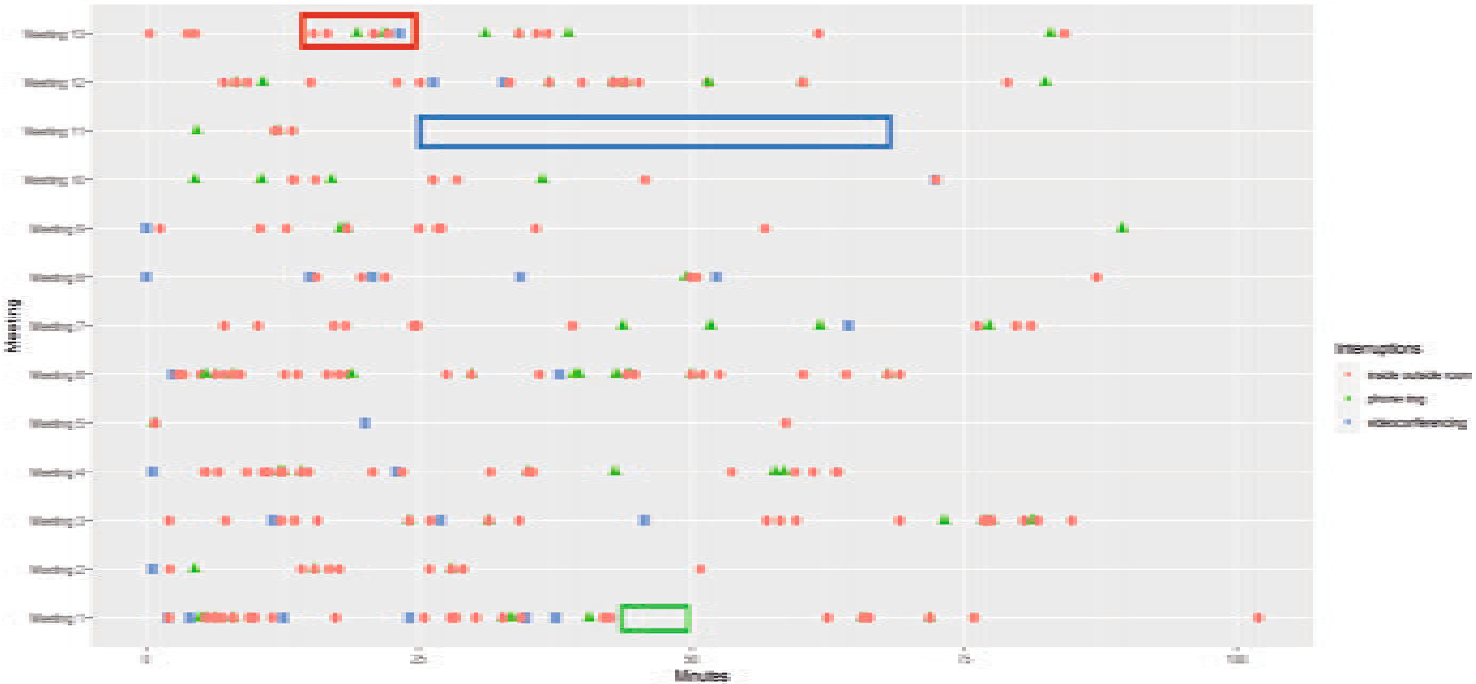
Using the open source programming software R (R Core Team, 2021), we used a zero-inflated multilevel Poisson regression model (Lee et al., 2006). This model is a good fit for our count data, because we observe an excess of zero counts in verbal contributions (e.g., reflecting neutral valence statements). We account for the multi-level structure of the data, meaning we account for weekly meeting effects in the calculation of the *z*-values. The control group is listed as the period of conversational time that is uninterrupted.

RESULTS

In total, fourteen oncological MDTM's are observed, resulting in approximately eighteen hours of video footage, ranging from meetings that take minimum 41 minutes to maximum one hour and 32 minutes (*Mean* = 1h 16 min; *SD* = 15min). During these meetings, three main intrusive interruptions are observed: (1) videoconferencing tool issues; (2) people entering or leaving the meeting and, (3) phones ringing. The occurrence and frequencies of these types of workflow interruptions per meeting are visually shown in Figure 5.1.

Table 5.1 shows the descriptive statistics of time and occurrences of the three main interruptions per MDTM. In almost all MDTMs, each of these intrusive interruptions

Figure 5.1
*Visual overview of intrusive workflow interruptions per meeting**



* The red box shown in meeting 13 is a conversational example that is categorized in the interruptive conversational episode category. The green box in meeting 1 showcases the time window of five minutes after interruptive events. The blue box in meeting 11 showcases the comparison group of uninterrupted conversational time.

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emerge multiple times. First, regarding the videoconferencing issues, we notice that – on average – more than one time per MDTM issues regarding the videoconferencing system are discussed (*Mean* = 1.86; *SD* = 1.35) that take on average more than one minute per occurring issue. To illustrate, more than one time per meeting MDT members talks explicitly about connection issues, screen sharing difficulties, or physicians that are not able to get through the system in order to contribute to the conversation. A second intrusive incident observed consisted of physicians leaving or entering the room after the meeting has started and, discussions regarding treatment plans for patients were ongoing. We observe that, — on average, — people physically enter and or leave the room eleven times per MDTM (*Mean* = 11.71; *SD* = 6.99), and with a maximum of 25 times. Finally, we observe beepers or phones ringing during patient case discussions. Physicians are accessible through phones in case medical emergency situations arrive. However, we observe that, — on average, — the MDTM is interrupted by a phone call almost up to five times (*Mean* = 4.71; *SD* = 2.97), with a maximum of twelve times. These insights suggest that MDTMs are highly interruptive working environments.

Table 5.1
Descriptive overview of intrusive workflow interruptions

Interruption		*Min.*	*Max*	*Mean*	*SD*	*Total*
Videoconferencing issues						
	Time per meeting in HH:MM:SS	00:00:00	00:06:26	00:01:24	00:01:56	00:19:31
	Number of issues	0	5	1.86	1.35	26
People entering, leaving meeting						
	Time per meeting in HH:MM:SS	00:00:10	00:04:07	00:01:28	00:01:06.	00:20:35
	Number of occurrences	2	25	11.71	6.99	164
Phone ring						
	Time per meeting in HH:MM:SS	00:00:03	00:02:27	00:00:44	00:00:43	00:10:10
	Number of occurrences	1	12	4.71	2.97	66

Notes: The external interruptions are displayed in absolute count values and time in HH:MM:SS format.

Next, we consider the change of *communication valence* and *communication content* in response to intrusive events. Table 5.2 showcases how communication content and communication valence change (1) during the intrusive event, (2) within the five minute period after the intrusive event and, (3) during uninterrupted conversational time.

Table 5.2
Comparison of communicative statements during and after an interruptive event, compared to uninterrupted conversational time using zero-inflated Poisson regression comparisons

Behaviors		***Timepoint***	***Frequency***	***Test statistic***	***Significance level***
	Interaction level	*Timepoint*	*Occurrence rate in %*	Z value	P value
Content	Question clarification + clarification	During interruption	**2.80%**	**-3.48****	**< .001**
		After Interruption	**8.12%**	**3.50****	**< .001**
		Uninterrupted	5.85%		
Valence	Negativity	During interruption	0.96%	-1.32	0.188
		After Interruption	**2.48%**	**2.54***	**0.014**
		Uninterrupted	1.18%		
	Positivity	During interruption	**4.57%**	**2.55***	**0.011**
		After Interruption	1.92%	-1.83	0.068
		Uninterrupted	2.57%		

Notes: Zero-inflated Poisson regression models are used to model count data that has an excess of zero counts. As we observe the occurrence rates of specific behaviors that occur on a rather low basis in the whole conversation. We accounted for the weekly meetings, meaning that we control for the meeting effects in the calculation of the Z values. The control group is listed as the period of conversational time that is uninterrupted.

To test Hypothesis 1, we calculated the total amount of negativity statements observed during the interruptive episode, as shown by the red box in Figure 5.1, and compared this with the frequency count during uninterrupted conversational time (see the blue box displayed in Figure 5.1 as an example). We do not observe significantly more negativity during the interruption episode (z = -1.32, p = 0.19) compared to uninterrupted conversational time. Moreover, in Hypothesis 2, we aim to test if negativity is evidenced more during the five-minutes time window directly after the interruptive event (an example is shown in the green box highlighted in Figure 5.1). The results lend support for Hypothesis 2, as we did find

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a significant increase in negativity statements in the five minute time windows directly after the interruptive event, ($z = 2.54$, $p = 0.01$), compared to uninterrupted conversational time. Taken together, these findings suggest that negativity becomes more frequent in the minutes after the interruptive event, thus impacting the team's conversation in a negative way. Interestingly, the negativity statements do not necessarily connect to statements related to the interruption at hand, rather we see an increase in negative tonal variance in statements regarding discussing potential treatments for patients:

"I get that but if that one has a H3 F3A mutation uhm with average prognosis of 9 months you know what I mean he's going to die too and that we know that we can only give radiotherapy and no chemotherapy for example"

Although it is hard to fully grasp the negative tonal variance based on the quote described above, we notice more negativity embedded in the way in which the statement is carried out, compared to conversational time not related to an interruption. While most of the communicative statements are neutral in how they are phrased, several statements clearly exhibited frustration in tonal variance, such as the one listed above.

To test Hypothesis 3, we followed a similar procedure calculating the amount of positivity statements during and directly after the interruptive event, and, during uninterrupted conversational time. Contrary to our hypothesis, we see significantly more positivity during the interruptive episode ($z = 2.55$, $p = 0.01$), compared to uninterrupted conversational time. Additional analysis of the actual transcripts reveals that teams cope with the interruption by using humor statements (see transcripts Table 5.3). However, the positivity does not continue in the minutes after the interruptive event. As expected in Hypothesis 4, we do not see significant differences in positivity statements after the interruptive episode ($z = 1.92$, $p = 0.06$), compared to uninterrupted conversational time. In sum, the data shows that multidisciplinary teams initially respond with humor statements towards interruptive events, but the positivity disappears quickly in the minutes after the interruptive event.

Hypothesis 5 states that clarification statements would increase during interruptive events. However, the results do not support this expectation, as instead, we observe a decrease of clarification statements during the interruptive event ($z = -3.48$, $p < 0.001$), compared to uninterrupted conversational time. However, we do find support for hypothesis 6, because we observe a significant increase of clarification statement in the minutes after the interruptive episode ($z = 3.50$, $p < 0.001$), compared to uninterrupted conversational time. Taken together, these findings suggest that during the interruption, the team does not directly respond to the interruption, but the effect spills over and clarification statements are sought more often in the minutes after the interruptive event.

Table 5.3
Humor examples after interruptions

Example	Sender	Transcripts	Coding
Episode 1	Person A	Yes, shall I read it out loud, because the audio keeps on cutting out, such an inconvenience	Videoconferencing issues
Episode 1	Person B	A little word finding problems	Humor
Episode 2	Person A	Oh yes, we have again that the connection is very bad, we really should have that looked at	Videoconferencing issues
Episode 2	Person B	But we don't have that issues with ****	Videoconferencing issues
Episode 2	Person C	It is your fault, we figured that out	Humor
Episode 2	Person A	We also don't have these issues with other parties	Humor
Episode 2	Team together	(laughing)	Laughter
Episode 3	Person A	*leaves the room*	Leaving room
Episode 3	Person B	You cannot leave here right, you do understand this	Humor
Episode 3	Person A	There is still one patient waiting for me	Humor
Episode 4	Person A	*enters the room again*	Enter room
Episode 4	Person B	You really did miss something, I cannot repeat this, but it was a really beautiful, special, ***	Humor

DISCUSSION

This study investigates which workflow interruptions in actual organizational multidisciplinary teams naturally emerge and how these interruptions influence (1) communication *valence* and (2) communication *content*. This paper provides evidence for a highly interruptive work environment, characterized by videoconferencing issues disrupting the meeting, people leaving and entering the room, and telephones or beepers going off. We find these intrusive events to significantly impact the *content* as well as the *valence* of the communication. Contrary to our hypothesis, we do not see an initial negative response towards intrusive events, rather the negativity statements are observable in the minutes after the interruptive episodes in the conversational space.

Instead, we observe an initial increase in positivity behaviors, which might serve as a coping mechanism for the team to deal with the interruption at hand, but subsequently decreases as the meeting progresses. We expect that teams use positivity to diminish frustration felt during interruptive episodes. One recent study already found evidence for humor as a shared coping strategy to deal with environmental stressors in teams (Hmieleski & Cole, 2022). Next, in contrast to our expectations, the initial response did not showcase more clarification or conversational repetitiveness. Rather, we see the clarification statements significantly showing up in the minutes after the interruptive episode. This finding implies that it takes time to restore the team's focus and shift back to the primary task, and thus the effect of the interruption on the communication process persist for longer periods of time. An increase in clarification statements in the minutes after the interruptive event implies reduced time efficiency, as repeating information takes time, and a loss of focus in the discussion, resulting in unnecessarily lengthy and thus less efficient team meetings. This is important because interruptions only add towards experienced fatigue in these prolonged MDTMs (Soukup et al., 2019).

In sum, although we see an initial positive reaction towards interruptions at hand, the positivity is quickly replaced by increased negativity statements and clarification statements. Although we do not have 'formal' effectiveness or other outcome measures available in this study, prior research shows that negativity represents a more dysfunctional form of communication which hinders problem solving and finding solutions, and threatens team and organizational performance (Aubé & Rousseau, 2016; Kauffeld & Lehmann-Willenbrock, 2012). We conclude that workflow interruptions and the subsequent verbal reactions can derail team processes and harm the team functioning, which subsequently may also relate to more negative outcomes.

However, despite the emphasis on negative effects of work interruptions in this paper and research in general, scholars may not overlook potential positive consequences for the team. Our findings also suggest positive effects in terms of humor statements. Although the effect does not show in our dataset, prior research found that positivity might be related to team performance, team effectiveness and task efficiency (Jouanne et al., 2017; Lehmann-Willenbrock et al., 2017; Soukup, Lamb, Shah, et al., 2020). The attentional diversity caused by external work interruptions may provide positive 'windows of opportunities' for meeting basic psychological needs (Deci et al., 2017; Gagné & Deci, 2005); to improve or reflect on work processes (Okhuysen & Eisenhardt, 2002); or to recover and take cognitive breaks (Jett, 2003). To illustrate these opportunities in the team context: the need for relatedness may be satisfied by having an enjoyable side conversation with fellow team members after the interruption (Gagné &

Deci, 2005). Secondly, teams may benefit from the flexibility that interruptions provide by enabling the team to adjust their work practices to better match the characteristics of the task (Okhuysen & Eisenhardt, 2002). Thirdly, interruptions may serve as time away from the conversation to revitalize cognitively, which is particularly important when fatigued during lengthy team meetings (Soukup et al., 2019). This line of reasoning has been described mainly in theory, and has not been investigated in empirically in the context of actual organizational teams. Thus, we suggest future research to investigate workflow interruptions and the link with important outcome measures in general (Puranik et al., 2021).

Another interesting road to explore further is to unravel interruption characteristics and explore how variations in interruptions may influence the conversation subsequently. To illustrate, characteristics such as high intensity levels or lengthy interruptive episodes might have more harmful effects compared to interruptions lower in intensity or shorter in time. Additionally, expected internal interruptions may be easier for the team to neglect and continue the task at hand, compared to unexpected interruptions.

Theoretical contributions

Firstly, we contribute towards understanding the mechanisms of workflow interruptions and how they influence the conversation in real-world multidisciplinary healthcare teams. Particularly, we illustrate that there are differences in the team's initial response, as well as the 'longer' time-frame effects in the minutes after the interruptive event. By applying an explicit temporal lens, we respond to persistent calls for greater consideration of time in organizational research (Ancona et al., 2001; Cronin et al., 2011; Klonek et al., 2020). We advocate for theory development of how interruptions affect the conversation that take a more temporal lens, describing the initial as well as longer term time window effects of these events that take place.

Practical implications

Firstly, we want to raise awareness of the current state of workflow interruptions observed in multidisciplinary decision-making boards as they illustrate a highly interruptive working environment. Moreover, it is important to understand that intrusive episodes directly impact *content* as well as *valence* communication in teams. Therefore, we advise to organize meetings in such way that might limit the amount of interruptive episodes. One rather straightforward way of obtaining this is to work towards stable IT videoconferencing systems allowing the MDT members to work efficiently in a hybrid setting. Another more structural proposition is connected to restructuring how work is organized within the hospital and the role of MDTMs in the broader work package of attendees. Currently, MDTMs are work activities that participants attend and contribute to on top of other regular work activities, meaning no formal time in the schedule is allocated to MDTMs. As a result, medical physicians are contacted for patient treatment *during* MDTMs, resulting in highly interruptive work environments. The amount of interruptions can be significantly reduced when MDTMs are formally scheduled as uninterrupted work time in the work schedules of medical physicians.

Given the frequency that interruptions are observed in these multidisciplinary decision-making boards, we recommend designing the team environment to reduce unnecessary interruptions and distractions, thus providing team members greater mental space to contribute to the development of patient treatment plans. To illustrate, one solution might be to separate availability, for urgent matters only, during the team meeting and shut down any non-urgent communication distractions. Hence, team leaders may want to develop explicit social norms and put more emphasis on social control and individual accountability to avoid non-urgent communication distractions. Furthermore, if team leaders recognize that team members have a tendency to repeatedly engage in non-urgent distractions, the leader may take into account that these type of behaviors elicit spill-over effects of negativity and thus speak to individuals to encourage behavioral change.

CONCLUSION

This research showed which workflow interruptions in healthcare MDTMs naturally occurred and how they impact communication among team members. Our findings indicate that the meeting environment is highly interruptive, with issues such as videoconferencing problems, disruptive beepers/phones that go off and, people leaving and entering the meeting room. Initially, team members respond with positivity to interruptions, but their statements become increasingly negative in nature in the minutes following the interruption. This is accompanied by conversational repetitiveness. Our study provides objective and detailed empirical insights into the relationship between workflow interruptions and changes in communication within healthcare teams.

REFERENCES

Addas, S., & Pinsonneault, A. (2013). *IT Interruptions and Coordination Effectiveness in Software Development Groups: A Conceptual, Multilevel Model*. 6.

Addas, S., & Pinsonneault, A. (2018). E-mail interruptions and individual performance: Is there a silver lining? *MIS Quarterly*, *42*(2), 381–406. https://doi.org/10.25300/MISQ/2018/13157

Altmann, E. M., Trafton, J. G., & Hambrick, D. Z. (2014). Momentary interruptions can derail the train of thought. *Journal of Experimental Psychology: General*, *143*(1), 215–226. https://doi.org/10.1037/a0030986

Ancona, D. G., Goodman, P. S., Lawrence, B. S., & Tushman, M. L. (2001). Time: A new research lens. *Academy of Management Review*, *26*(4), 645–663.

Aubé, C., & Rousseau, V. (2016). Yes, we complain … so what? *Journal of Managerial Psychology*, *31*(7), 1137–1151. https://doi.org/10.1108/JMP-08-2015-0304

Ayoko, O. B., Konrad, A. M., & Boyle, M. V. (2012). Online work: Managing conflict and emotions for performance in virtual teams. *European Management Journal*, *30*(2), 156–174. https://doi.org/10.1016/j.emj.2011.10.001

Baethge, A., & Rigotti, T. (2013). Interruptions to workflow: Their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands. *Work & Stress*, *27*(1), 43–63. https://doi.org/10.1080/02678373.2013.761783

Baethge, A., Rigotti, T., & Roe, R. A. (2015). Just more of the same, or different? An integrative theoretical framework for the study of cumulative interruptions at work. *European Journal of Work and Organizational Psychology*, *24*(2), 308–323.

Bales, R. F. (1950). A set of categories for the analysis of small group interaction. *American Sociological Review*, *15*(2), 257–263.

Barsade, S. G. (2002). The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly*, *47*(4), 644–675.

Barsade, S. G., & Knight, A. P. (2015). Group affect. *Annual Review of Organizational Psychology and Organizational Behavior*, *2*(1), 21–46.

Cheshin, A., Rafaeli, A., & Bos, N. (2011). Anger and happiness in virtual teams: Emotional influences of text and behavior on others' affect in the absence of non-verbal cues. *Organizational Behavior and Human Decision Processes*, *116*(1), 2–16.

Cochran, A., & Elder, W. B. (2015). Effects of disruptive surgeon behavior in the operating room. *The American Journal of Surgery*, *209*(1), 65–70.

Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? *Academy of Management Annals*, *5*(1), 571–612.

Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*, 19–43.

Dinh, J. V., Traylor, A. M., Kilcullen, M. P., Perez, J. A., Schweissing, E. J., Venkatesh, A., & Salas, E. (2020). Cross-Disciplinary Care: A Systematic Review on Teamwork Processes in Health Care. *Small Group Research*, *51*(1), 125–166. https://doi.org/10.1177/1046496419872002

Edney, L. C., Gray, J., & Karnon, J. (2020). A scoping review of the economics of multidisciplinary teams in oncology care. *Journal of Cancer Policy*, *26*, 100257. https://doi.org/10.1016/j.jcpo.2020.100257

Fletcher, K. A., Potter, S. M., & Telford, B. N. (2018). Stress outcomes of four types of perceived interruptions. *Human Factors*, *60*(2), 222–235.

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4), 331–362.

Galluch, P., Grover, V., & Thatcher, J. (2015). Interrupting the Workplace: Examining Stressors in an Information Technology Context. *Journal of the Association for Information Systems*, *16*(1). https://doi.org/10.17705/1jais.00387

Gerpott, F. H., Chiu, M. M., & Lehmann-Willenbrock, N. (2020). Multilevel antecedents of negativity in team meetings: The role of job attitudes and gender. *Managing Meetings in Organizations*.

Gillespie, B. M., Chaboyer, W., & Fairweather, N. (2012). Interruptions and Miscommunications in Surgery: An Observational Study. *AORN Journal*, *95*(5), 576–590. https://doi.org/10.1016/j.aorn.2012.02.012

Hareli, S., & Rafaeli, A. (2008). Emotion cycles: On the social influence of emotion in organizations. *Research in Organizational Behavior*, *28*, 35–59.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin*, *121*(1), 43.

Hmieleski, K. M., & Cole, M. S. (2022). Laughing all the way to the bank: The joint roles of shared coping humor and entrepreneurial team-efficacy in new venture performance. *Entrepreneurship Theory and Practice*, *46*(6), 1782–1811.

Humphrey, S. E., Hollenbeck, J. R., Meyer, C. J., & Ilgen, D. R. (2007). Trait configurations in self-managed teams: A conceptual examination of the use of seeding for maximizing and minimizing trait variance in teams. *Journal of Applied Psychology*, *92*(3), 885.

Jett, Q. R. (2003). Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life. *Academy of Management Review*, 14.

Jouanne, E., Charron, C., Chauvin, C., & Morel, G. (2017). Correlates of team effectiveness: An exploratory study of firefighter's operations during emergency situations. *Applied Ergonomics*, *61*, 69–77. https://doi.org/10.1016/j.apergo.2017.01.005

Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. *Small Group Research*, *43*(2), 130–158.

Keyton, J., & Beck, S. J. (2009). The influential role of relational messages in group interaction. *Group Dynamics: Theory, Research, and Practice*, *13*(1), 14.

Klonek, F. E., Meinecke, A. L., Hay, G., & Parker, S. K. (2020). Capturing team dynamics in the wild: The communication analysis tool. *Small Group Research*, *51*(3), 303–341.

Kolbe, M., Grote, G., Waller, M. J., Wacker, J., Grande, B., Burtscher, M. J., & Spahn, D. R. (2014). Monitoring and talking to the room: Autochthonous coordination patterns in team interaction and performance. *Journal of Applied Psychology*, *99*(6), 1254.

Lee, A. H., Wang, K., Scott, J. A., Yau, K. K. W., & McLachlan, G. J. (2006). Multi-level zero-inflated Poisson regression modelling of correlated count data with excess zeros. *Statistical Methods in Medical Research*, *15*(1), 47–61. https://doi.org/10.1191/0962280206sm429oa

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2013). *The upward spirals in team processes: Examining dynamic positivity in problem solving teams*.

Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2017). Understanding positivity within dynamic team interactions: A statistical discourse analysis. *Group & Organization Management*, *42*(1), 39–78.

Leroy, S., Schmidt, A. M., & Madjar, N. (2020). Interruptions and task transitions: Understanding their characteristics, processes, and consequences. *Academy of Management Annals*, *14*(2), 661–694.

Nancarrow, S. A., Booth, A., Ariss, S., Smith, T., Enderby, P., & Roots, A. (2013). Ten principles of good interdisciplinary team work. *Human Resources for Health*, *11*(1), 19. https://doi.org/10.1186/1478-4491-11-19

Okhuysen, G. A., & Eisenhardt, K. M. (2002). Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility. *ORGANIZATION SCIENCE*, *13*(4), 18.

Omilion-Hodges, L. M., Imes, R., & Hester, J. (2021). Editorial: Team and Leader Communication in the Healthcare Context: Building and Maintaining Optimal Transdisciplinary Teams. *Frontiers in Communication*, *6*. https://www.frontiersin.org/article/10.3389/fcomm.2021.669399

Puranik, H., Koopman, J., & Vough, H. C. (2020). Pardon the Interruption: An Integrative Review and Future Research Agenda for Research on Work Interruptions. *Journal of Management*, *46*(6), 806–842. https://doi.org/10.1177/0149206319887428

Puranik, H., Koopman, J., & Vough, H. C. (2021). Excuse me, do you have a minute? An exploration of the dark-and bright-side effects of daily work interruptions for employee well-being. *Journal of Applied Psychology*.

Raes, E., Boon, A., Kyndt, E., & Dochy, F. (2015). Measuring team learning behaviours through observing verbal team interaction. *Journal of Workplace Learning*.

Rivera-Rodriguez, A. J., & Karsh, B.-T. (2010). Interruptions and distractions in healthcare: Review and reappraisal. *BMJ Quality & Safety*, *19*(4), 304–312.

Rosell, L., Wihl, J., Hagberg, O., Ohlsson, B., & Nilbert, M. (2019). Function, information, and contributions: An evaluation of national multidisciplinary team meetings for rare cancers. *Rare Tumors*, *11*, 2036361319841696.

Schippers, M. C., Edmondson, A. C., & West, M. A. (2014). Team reflexivity as an antidote to team information-processing failures. *Small Group Research*, *45*(6), 731–769.

Soukup, T., Gandamihardja, T. A., McInerney, S., Green, J. S., & Sevdalis, N. (2019). Do multidisciplinary cancer care teams suffer decision-making fatigue: An observational, longitudinal team improvement study. *BMJ Open*, *9*(5), e027303.

Soukup, T., Lamb, B. W., Shah, N. J., Morbi, A., Bali, A., Asher, V., Gandamihardja, T., Giordano, P., Darzi, A., Green, J. S. A., & Sevdalis, N. (2020). Relationships Between Communication, Time Pressure, Workload, Task Complexity, Logistical Issues and Group Composition in Transdisciplinary Teams: A Prospective Observational Study Across 822 Cancer Cases. *Frontiers in Communication*, *5*, 101. https://doi.org/10.3389/fcomm.2020.583294

Soukup, T., Murtagh, G. M., Lamb, B. W., Bali, A., Gandamihardja, T., Darzi, A., Green, J. S. A., & Sevdalis, N. (2021). Gaps and Overlaps in Cancer Multidisciplinary Team Communication: Analysis of Speech. *Small Group Research*, *52*(2), 189–219. https://doi.org/10.1177/1046496420948498

Tschan, F., Vetterli, M., Semmer, N. K., Hunziker, S., & Marsch, S. C. U. (2011). Activities during interruptions in cardiopulmonary resuscitation: A simulator study. *Resuscitation*, *82*(11), 1419–1423. https://doi.org/10.1016/j.resuscitation.2011.06.023

van der Meer, S. A., Lehmann-Willenbrock, N., Delahaij, R., & Homan, A. C. (2022). The Influence of Intrusions on Team Interaction: An Explorative Field Study. *Small Group Research*, 10464964211073590.

Walraven, J. E., van der Hel, O. L., van der Hoeven, J. J. M., Lemmens, V. E., Verhoeven, R. H., & Desar, I. M. (2022). Factors influencing the quality and functioning of oncological multidisciplinary team meetings: Results of a systematic review. *BMC Health Services Research*, *22*(1), 1–27.

Wang, B., Liu, Y., & Parker, S. K. (2020). How does the use of information communication technology affect individuals? A work design perspective. *Academy of Management Annals*, *14*(2), 695–725.

Weigl, M., Antoniadis, S., Chiapponi, C., Bruns, C., & Sevdalis, N. (2015). The impact of intra-operative interruptions on surgeons' perceived workload: An observational study in elective general and orthopedic surgery. *Surgical Endoscopy*, *29*(1), 145–153. https://doi.org/10.1007/s00464-014-3668-6

Weiss, H. M., & Cropanzano, R. (1996). Affective events theory. *Research in Organizational Behavior*, *18*(1), 1–74.

Wiesche, M. (2021). Interruptions in Agile Software Development Teams. *Project Management Journal*, *52*(2), 210–222. https://doi.org/10.1177/8756972821991365

Zajac, S., Woods, A., Tannenbaum, S., Salas, E., & Holladay, C. L. (2021). Overcoming challenges to teamwork in healthcare: A team effectiveness framework and evidence-based guidance. *Frontiers in Communication*, *6*, 606445.

Zoethout, H., Wesselink, R., Runhaar, P., & Mulder, M. (2017). Using transactivity to understand emergence of team learning. *Small Group Research*, *48*(2), 190–214.

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CHAPTER 6

Conclusion

The ways in which we communicate in organizational teams has captured the attention of scholars and turned into a distinct research area in its own right. Over the past five years of my dissertation project, I have contributed to this field and aimed to provide a better understanding of communicative processes within organizational teams. I find it fascinating that teams (unconsciously) produce patterns in conversations and without careful analysis, these patterns and their relevance for organizational and team functioning remain widely hidden or unknown. This final chapter integrates my insights and reflections on the four research projects presented in each chapter of this dissertation.

INTEGRATIVE SUMMARY

As team processes are often consigned to a 'black box' (van Swol & Ahn, 2021), this dissertation contributes to unpacking team-level communicative processes as drivers for organizational team functioning. Both conceptually and empirically, we aimed to untangle how communicative processes unfold during collaboration periods in organizational teams. In the first part of this dissertation, we contributed to a more process-oriented understanding of team-based collective intelligence. In addition, we developed a comprehensive framework to study communicative patterns from various aspects (i.e., *content*, *structure,* and *temporality*) and showed how patterned communication may relate to team and organizational-level outcomes. In our own empirical work, we found fine-grained evidence for more back-and-forth communicative patterns underlying the decision-making process in multidisciplinary healthcare team meetings, which seems to be rooted in insufficient orientation of the patients' background problems. In addition, we observed that team members respond with emotionally laden communication after naturally occurring workflow interruptions, together with more conversational clarification. In sum, both scholars and practitioners benefit from understanding patterned communication because these insights offer sound foundations to reflect on improvements regarding organizational team functioning.

MAIN THEORETICAL CONTRIBUTIONS

This dissertation departs from organizational psychology thinking, aiming to unpack the black box of the communicative processes in the traditional input-process-output framework (Hackman, 1987; McGrath, 1984). In addition, we draw from the theory of ecological rationality (Gigerenzer and Todd, 1999) and transpose that line of thinking towards the team-level to posit that communicative behaviors are not good or bad per se, rather they are more or less appropriate to the environmental conditions in which the communication takes place. Next, we draw from the multilevel theory of emergence to show how individual-level communicative statements manifest in higher level communicative patterns over time (Kozlowski & Klein, 2000). Furthermore, we apply this thinking coming from organizational psychologists to the field of healthcare management. In our own empirical work, we contribute by showing in detail how team dynamic decision-making models actually work in the context of multidisciplinary healthcare teams (Forsyth, 2018; Poole & Baldwin, 1986). Our empirical findings help to update traditional decision-making models that posit solely linear decision-making (Poole & Baldwin, 1986; Tschan, 2002). Next, we contribute to showing which workflow interruptions naturally emerge in these multidisciplinary healthcare teams, mostly contributing to theory around 'intrusions' as a key type of work interruption (according to the conceptualization of Jett, 2003). Although research primarily focusses on workflow interruptions at the individual-level (Altmann et al., 2014; Baethge & Rigotti, 2013; Gillespie et al., 2012), we contribute to understanding how organizational teams are likewise prone to various interruptions and how it relates to changes in the way in which teams communicate (see also; van der Meer et al., 2022). Specifically, we contribute to understanding the communicative consequences of workflow interruptions for the team, in fine-grained and small-scale time windows (i.e., immediate response and subsequent five-minute time windows).

PRACTICAL IMPLICATIONS

The Dutch national research agenda has emphasized the importance of improving multidisciplinary healthcare, while maintaining affordability. We contribute to this call by reflecting on evidence-based recommendations for improving communicative processes in multidisciplinary team meetings. In particular, we offer practical guidelines to hospitals seeking to improve multidisciplinary team meeting (MDTM) practices based on key observations in actual medical team meetings. In the following, we summarize notable observations and end this section with recommendations for practice.

Apart from our key research findings (i.e., insufficient initial orientation during the team decision-making process and the effect of workflow interruptions in medical hospital teams) several observations provide evidence for *insufficient preparation* of the patients' cases *before* the start of the MDTM. That is, patients cases are introduced only to find out during the discussion that important information is lacking, which consequently result in the treatment plan proposition to be delayed until all the necessary information is available. A substantial amount of time is spent presenting the patient's medical history to the team, only to realize that essential information is missing, making it impossible to formulate suitable treatment plans collaboratively. Based on initial estimates from our sample, it appears that this issue may reflect as many as eight percent of all patient cases. In addition, we observed instances where radiologists were reluctant to contribute their expertise during MDTMs, because patients were introduced last minute and the radiologist was expected to provide on-the-spot interpretations, without adequate preparation time. The radiologist argued that, without well-prepared tumor imaging interpretations, it is difficult to ensure high quality radiology input. Our estimates indicate that this issue affects approximately three percent of all patient cases, which we consider to be a signal reflecting suboptimal patient care.

Taking these observations together, we put forward that adequate preparation time *ahead* of the meeting is needed to address and filter out logistical issues that otherwise arise *during* MDTMs. If one person is assigned to review all patient cases for (in) completeness and tracks important missing information, the team as a collective does not need to deal with these issues. As incomplete information prior to the MDTMs impedes the decision-making process and unnecessary lengthens meetings, we believe that hospitals may benefit from the use of formal checklists to ensure all essential patient information is available prior to the start of the MDTM.

Secondly, we reflect on ways in which hospitals can restructure their MDTMs to better integrate them into the overall job requirements of medical physicians, with the goal of reducing interruptions and mitigating their (negative) impact. Currently, MDTMs are considered as additional work activities that medical physicians attend and contribute to on top of their regular work duties, without any allocated formal uninterrupted time in their schedule. As a result, medical physicians are contacted from outside the meeting for patient treatment *during* MDTMs, resulting in highly interruptive MDTMs with beepers going off, people leaving and entering the room to take phone calls or deal with emergency patient situations. The number of interruptions can be significantly reduced when MDTMs are formally scheduled as uninterrupted work time in the work schedules of medical physicians.

Thirdly, some literature on MDTM functioning proposes that the meeting chair should not contribute content-wise in the discussions, but rather their main task should be to navigate and lead the communicative processes between disciplines. We believe that this recommendation may help medical physicians to, for example, not shift too quickly into solution-oriented communication, but ensure the initial problem orientation phase is sufficiently clear. The cognitive load for meeting chairs is substantive, as they are expected to constantly shift between roles as meeting facilitator and discipline knowledge contributor. The cognitive role overload may be especially prevalent if the chair is simultaneously representing a sole discipline (which we have observed in our data). Thus, we advise to separate chair responsibilities and discipline knowledge contributors as formal roles within MDTMs.

LIMITATIONS CONNECTING OPPORTUNITIES FOR FUTURE RESEARCH

In this closing section, we want to discuss several limitations, connected to opportunities for future research, that hopefully further spark some enthusiasm for scholars in the study of team-based communicative patterns.

One limitation of this dissertation pertains to the overarching focus of verbal team communication, thereby neglecting the non-verbal cues, which are inherently part of multimodal team communication. While verbal communication is highly informative, some scholars argue that the nonverbal signals carry equally or even greater importance (Burgoon & Dunbar, 2018). We marginally tackle this aspect in chapter five, as we capture and code emotional laden exchanges and find that the valence statements changed significantly in response to natural workflow interruptions. However, other types of nonverbal communication such as facial expressions, gestures, eye contact, seating arrangements, or body language might be relevant. Additional research may seek to observe and explore the extent to which these elements shape or influence the team collaboration. Although video recordings are available to rewatch and potentially code for nonverbal communicative dynamics, facial expressions – for example – are more difficult to grasp as we only had one camera to capture the entire team. Ideally, we would zoom in on all faces of team members and follow changes in emotional expression as the conversations unfolds as well as how other members react to emotional laden cues. That is an interesting area to explore, as understanding, identifying, and managing emotions in team collaboration has been found to positively correlate with team performance (Feyerherm & Rice, 2002; Rezvani et al., 2018). As algorithms nowadays become better at predicting emotions of facial expressions in the wild (e.g., Koduru et al., 2020; Mehta et al., 2019; Murugappan & Mutawa, 2021), research designs would be strengthened if verbal and nonverbal communicative resources were integrated and understood in a coordinated manner.

Although we contribute to some extent to the consideration of context both conceptually and empirically in this dissertation, we are far from identifying all interesting and relevant contextual dimensions that shape communicative patterns in organizational teams. To illustrate, in highly collaborative organizational settings, communicative patterns might be more oriented towards the benefit of the collective (e.g., decentralization, co-contribution), while in competitive organizational contexts, communicative patterns may be more oriented towards personal gain (e.g., centralization, power influence). Additionally, team members quickly learn societal and cultural values, norms, and expectations that surround an organization and thus behave according to what is perceived as good, desired, or valuable within the team. Thus, greater consideration of contextual dimensions in further research may help us understand why some communicative patterns are more frequent in various organizational settings than others (e.g. Johns, 2006).

Third, this dissertation uses specific theories as a foundation in exploring patterned communication (e.g., ODDI model for group decision-making; Forsyth, 2018). However, there exists a rather broad set of other theoretically validated coding schemes, all capturing a wide range of interesting team dynamics, resulting in interesting areas for future research. To illustrate, coding schemes that capture conflict strategies, such as Verbal Tactics Coding Scheme (VTCS) observe conflict in problem-solving discussion. The VTCS classifies each communicative statement in a discussion based on the function it serves in, for example, managing, escalating, or minimizing conflict issues (Sillars, 2018). We recall one example in our data where medical physicians who initiated procedural issues in the team conversation, were acknowledged by some, while also experiencing 'topic avoidance' statements in some responses (for transcript examples see chapter 4, Table 4.7). Scholars need to be mindful of the theoretical foundation of the coding scheme and we advise future researchers to choose one carefully that matches their research context and interest, as that mainly drives the findings of patterned communication.

Lastly, this dissertation has conducted manual coding techniques to understand the content of communicative patterns in medical MDTMs, which I have experienced firsthand as painstaking endeavors (also described in; Mathieu et al., 2019). While I perceive this methodology more as a strength of this dissertation than as a limitation, I see big advantages in upcoming artificial intelligence systems to help scholars with, for example, automated coding and detecting communicative patterns in organizational teams. To illustrate, machines can be trained to classify discussion from a set of human-coded examples and subsequently use its underlying mathematical representation to classify new, unlabeled or uncoded data (for an introduction to supervised machine learning techniques, see Bonito & Keyton, 2018). Nevertheless, I am also grateful to have had the time to observe, study and analyze communicative transcripts of multidisciplinary team meetings in depth, as that allowed me to understand this medical setting extremely well and helped me adopt a 'targeted' approach to identify interesting team processes that took place within these meetings. However, with sophisticated algorithms and artificial intelligence rapidly evolving in our society nowadays, I would advise scholars to partially code/label communicative data manually, but to subsequently lean on automated algorithms to help with automated content coding (if the context allows). During my doctoral training, I was able to attend conferences and symposia that promote collaborations among social and computer scientists that have the potential to spark synergy between these disciplines (e.g., Hung et al., 2020). As I look to the future, I am excited about the potential for further interdisciplinary research work in the area of patterned communication in organizational teams.

REFERENCES

Altmann, E. M., Trafton, J. G., & Hambrick, D. Z. (2014). Momentary interruptions can derail the train of thought. *Journal of Experimental Psychology: General*, *143*(1), 215–226. https://doi.org/10.1037/a0030986

Baethge, A., & Rigotti, T. (2013). Interruptions to workflow: Their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands. *Work & Stress*, *27*(1), 43–63. https://doi.org/10.1080/02678373.2013.761783

Bonito, J. A., & Keyton, J. (2018). Introduction to machine learning. *The Cambridge Handbook of Group Interaction Analysis*, 387–404.

Boos, M. (2018). CoCo: A category system for coding coherence in conversations. *The Cambridge Handbook of Group Interaction Analysis*, 502–509.

Burgoon, J. K., & Dunbar, N. E. (2018). *Coding nonverbal behavior. The Cambridge Handbook of Group Interaction Analysis*, 184–190.

Feyerherm, A. E., & Rice, C. L. (2002). Emotional intelligence and team performance: the good the bad and the ugly. *The International Journal of Organizational Analysis*, *10*(4), 343–362. https://doi.org/10.1108/eb028957

Forsyth, D. R. (2018). *Group dynamics*. Cengage Learning.

Gillespie, B. M., Chaboyer, W., & Fairweather, N. (2012). Interruptions and Miscommunications in Surgery: An Observational Study. *AORN Journal*, *95*(5), 576–590. https://doi.org/10.1016/j.aorn.2012.02.012

Hackman, J. R. (1987). *The design of work teams. InHandbook of Organizational Behavior, ed. JW Lorsch*. Englewood Cliffs, NJ: Prentice-Hall.

Hung, H., Murray, G., Varni, G., Lehmann-Willenbrock, N., Gerpott, F. H., & Oertel, C. (2020). Workshop on Interdisciplinary Insights into Group and Team Dynamics. *Proceedings of the 2020 International Conference on Multimodal Interaction*, 876–877.

Jett, Q. R. (2003). Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life. *Academy of Management Review*, 14.

Johns, G. (2006). The essential impact of context on organizational behavior. *Academy of Management Review*, *31*(2), 386–408.

Koduru, A., Valiveti, H. B., & Budati, A. K. (2020). Feature extraction algorithms to improve the speech emotion recognition rate. *International Journal of Speech Technology*, *23*(1), 45–55.

Kozlowski, S. W., & Klein, K. J. (2000). *A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes.*

Mathieu, J. E., Gallagher, P. T., Domingo, M. A., & Klock, E. A. (2019). Embracing complexity: Reviewing the past decade of team effectiveness research. *Annual Review of Organizational Psychology and Organizational Behavior*, *6*, 17–46.

McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14). Prentice-Hall Englewood Cliffs, NJ.

Mehta, D., Siddiqui, M. F. H., & Javaid, A. Y. (2019). Recognition of emotion intensities using machine learning algorithms: A comparative study. *Sensors*, *19*(8), 1897.

Murugappan, M., & Mutawa, A. (2021). Facial geometric feature extraction based emotional expression classification using machine learning algorithms. *Plos One*, *16*(2), e0247131.

Poole, M. S., & Baldwin, C. L. (1986). Developmental processes in group decision making. *Communication and Group Decision-Making*, 35–62.

Rezvani, A., Barrett, R., & Khosravi, P. (2018). Investigating the relationships among team emotional intelligence, trust, conflict and team performance. *Team Performance Management: An International Journal*, *25*(1/2), 120–137. https://doi.org/10.1108/TPM-03-2018-0019

Sillars, A. L. (2018). *VTCS: Verbal Tactics Coding Scheme*.

Tschan, F. (2002). Ideal cycles of communication (or cognitions) in triads, dyads, and individuals. *Small Group Research*, *33*(6), 615–643.

van der Meer, S. A., Lehmann-Willenbrock, N., Delahaij, R., & Homan, A. C. (2022). The Influence of Intrusions on Team Interaction: An Explorative Field Study. *Small Group Research*, 10464964211073590.

van Swol, L. M., & Ahn, P. H. (2021). Inside the Black Box: Group Processes and the Role of Communication. In *The Emerald Handbook of Group and Team Communication Research* (pp. 157–170). Emerald Publishing Limited.

Zoethout, H., Wesselink, R., Runhaar, P., & Mulder, M. (2017). Using transactivity to understand emergence of team learning. *Small Group Research*, *48*(2), 190–214.

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