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# Igniting and resolving content disagreements during team interactions: A statistical discourse analysis of team dynamics at work

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## Summary

Disagreements are integral to fruitful team collaboration but have rarely been studied within actual team interactions. We develop a temporal account of how disagreement episodes begin and are resolved during team interactions, testing explanatory factors at multiple levels: team context (team conflict states and team productivity), individual characteristics and perceptions (individual status and perceptions of team viability), and behavioral patterns (problem solving versus off-task communication) with a statistical discourse analysis of 32,448 turns of talk by 259 employees during 43 team meetings. As hypothesized, problem-solving behaviors (e.g., describing problems and proposing solutions) ignited content disagreements, often by participants who perceived greater team viability. In contrast, after off-task behaviors or talk by higher status team members, participants started fewer content disagreements. Moreover, content disagreements started by higher status individuals were more likely than those started by others to be resolved with agreements, especially via agreements with higher status individuals. Also, problem-solving behaviors facilitated the resolution of disagreement episodes with agreement, whereas off-task behaviors hindered them. Contrary to our hypotheses, team conflict states and productivity were not linked to starting or ending disagreements. We discuss the conceptual and methodological importance of capturing team interaction dynamics at work and derive practical implications for managing content disagreement.

**KEYWORDS**

disagreement, dynamic multilevel modeling, temporal team interactions, status, team viability

## 1 | INTRODUCTION

*Honest disagreement is often a good sign of progress.*
M. Gandhi

Disagreements encompass a range of verbal behaviors that are opposed to agreement (for an overview, see Angouri & Locher, 2012). In contrast to reflexive, uncritical agreements that can hinder team problem solving (e.g., Aldag & Fuller, 1993; Esser, 1998; Leana, 1985), disagreements can help teams create better solutions through integrating divergent perspectives and sparking new ideas (e.g., Jansen, Van de Vliert, & West, 2004; Paulus & Brown, 2007). In this study, we focus on rejections or contradictions of other members' contributions without personal judgment (*content disagreement*). Content disagreement can be crucial not only for superior team problem solving and decision making but also for team and organizational effectiveness more broadly (e.g., Ellis et al., 2003; Garvin, Edmondson, & Gino, 2008; Kellermanns, Floyd, Pearson, & Spencer, 2008; Van Offenbeek, 2001). As content disagreements can display and integrate different perspectives, they can help team members learn about one another's views, their interactions, and their organization (i.e., organizational learning; e.g., Argyris & Schön, 1996; Edmondson, 2002; Senge, 1990).

Yet some studies offer an alternate view. For example, Van Woerkom and Sanders (2010) report negative effects of disagreement on opinion sharing in teams. We believe that there are four reasons for such ambiguities in the literature, namely, (1) a lack of distinction between disagreements on the one hand (i.e., behaviors at specific points in team interactions) and emergent team conflict; (2) lack of distinction among different types of disagreements and their resolutions; (3) lack of quantitative research on behaviors during actual

  

disagreements within temporal social interactions (cf. Garner, 2013); and (4) inadequate statistical modeling of the interplay among individual attitudes, team attributes, and behavioral dynamics that trigger disagreement occurrences. To resolve these ambiguities, we examine disagreement episodes and resolutions as they unfold in real time during regular team meeting interactions—rather than relying on aggregations of such behaviors or post hoc self-reports. We draw from psychological perspectives of disagreement and team interactions, and we use quantitative methodology and statistical modeling to test our hypotheses.

Importantly, disagreements within teams are not isolated occurrences. Instead, each disagreement begins and ends within social and temporal contexts, so we must account for explanatory mechanisms at multiple levels (team, individual, and behavioral or turn of talk level; e.g., Chiu & Lehmann-Willenbrock, 2016). The behaviors that shape disagreement episodes at the behavioral level are nested in the individuals who produce them, who in turn are nested in teams. Consequently, disagreement episodes are affected by influences stemming from the team context, from individual characteristics and attitudes, and from temporal dynamics at the behavioral event level. Hence, we integrate theory about team contextual factors, emergent team states, and individual-level influences on dynamic team interaction processes in ongoing teams to develop a multilevel temporal account of disagreement episodes in ongoing team interactions.

In terms of team contextual influences, we consider the role of general team productivity levels and previously emerged team conflict states (i.e., members' shared perceptions about task and relationship conflict experienced to date; e.g., Maltarich, Kukenberger, Reilly, & Mathieu, in press). Teams with superior productivity might capitalize on disagreements to improve their performance or have greater confidence to express their ideas (including conflicting ones), both of which tend to yield more disagreements (e.g., Lovelace, Shapiro, & Weingart, 2001; Van Woerkom & Sanders, 2010). Furthermore, a team that experiences greater intragroup conflict might (a) view disagreement as socially acceptable and hence express more disagreements compared to other teams (Weingart, Behfar, Bendersky, Todorova, & Jehn, 2016) or (b) suffer more social embarrassments, fear the consequences of fueling disagreements, and refrain from voicing disagreements (for an overview, see Weingart et al., 2016).

Next, we consider the influence of individual perceptions of team viability and individual status. Individuals who care more about the long-term future of their team (i.e., who experience high team viability, e.g., Bell & Marentette, 2011) might be more likely than others to invite ideas from others, identify flaws, and share alternatives—the latter two often foster disagreements. Furthermore, people are often more likely to agree with a high-status team member than a low-status one and less likely to disagree with the former than the latter (Chiu & Khoo, 2003).

Moreover, temporal dynamics at the event level can influence team behaviors in general (e.g., Chiu & Lehmann-Willenbrock, 2016; Lehmann-Willenbrock, Chiu, Lei, & Kauffeld, 2017) and ignite or resolve disagreements. Specific behaviors can create distinct momentary conversational contexts that could influence the likelihoods of starting or ending disagreements. Problem-solving behaviors and sequences (e.g., identifying problems and proposing solutions) might invite alternate views, thereby starting disagreements but also helping to resolve them. In contrast, off-task behaviors and sequences (e.g., laughing or engaging in side conversations) might distract from the central task to reduce tension, thereby reducing the likelihoods of both starting a disagreement and ending an ongoing one.

To address these issues, we apply a multilevel, time-series method, *statistical discourse analysis* (SDA; Chiu, 2008b; Chiu & Lehmann-Willenbrock, 2016), to videotaped meeting conversations ($N$ = 32,448 turns of talk) in a sample of 43 real teams. Although inspired by discourse analysis, SDA itself is a statistical method built on ordinary least squares regression (see details in Chiu & Lehmann-Willenbrock, 2016). Our study contributes to the literature on workplace dynamics, teams' temporal processes, and temporal dynamics surrounding disagreements in three key ways. First, we introduce and test a multilevel (team, individual, and turn of talk), time-series, explanatory model for igniting verbally expressed disagreements, thereby addressing repeated calls to study the temporal nature of team interactions (e.g., Cronin, Weingart, & Todorova, 2011; Waller, Okhuysen, & Saghafian, 2016). Second, we introduce and test a corresponding multilevel, time-series, explanatory model for resolving a disagreement with an agreement. Third, we disentangle disagreement behaviors embedded in temporal team interaction sequences from emergent conflict states, thus resolving ambiguities in the team conflict literature. As this study can inform our understanding of how teams ignite and resolve disagreements at the behavioral level, it can yield important insights for managing team dynamics—a critical leadership challenge (e.g., Morgeson, DeRue, & Karam, 2010).

## 2 | THEORETICAL BACKGROUND AND HYPOTHESES

Team interactions are complex, temporal, multilevel phenomena. Early work by McGrath (1984) described them as "patterned relations" (p. 11). They are complex because they (a) entail members' interdependent acts (Marks, Mathieu, & Zaccaro, 2001, p. 357), (b) require constant coordination among member contributions (e.g., Kolbe et al., 2014), and (c) are at the core of teamwork itself (for an overview, see Grossman, Friedman, & Kalra, 2017). Team interactions are inherently temporal because team task accomplishment requires temporal rhythms (e.g., Mohammed, Hamilton, & Lim, 2009; Zellmer-Bruhn, Waller, & Ancona, 2004), and team dynamics are temporally patterned (e.g., Massey, Montoya-Weiss, & Hung, 2003; see also Lehmann-Willenbrock & Allen, 2017). Finally, team interactions are multilevel phenomena because their constituent behaviors are nested in temporal behavioral contexts, in individuals, and in teams. Hence, discrete interaction events such as disagreement are subject to influences at the behavioral event level, at the individual level, and at the team level.

Regarding multilevel influences on team interactions, research insights to date are limited. Current multilevel thinking in team research typically argues how emergent team states manifest upward from individual-level characteristics and interactions among individuals (e.g., Kozlowski, Chao, Grand, Braun, & Kuljanin, 2013). This perspective is certainly helpful for understanding how emergent team constructs come into existence in the first place, yet it does not explain

how these constructs, once emerged, affect ongoing teams' future behaviors and interactions. Hence, we develop a multilevel and temporal perspective of team interactions themselves, adopting a microlevel, temporal, behavioral approach to team interactions and accounting for explanatory variables at multiple levels (behavioral, individual, and team).

Figure 1 illustrates our overall theoretical approach. As depicted in Figure 1, we consider disagreement episodes in team interactions as specific behavioral events nested in temporal behavioral contexts, individuals, and teams. In other words, the events that comprise a disagreement episode are subject to team context influences, individual influences, and behavioral dynamics at the event level. At the team and individual levels, we further distinguish between relatively stable characteristics and dynamic states, both of which may affect team interactions in general and disagreement episodes within such interactions in particular. Next, we consider the multilevel influences on disagreement episodes in temporal team interactions from a top-down perspective, beginning with team-level influences, moving to individual-level influences, and finally zooming in on microlevel behavioral dynamics.

In terms of team-level influences, relatively stable team context variables that affect the ways in which a disagreement episode unfolds include team composition characteristics, such as the gender ratio (sometimes termed *cumulative* team constructs, as they are based in individual characteristics that cumulate at the team level; Cronin et al., 2011). Relatively stable context characteristics also include a team's overall performance level across longer time spans, which can serve as an input for future interactions (Ilgen, Hollenbeck, Johnson, & Jundt, 2005). Dynamic influences at the team level concern emergent team states, such as team conflict states (e.g., Cronin et al., 2011; Kozlowski et al., 2013). The distinction between emergent team states and behavioral interaction dynamics is important, both conceptually and methodologically (for reviews, see Fulmer & Ostroff, 2016; Kozlowski et al., 2013). As Marks et al. (2001, p. 357) noted, emergent team states such as team conflict states are "cognitive, motivational, and affective states of teams, as opposed to the nature of their member interaction." Furthermore, as emergent states are the product of prior team experiences and interactions, they become inputs for subsequent interaction processes (Marks et al., 2001; see also Ilgen et al., 2005). Hence, in ongoing teams, emergent team states continue to affect future interactions. As such, we consider their influence on specific disagreement episodes at the behavioral level.

In terms of influential factors at the individual level, we again distinguish between stable individual properties, such as an individual's tenure-based status in the team, and more fluid individual attitudes about the team. Both stable individual characteristics and individual attitudes may affect how a disagreement episode unfolds: by influencing actions of the current speaker at a given moment of the interaction or by influencing actions of the following speaker or both. In other words, they may affect the likelihood that an individual disagrees, and they may also affect the likelihood that others disagree with this individual. Similarly, these individual-level characteristics and attitudes may affect the likelihood of resolving a disagreement. We particularly consider how the relatively stable role of individual status affects behaviors and interactions, specifically igniting and resolving disagreements, given the impact of individual status for communication behavior more broadly (e.g., Bienefeld & Grote, 2014; Weisband, Schneider, & Connolly, 1995). We also consider fluid individual attributes, such as experiences of team viability, which is an important indicator of perceived team effectiveness (e.g., Balkundi & Harrison, 2006; Bell & Marentette, 2011) and as such might affect both individual interaction behavior in general and disagreement behavior in particular.

Yet team interaction in general, and the initiation and resolution of disagreement in particular, depends not only on characteristics of each individual speaker or the surrounding team context but also on the conversational dynamics preceding each behavior. A person's behaviors during team interactions typically respond to other team members' behaviors and in turn invite specific future behaviors from them, thereby forming temporal sequences of behavior. As the behaviors within a temporal sequence of team interactions are often related to one another (for an overview, see Chiu & Lehmann-Willenbrock, 2016), we must account for the ways in which recent behaviors (*microtime context*) affect the likelihood of a target behavior (in our case, starting a disagreement or resolving it) at each moment in time. Hence, beyond team- and individual-level influences, we also explore how the microtime context at the behavioral level influences the ignition or resolution of disagreements. Specifically, we test how attributes of team members' recent turns of talk might be related to the likelihoods of igniting or resolving disagreements at each conversational turn (Chiu, 2008b; Chiu & Lehmann-Willenbrock, 2016).

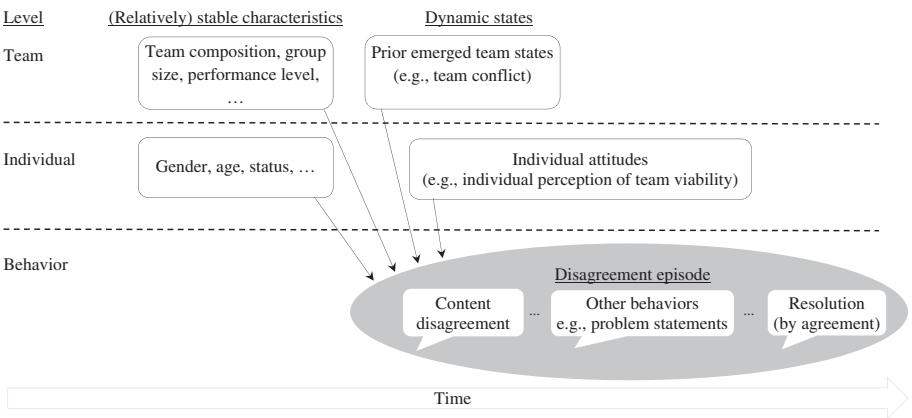


**FIGURE 1** A multilevel temporal model of disagreements embedded in team interactions

After differentiating content disagreement from related constructs and clarifying the behavioral qualities of this phenomenon in the context of temporal team interactions, we explore multilevel influences at the team, individual, and behavioral levels on igniting and resolving disagreements in temporal team interactions.

## 2.1 | Defining content disagreement

Content disagreement refers to a set of observable behaviors within a team's interaction flow. Embedded within a conversational context, content disagreement can be defined as "an oppositional stance (verbal or non-verbal) to an antecedent verbal (or non-verbal) action" (Kakava, 1993, p. 36). As we explicitly focus on verbal expressions of disagreement during team interactions in this study, we follow earlier conceptualizations (Angouri, 2012; Angouri & Locher, 2012; Kakava, 1993, 2002) and define content disagreement in terms of verbal statements that express opposition with prior discussion content or contributions by other team members. Simple rejections, counterarguments, or contradictions of a prior opinion, solution, or suggestion all qualify as content disagreements.

To delineate content disagreement clearly, we disentangle it from personal insult by distinguishing between content disagreement on the one hand (i.e., disagreeing with prior content or disagreeing based on facts) and personal criticisms on the other hand (i.e., criticizing characteristics of a previous speaker rather than focusing on the discussion content; Kauffeld & Lehmann-Willenbrock, 2012). A disagreement that threatens the public self-image (face) of the target team member (face attack, e.g., "Stupid idea"; Tracy, 2008) can reduce participation, as group members withhold their ideas rather than risk losing face (Chiu, 2008a; Van Woerkom & Sanders, 2010). In contrast, a content-based disagreement is an expressed rejection of prior discussion content by other team members (e.g., Angouri, 2012; Angouri & Locher, 2012). Examples include simple rejections (e.g., "That's not true") or contradictions of a prior contribution without negative judgment of the person (e.g., "I don't see it like that").

Content disagreement is not the same as task conflict, neither conceptually (in terms of the scope of the construct) nor methodologically (in terms of its measurement and analysis). Yet we acknowledge that task conflict and content disagreement can overlap. Though conflict scholars have typically focused on team members' perceptions of disagreements about how to accomplish particular aspects of their tasks (e.g., De Dreu, 2006; Jehn, 1995; Simons & Peterson, 2000), recent work highlights the role of actual expressions of conflict (Todorova, Bear, & Weingart, 2014; Weingart et al., 2016). When an instance of content disagreement indicates a difference of opinion regarding the team's task content and related decisions, this disagreement can be viewed as a discrete expression of task conflict. Yet there are also other cases when content disagreements differ from task conflict, specifically recognized errors. For example, during a team meeting, a member may disagree with a previous statement about organizational knowledge ("No, that guy retired a while ago"), with details of a solution ("No, actually what I meant was"), or with the documentation of the meeting results so far ("Hang on, that's wrong—looks like a typo"). All of these are examples of content disagreement, but they would not be considered expressions of task conflict.

Content disagreements can yield at least four benefits for teams: increased attention, expression of more ideas, improved problem solving, and greater learning. As a disagreement legitimizes different opinions, it stimulates group members to pay attention and share more of their own ideas, including those unrelated to the specific disagreement (e.g., De Dreu & West, 2001; Nemeth & Rogers, 1996). Furthermore, workplace teams often accept disagreements based on different opinions as part of a normal problem-solving process, not as face threatening (Angouri, 2012). Teams with more non-face-threatening disagreements are more likely to solve a problem (Chiu & Khoo, 2003). Moreover, teams whose members' initial ideas are more divergent tend to learn more than other teams (Van Offenbeek, 2001). Next, we turn our attention to multilevel influences on igniting and resolving content disagreements (see Figure 1).

## 2.2 | Team-level influences: team productivity as a context factor

Grounded within an input–mediator–output–input approach (e.g., Ilgen et al., 2005), where team performance outputs can serve as inputs to future team interactions, we consider how workplace teams' performance histories might influence their ignition or resolution of disagreements. Team productivity or objective team performance can be defined as the measurable quality and quantity of the results of a team's activity that are valued by one or more constituencies (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Mathieu, Maynard, Rapp, & Gilson, 2008). Hackman (1987) identified productivity as a core component of team effectiveness, such that "the productive output of the work group should meet or exceed the performance standards of the people who receive and/or review the output" (p. 323). Considering the role of content disagreement for team learning and adaptation (e.g., Raes, Kyndt, Decuyper, Van den Bossche, & Dochy, 2015), we expect team productivity to serve as a general context factor for team interaction dynamics that might influence the ignition of content disagreements.

Specifically, we argue that highly productive teams might use disagreements more effectively or have more confidence, compared to other teams. Team productivity can be related to the ways in which teams share ideas, disagree constructively, and resolve their disagreements to integrate their different views into a superior solution or decision (e.g., Chiu, 2008b; Paletz, Schunn, & Kim, 2011; Van Offenbeek, 2001). High-productivity teams might also have greater confidence than other teams to propose new ideas (i.e., team potency; e.g., Pearce, Gallagher, & Ensley, 2002; Hu & Liden, 2011), including conflicting ones that yield content disagreements. For these reasons, high-productivity teams might have more content disagreements than other teams.

> **Hypothesis 1.** *Content disagreements are more likely in highly productive teams than in less productive teams.*

## 2.3 | The role of previously emerged team conflict states

Distinguishing between discrete disagreement behaviors in current team interactions and longer term, previously emergent conflict states

is essential not only from a multilevel point of view (see Figure 1) but also from a conceptual stance. Emerged team conflict states are the product of prior team interactions (e.g., Cronin et al., 2011; Kozlowski et al., 2013; Marks et al., 2001). In contrast, disagreement episodes refer to behavioral dynamics within ongoing team interactions. Naturally, emergent team conflict states and disagreement episodes in team interactions can be related. For instance, a history of repeated disagreements can result in (accumulated) perceptions of intragroup conflict. Moreover, as illustrated in Figure 1, emergent conflict states can also ignite—or inhibit—subsequent disagreements in ongoing team interactions. Specifically, among ongoing teams that share a history, those with greater intragroup conflict might have more disagreements. A team that perceives greater intragroup conflict states might not only tolerate disagreements but also view them as more socially acceptable and even normative (Ehrhart & Naumann, 2004). As a result, teams perceiving greater intragroup conflict might disagree more often than teams that experience less intragroup conflict do (e.g., Weingart et al., 2016). Similarly, groups with greater existing conflict often experience more disagreements (Kennedy & Pronin, 2008).

On the other hand, teams perceiving greater intragroup conflict, especially intragroup relationship conflict, might fear the consequences of fueling disagreements and therefore refrain from voicing disagreements (for an overview, see Weingart et al., 2016). Moreover, when intragroup conflict leads to face attacks, group members may withhold their ideas rather than risk others disagreeing and subsequently losing face (Chiu, 2008a; Van Woerkom & Sanders, 2010). Yet even without face attacks, some group members may fear personal embarrassment during conflicts. As a result, they defer to others rather than disagree with them and withhold controversial ideas to avoid disagreement by others (Tudge, 1989). Still others may value social harmony (Graziano & Tobin, 2009) in high-conflict groups and likewise avoid both disagreeing and expressing ideas with which others might disagree.

As such, both tendencies of intragroup conflict states, either encouraging or discouraging disagreements, find some support in the existing literature on team conflict. Hence, we have competing hypotheses:

> **Hypothesis 2a.** *In groups with greater perceived intragroup conflict, the likelihood of content disagreements during temporal team interactions is greater than in other groups.*

> **Hypothesis 2b.** *In groups with greater perceived intragroup conflict, the likelihood of content disagreements during temporal team interactions is less than in other groups.*

## 2.4 | Individual-level influences: individual status and disagreements

Status in terms of social hierarchy can be defined as "an implicit or explicit rank order of individuals … with respect to a valued social dimension" (Magee & Galinsky, 2008, p. 354). Within an organization, higher status individuals typically have superior job titles, earn more money, have more schooling/training, are older, and/or have longer tenure within the organization (Bendersky & Hays, 2012). Status has also been linked to speaking up (Bienefeld & Grote, 2014; Morrison, 2011) and to social influence via increased conversation shares (Ng, Bell, & Brooke, 1993), which suggests that status might also be linked to the likelihood of starting disagreements in team interactions. As higher status individuals are expected to contribute positively to a desired outcome, other members might selectively invite them to do so or defer to them, while discouraging, undervaluing, or outright ignoring lower status members' ideas (Chiu, 2000). Thus, a person is more likely to agree with high-status team members and less likely to disagree with them (Bunderson & Reagans, 2011; Chiu & Khoo, 2003). We specifically focus on team members' education, age, and organizational tenure as important indicators of status in this study (cf. Bendersky & Hays, 2012). Hence, we expect the following:

> **Hypothesis 3.** *Team members are less likely to initiate disagreements with high-status individuals than with-low status individuals.*

Moreover, status might influence not only the initiation of disagreements but also their resolution in two ways. First, an individual's status could affect whether the team resolves his or her disagreement with an agreement. Second, an individual's status could also affect whether others agree with him or her. Past studies show some support for these arguments. For example, team members typically value and defer more to higher status team members' ideas than to those of lower status ones (Bendersky & Hays, 2012; Bunderson, 2003; Joshi & Knight, 2015). Hence, team members might be more likely to value and resolve a disagreement ignited by a higher status team member than a lower status member. Moreover, team members might be more likely to resolve a disagreement by agreeing with an idea from a team member with higher status than from a team member with lower status. Put formally, we expect the following.

> **Hypothesis 4.** *A disagreement ignited by a higher status team member is more likely than those of others to be resolved with an agreement.*

> **Hypothesis 5.** *A disagreement is more likely to be resolved by agreement with a higher status team member than with other team members.*

## 2.5 | Individual perceptions of team viability

Whereas team productivity indicates past success, team viability anticipates an ongoing team's future (Bell & Marentette, 2011), captured by "members' satisfaction, participation, and willingness to continue working together" (Sundstrom, De Meuse, & Futrell, 1990, p. 122). This willingness to continue the team's collaboration into the future has also been described as "a team's potential to retain its members through their attachment to the team, and willingness to stay together as a team" (Balkundi & Harrison, 2006, p. 52). As such, team viability can be an important indicator of team effectiveness, in addition to productivity or performance (e.g., Bell & Marentette, 2011; Foo, Sin, & Yiong, 2006; Hackman, 1987).

Individuals who perceive greater team viability might be more likely than others to ignite disagreements. Specifically, those who

perceive high team viability have a greater investment in the present and future functioning of their team, so they are more likely to engage deeply with the team task, ask about one another's ideas, identify flaws, and share alternatives. All of these behaviors help team members complete their task, understand one another, and appreciate how their team interacts, yielding greater team learning overall (e.g., Raes et al., 2015; Van den Bossche, Gijselaers, Segers, & Kirschner, 2006). As team members share more of their thoughts, however, more of them are likely to differ, resulting in more content disagreements. Likewise, identifying flaws and sharing alternative ideas can also yield more disagreements (e.g., Kratzer, Leenders, & van Engelen, 2006; Stempfle & Badke-Schaub, 2002). Hence, when team members perceive high team viability, they might engage more deeply in their team discussion and exert more effort to disagree. We therefore hypothesize:

**Hypothesis 6.** *Team members who have higher perceptions of team viability are more likely than others to ignite a content disagreement.*

## 2.6 | Behavioral-level influences: problem-solving and off-task behaviors

In line with past studies on task communication and collaboration processes in groups and teams (Chiu, 2004; Jonassen & Kwon, 2001; Meloth & Deering, 1994; Orvis, Wisher, Bonk, & Olson, 2002), we also examine how preceding verbal behaviors may influence the ignition and resolution of disagreement episodes within the team interaction flow (see Figure 1), as past studies show that temporal dynamics during team conversations can affect team functioning and effectiveness. For example, a qualitative study of board meetings highlights conversational dynamics at the core of creative team processes and describes the concept of interaction flow as "an optimal, intensified, and synergetic mode of the conversational interaction within a small group" (Van Oortmerssen, Van Woerkum, & Aarts, 2015, p. 522). Previous quantitative research has also shown linkages between teams' temporal interaction patterns and their performance (e.g., Lehmann-Willenbrock & Allen, 2014; Lehmann-Willenbrock et al., 2017; Stachowski, Kaplan, & Waller, 2009).

As team members share problems and ideas for solutions, they provide problem-solving content, which serves as potential grist for disagreements, as team members publicly identify flaws or alternatives—especially incompatible ones (Chiu & Khoo, 2003). Proposing problems might ignite or end disagreements. A person may identify a problem with their current machinery, procedure, or goal (e.g., "Although maintenance has looked at it before, that machine tends to fail, especially when we face a high demand"). In response, a team member might indicate a flaw with a previous solution proposal to a problem under discussion (e.g., "We can't simply run it at a lower rate because customers will complain about the delay"). In these instances, others might subsequently dispute the problem's or flaw's likelihood, prevalence, or impact. For example, a team member might argue that customer complaints are extremely unlikely to occur when products are delivered in high quality, that they will occur in very few instances, or that they are not harmful enough to address. In these cases, identifying a problem would ignite a disagreement.

**Hypothesis 7.** *After a problem statement, a subsequent content disagreement is more likely than otherwise.*

Yet proposing a problem or identifying a flaw might also end a disagreement with an agreement. For example, if a team member identifies a fatal flaw, it could exclude one or more candidate solutions, yielding consensus around the remaining one (e.g., "We cannot use the other machine this month because it will be relocated to the other factory site."). Alternatively, a fatal flaw can rule out all potential solutions to a problem and force the team to agree to tolerate it. For example, a team member might say, "The deadline for delivering this product is tomorrow, so we don't have time to make any substantial changes to the process." In both cases, identifying a problem creates consensus on one path, either one solution or no solution.

**Hypothesis 8.** *After a problem statement, subsequent resolution of a disagreement with an agreement is more likely than otherwise.*

Proposing solutions might also ignite or end disagreements. A person might propose using a new procedure, new approach, and so on (e.g., "Instead of relying on that machine, how about we just attach those parts by hand"). In response, others might defend their existing procedure or approach (e.g., "Using the machine saves us so much time though"). Or they might find flaws in the new proposal. In each of these instances, the proposed solution ignites a disagreement. Alternatively, team members might agree on a solution proposal, which ends a disagreement with consensus (e.g., "Ok, let's give that a try").

**Hypothesis 9.** *After a proposed solution, a subsequent content disagreement is more likely than otherwise.*

**Hypothesis 10.** *After a proposed solution, subsequent resolution of a disagreement with an agreement is more likely than otherwise.*

Problem and solution statements that address the content of a disagreement can help identify and clarify specific areas of agreement versus disagreement (Waldron & Applegate, 1994). Team members can use these behaviors to build on areas of agreement, creatively integrating apparently opposing views or finding empirical tests for them (Wise & Chiu, 2011). By doing so, they increase their mutual understanding of one another, operate from increasingly similar information sets, and are more likely to have sufficiently overlapping understandings to agree on a solution or a decision (Dennen & Wieland, 2007).

In addition to problem-solving behaviors, we also consider the role of conversational distractions. Disagreements can increase the socioemotional tension within a team, so team members might ease these tensions (possibly preemptively) via distractions such as jokes and side conversations (*off-task behaviors*, Habib, 2008; Meyer, 2000). Although such behaviors can be helpful for maintaining a pleasant climate, previous research on group creativity suggests that off-task communication can impair problem solving and idea generation (for an overview, see Paulus & Brown, 2007). Off-task behavior might irritate team members who want to work on the problem. As a result,

they may engage in social disagreements, which can spill over into content disagreements (as a mask for their social disagreements). However, as off-task behaviors lack specific idea content, we expect that team members will typically be less likely to disagree with them. Likewise, off-task behaviors do not address the content of the disagreement, so they are unlikely to build the necessary shared understanding to resolve the disagreement via an agreement (Chiu, 2004). Instead, off-task behaviors may distract from the initial disagreement, such that resolving the disagreement becomes less likely. Our final set of hypotheses therefore posits:

> **Hypothesis 11.** *After an off-task behavior, a subsequent content disagreement is less likely than otherwise.*

> **Hypothesis 12.** *After an off-task behavior, subsequent resolution of a disagreement with an agreement is less likely than otherwise.*

In addition to testing our hypotheses, we reduce potential *omitted variable bias* (Kennedy, 2008) by controlling for several behavioral variables that might be linked to our outcomes according to previous findings, such as active listening and self-disclosure or expression of feelings (Higashinaka, Dohsaka, & Isozaki, 2008); asking questions and contributing organizational knowledge (Kauffeld & Lehmann-Willenbrock, 2012); voicing positivity (Lehmann-Willenbrock et al., 2017); and visualization (Regnell, Höst, Natt och Dag, Beremark, & Hjelm, 2000). We also control for team-level age and experience, as teams with older or more experienced teammates might have more knowledge or skills that help them identify problems that ignite disagreements or resolve them (e.g., Chen, Chiu, & Wang, 2012). Moreover, compared to men, women are less likely to disagree and often have better social skills and problem-solving skills, which can help resolve disagreements (McRae, 2009), so we control for individual gender as well as team-level gender composition. We also control for differences in interaction quantity (i.e., overall amount of individual contributions to a team interaction) and time (i.e., differences in outcomes across time, such as the beginning vs. end of a meeting, and temporal differences in relations between explanatory variables and outcomes).

## 3 | METHOD

### 3.1 | Sample and procedure

Data were obtained from a multistudy longitudinal research program in two medium-sized German firms. Our sample contained 259 employees nested in 43 teams. Eleven percent of the participants were women, typical for these fields of industrial work. Participants' ages ranged from 17 to 62 years ($M$ = 35.99, $SD$ = 1.21). Participants' organizational tenure varied between 2.5 months and 42 years ($M$ = 11.32, $SD$ = 8.96), and the average team tenure was 6.86 years (ranging from 4 months to 42 years; $SD$ = 6.27). Their average tenure in their profession was 10.25 years (ranging from 0.07 to 42 years). The majority of the participants completed an apprenticeship (85.9%); only 6.8% reported having no vocational training; 4.9% held a technical college degree, 1.5% held a university degree, and 1.1% reported a different vocational training.

We videotaped teams' monthly team meetings, in which they discuss their workflow, identify problems, and generate ideas for improvement. They self-organize these meetings, and team leaders do not attend them. Owing to the nature of shift work in the participating teams, six team members were present and attended each meeting on average ($M$ = 6.19, $SD$ = 0.97). The meetings lasted between 40 and 70 min.

### 3.2 | Behavioral measures

We coded all 32,448 turns of talk during the 43 videotaped team meetings with the act4teams coding scheme, distinguishing between problem-solving behaviors, off-task behaviors, disagreement and agreement behaviors, and behavioral controls (see Table 1). As such, our coding and analysis approach contained both qualitative and quantitative elements; the content analysis determined which of the mutually exclusive behavioral codes fit each individual communicative act, and the quantitative analyses tested the relations among these codes. Five coders were intensively trained with the act4teams coding scheme. According to the act4teams coding rules, behavioral units were defined as communicative statements, which, in context, could be understood by another member as equivalent to a single simple sentence (i.e., "sense units"; Bales, 1950). Unitizing and coding were performed using Interact software (Mangold, 2010), which enables behavioral annotations directly from a video without requiring verbal transcription. Whereas unitizing traditionally requires reliability analysis (Guetzkow's U), software-supported coding and live video entails units marked according to time rather than words. As two coders cannot unitize a video at the exact same nanosecond, behavioral units were identified by only one coder, whereas the behavioral annotations were performed by two separate coders for reliability analysis (for a similar procedure, see Lehmann-Willenbrock, Allen, & Kauffeld, 2013). The interrater reliability of the behavioral coding among our five raters was high, Fleiss' $\kappa$ = .81). Any disagreements between the raters were resolved by discussion to reach consensus.

Content disagreement was operationalized as any statement expressing opposition to prior contributions on the content level, such as disagreeing with an opinion or suggestion, contradicting a previous contribution, or dissenting from previous content. Examples include "I don't see it like that…," "That is not what it's about," and "That is not true." We also coded for four other types of disagreement: *problems with a solution* (e.g., "If we actually did this, it would damage…"), *criticizing statements* (e.g., "No, that's a stupid idea"), *blaming* (e.g., "you messed up here"), and statements signaling *no interest in change* (e.g., "Forget it, nothing ever works out here").

### 3.3 | Individual and team measures

In addition to coding behaviors, we surveyed team members on their demographics and individual job attitudes. Perceived intragroup conflict was measured with a validated German version of Jehn's conflict scale (Lehmann-Willenbrock, Grohmann, & Kauffeld, 2011), with four task conflict items (Cronbach's $\alpha$ = .84) and four relationship conflict items (Cronbach's $\alpha$ = .92). A sample item for task conflict was "How frequent are conflicts about ideas in your team?" and a sample item

**TABLE 1** Coded team interaction behaviors

| Problem solving behaviors | Off-task behaviors | Disagreement and agreement behaviors |
|---|---|---|
| *Problem* | *Complaining* | *Content disagreement* |
| identifying a (partial) problem | emphasizing the negative status quo, pessimism | based on reasons or facts |
| *Describing a problem* | *Side talk* | *Problem with a solution* |
| illustrating a problem | simultaneous talk on the side, typically between two individuals | e.g., pointing out difficulties that would follow a solution |
| *Connections with a problem* | *Laughter* | *Criticizing* |
| e.g., explaining causes or effects | audible laughter | disparaging comments about others |
| *Solution* | | *Blaming* |
| identifying a (partial) solution | | personalizing a problem or casting blame |
| *Describing a solution* | | *No interest in change* |
| illustrating a solution | | e.g., denying optimization opportunities |
| *Arguing for a solution* | | *Agreeing* |
| e.g., naming advantages of implementing a solution | | agreeing with suggestions, ideas, or opinions |
| **Behavioral-level controls** | | |
| *Question* | | *New problem* |
| about opinions, content, or experience | | changing the topic by stating a new problem |
| *Organizational knowledge* | | *Taking charge* |
| e.g., explaining the work flow | | taking on responsibility for future actions |
| *Positivity* | | *Action planning* |
| voicing optimism about implementing ideas and solutions | | agreeing on tasks to be carried out |
| *Expressing feelings* | | |
| e.g., expressing joy or sadness | | |
| *Active listening* | | |
| signalizing interest ("hmm", "yes") | | |
| *Visualizing* | | |
| using a flip chart or similar tools for documenting the discussion | | |

*Note*. Adapted from the act4teams coding scheme; behavioral codes in italics. Only relevant behavioral categories for the current study are shown. For details on the full coding scheme and its theoretical underpinnings, see Kauffeld and Lehmann-Willenbrock (2012).

for relationship conflict was "How much friction is there among members in your team?" with a 6-point Likert scale ranging from *never/none* to *very often/very much*.

Team viability (cf. Hackman & Wageman, 2005) was measured with two items on a 6-point Likert scale ranging from 1 (*completely disagree*) to 6 (*completely agree*). The items were "I would like to keep working in this team for a long time" and "I would like to continue to work together with the other members of my team" (Cronbach's $\alpha = .80$).

Finally, each month, both companies regularly assessed each team's productivity by measuring the ratio of achieved performance against its target performance (e.g., planned number of parts manufactured per month). Exceeding the target yields a team productivity rating exceeding 100%, whereas performance below the target yields a rating below 100%. To account for differences in performance standards and assessment in the two companies, we *z*-standardized all monthly performance ratings prior to further analyses. Team productivity was then operationalized as each team's annual average across these monthly *z* scores (yielding an average of 0.95 across all teams; ranging from −11.41 to 10.05).

## 3.4 | Identifying disagreement episodes

We defined a disagreement episode as a sequence of turns that (a) begins with a turn that has a type of disagreement and (b) ends with a disagreement ending that is not challenged by other members of the group within $M - 1$ turns (where $M$ is the number of group members and $M - 1$ is the number of both other group members and following turns in which others can challenge a disagreement ending). This definition favors clearer endings of disagreements at the possible cost of missing new disagreements within the $M - 1$ turns.

In each team discussion, we identified the first turn with a type of disagreement (content disagreement, problem with a solution, criticizing, blaming, or no interest, see Table 1). This was the first turn of the first disagreement episode. After this first turn, we found the first instance of a disagreement ending (either agreement, new problem, taking charge, or action plan, see Table 1) that was not followed by a disagreement within the next $M - 1$ turns. The sequence of turns from the first disagreement turn to the unchallenged disagreement

ending (inclusive) comprised a disagreement episode. We continued applying this procedure for the remaining turns after the disagreement ending in this group until its last turn. Note that some groups started disagreements, ran out of time, and did not end them. This procedure yielded a series of alternating nondisagreement and disagreement episodes.

Note that we analyzed only two aspects of these data: disagreements started by content disagreement and disagreements ending in agreement. We also modeled other ways of beginning and ending disagreements to reduce omitted variable bias (Kennedy, 2008).

## 3.5 | Statistical discourse analysis

Statistically analyzing social interaction processes requires addressing analytic problems regarding the dependent and explanatory variables (see Table 2), which we solved via SDA (Chiu, 2008b; Chiu & Lehmann-Willenbrock, 2016). Dependent variable issues include dichotomy, infrequency, multiplicity, time, and nested data. For dichotomous outcomes (e.g., *start of a content disagreement* vs. not), ordinary least squares regressions can bias the standard errors, whereas a logit regression estimates them correctly (Kennedy, 2008). As infrequent outcomes (<25% occurrence) can bias logit regression results, we estimate the logit bias and remove it (King & Zeng, 2001). As multiple outcomes can have correlated residuals that underestimate standard errors, we use a multivariate outcome model (Goldstein, 2011).

Failure to account for similarities in turns of talk within the same episode or in adjacent turns (*serial correlation* of residuals) can underestimate the standard errors (Kennedy, 2008). Thus, we modeled episodes as a level in a multilevel analysis (Wise & Chiu, 2011). Furthermore, we test all groups for serial correlation in adjacent turns with *Q* statistics (Ljung & Box, 1979). If serial correlation of the outcome (e.g., *start of a content disagreement*) is significant, adding the lagged outcome variable in the previous turn (*start of a content disagreement* [−1]) as an explanatory variable may remove the serial correlation (Chiu & Khoo, 2005). As the data were nested (turns within episodes and individuals within teams), failure to model similar turns from the same versus different episodes or individuals on the same versus different teams can bias the results (Goldstein, 2011). SDA models nested data properly with a multilevel analysis (Goldstein, 2011).

Explanatory variable issues include sequences, false positives, and robustness. As preceding turns might influence the current turn, the analysis must model previous sequences of turns (Kennedy, 2008). A vector autoregression (Kennedy, 2008) tests whether characteristics of sequences of recent turns (microtime context) influence the current turn (e.g., the likelihood of new idea). Testing many hypotheses also increases the risk of false positives (Type I errors; Benjamini et al., 2006). The two-stage linear step-up procedure reduces false positives more effectively than 13 other methods, according to computer simulations (Benjamini et al., 2006). Lastly, results from one analysis may not be robust. To test the consistency of the results (*robustness*), we (a) ran a single dependent variable model for each dependent variable and (b) analyzed subsets of the data.

## 3.6 | Explanatory model

We tested an explanatory model for both starting content disagreements and ending disagreements with agreements. Equation 1 specifies these two dependent variables and the three levels of explanatory variables (group, episode, and turn of talk) included in our statistical model.

$$\textbf{Disagree\_DV}_{yijk} = F\left(\beta_{y000} + f_{y0jk} + g_{y00k}\right) + e_{yijk} \quad (1)$$

In this equation, the probability that the dependent variable *y* (*start of a content disagreement* or *ending a disagreement with an agreement*) of **Disagree_DV** occurs at turn *i* of episode *j* in group *k* is its expected value via the logit or probit link function (F) of the overall mean $\beta_{y000}$ and the unexplained components (*residuals*) at the episode and group levels ($f_{y0jk}$, $g_{y00k}$), with the turn-level residual $e_{yijk}$.

Equation 2 specifies the vectors of explanatory variables that might be related to the two dependent variables in our statistical model. First, we entered *Firm_1* (vs. Firm 2).

**TABLE 2** Addressing analytic difficulties with specific strategies in statistical discourse analysis

| Analytic difficulty | Strategy |
|---|---|
| Dependent variables | |
| Differences across episodes ($E_1 \neq E_2$) | Breakpoint analysis (Chiu & Khoo, 2005) |
| Nested data (turns within episode within groups) | Multilevel cross-classification (Goldstein, 2011) |
| Serial correlation ($t_3$ is similar to $t_4$) | Multilevel analysis (Goldstein, 2011) |
| Discrete (yes or no) | *Q* statistics (Ljung & Box, 1979) |
| Infrequent (000010) | Logit or probit (Kennedy, 2008)<br>Logit bias estimator (King & Zeng, 2001) |
| Multiple ($Y_1$, $\mathbf{Y_2}$) | Multivariate, multilevel cross-classification (Goldstein, 2011) |
| Explanatory variables | |
| Sequences ($X_{t-2}$ or $X_{t-1} \rightarrow Y_0$) | Vector autoregression (Kennedy, 2008) |
| False positives (Type I errors) | Two-stage linear step-up procedure (Benjamini, Krieger, & Yekutieli, 2006) |
| Robustness of results | Single-outcome models<br>Analyses of subsets of data (Kennedy, 2008) |

$$\begin{aligned}\textbf{Disagree\_DV}_{yijk} = {} & F(\beta_{y000} + f_{y0jk} + g_{y00k} + \beta_1 \textit{Firm\_1} + \beta_{y00s} \\ & \textbf{Group}_{y00k} + \beta_{ytjk}\textbf{Time}_{yijk} + [\beta_{yujk}\textbf{Disagreement\_starter}_{yijk} \\ & + \beta_{yujk}\textbf{Disagreement\_type}_{yijk}] + \beta_{yvjk}\textbf{Current\_Speaker}_{yijk} \\ & + \beta_{ywjk}\textbf{Current\_Behavior}_{yijk} + \varphi_{yxjk}\textbf{Earlier\_Speaker}_{y(i-1)jk} \\ & + \varphi_{yzjk}\textbf{Earlier\_Behavior}_{y(i-1)jk} + \cdots + e_{yijk}\end{aligned} \quad (2)$$

Each set of explanatory variables below was tested for significance with a nested hypothesis test (chi-square log likelihood, Kennedy, 2008).

Next, we entered group variables: group means (team-level aggregates of perceived task conflict, perceived relationship conflict, and perceived team viability; team average age, team tenure, and organizational tenure), number of women in group, productivity, group size, women ratio, and total group number of turns (**Group**). When the dependent variable was *start of a content disagreement*, this specification tested 1, 2a, 2b, and 6. When the dependent variable was *ending a disagreement with an agreement*, this specification tested 1, 2a, and 2b. Then, we entered time variables, start time of turn, and duration of turn (**Time**).

For the dependent variable *ending a disagreement with an agreement* only, we added two additional sets of variables. We added the characteristics of the person who started the disagreement (corresponding to the individual variables of **Group**: starter's perceived task conflict, …, starter's organizational tenure, gender; **Disagreement_starter**), which tests 4. Then, we added the type of disagreement (content disagreement, problem with a solution, criticize, blame, no interest in change; **Disagreement_type**).

Variables reflecting the attributes or behaviors of the current speaker followed (corresponding to the individual variables of **Group**: perceived task conflict, …, organizational tenure, gender; **Current_Speaker**). Then, we entered behavior variables: start time of turn and duration of turn, problem-solving behaviors (problem, describing a problem, connections with a problem, solution, describing a solution, and arguing for a solution), off-task behaviors (complain, side talk, and laugh), and other behavioral variables (agree, actively listen, express feelings, question, organizational knowledge, positivity, and visualizing; **Current_Behavior**).

Then, we added a vector autoregression (Kennedy, 2008) of variables regarding speakers in earlier turns before the disagreement episode. When the dependent variable was *start of a content disagreement*, this specification tested 3, 7, and 9. When the dependent variable was *ending a disagreement with an agreement*, this specification tested 5, 8, and 9. Recent behaviors might have stronger effects than behaviors in the distant past (Slavin, 2005), so earlier speaker and behavior variables were added in reverse order, first at Lag 1 (**Earlier_Speaker** and **Earlier_Behavior**; i.e., Lag 1 of the individual and behavioral variables in **Current_Speaker** and **Current_Behavior**). Then, variables at Lag 2 were added, and so on until the last lag had no significant variables.

An alpha level of .05 was used. The two-stage linear step-up procedure controlled for false positives (Benjamini et al., 2006). We reported the marginal effect of each variable as the percentage increase or decrease (+E% or −E%) in the outcome variable (Kennedy, 2008) at each turn. As each team meeting averaged 755 turns and 21 disagreements, the net result across an entire meeting, assuming their independence, is the union of the E% changes across all 755 turns ($1 - [1 - |E\%|]^{755}$) or 21 disagreements ($1 - [1 - |E\%|]^{21}$). Statistical power exceeded 0.99 for effect sizes of 0.1 at the turn level ($N$ = 32,448) and 0.2 at the episode level ($N$ = 899; see Appendix A, Table A1 for details). As statistical power for an effect size of 0.4 is only 0.77 at the group level ($N$ = 43), group-level results must be interpreted cautiously.

## 4 | RESULTS

Overall, team members started 899 disagreements, including 352 content disagreements. They ended 873 disagreements, 678 of them with agreements (see Tables 3 and 4 for summary statistics and Table A2 for the correlation–variance–covariance matrix).

### 4.1 | Starting disagreements

The *start of a content disagreement* differed significantly only across turns (96%) and across teams (4%). Meanwhile, *ending a disagreement with an agreement* showed only significant variance across turns

**TABLE 3** Summary statistics for disagreement episodes ($N$ = 899)

| Variable | Mean | Minimum | Maximum | No. of disagreements |
|---|---|---|---|---|
| Starts disagreement with … | | | | |
| Problem with a solution | 0.008 | 0 | 1 | 247 |
| Content disagreement | 0.011 | 0 | 1 | 352 |
| Criticizing | 0.006 | 0 | 1 | 201 |
| Blaming | 0.001 | 0 | 1 | 17 |
| No interest in change | 0.003 | 0 | 1 | 82 |
| Total disagreements started | 0.028 | 0 | 1 | 899 |
| Ends disagreement with … | | | | |
| Agreement | 0.021 | 0 | 1 | 678 |
| New problem | 0.005 | 0 | 1 | 158 |
| Taking charge | 0.001 | 0 | 1 | 19 |
| Action planning | 0.001 | 0 | 1 | 18 |
| Total disagreements ended | 0.027 | 0 | 1 | 873 |

*Note*. Some disagreements did not have clear endings when the groups ran out of time.

**TABLE 4** Summary statistics for turns of talk ($N$ = 32,448)

| Variable | Mean | *SD* | Minimum | Maximum |
|---|---|---|---|---|
| Dependent variables | | | | |
| Content disagreement start | 0.011 | | 0 | 1 |
| Agreement end | 0.021 | | 0 | 1 |
| Organization | | | | |
| Firm 1 (vs. Firm 2) | 0.350 | | 0 | 1 |
| Team attributes | | | | |
| Mean task conflict | −0.085 | 0.572 | −1.112 | 1.808 |
| Mean relationship conflict | −0.126 | 0.750 | −1.533 | 1.694 |
| Mean team viability | 0.119 | 0.600 | −1.573 | 1.187 |
| Number of women in group | 0.776 | 1.512 | 0.000 | 5.000 |
| Mean age | 35.991 | 4.214 | 26.916 | 52.137 |
| Mean team tenure | 6.876 | 3.633 | 2.771 | 30.000 |
| Mean organizational tenure | 10.561 | 5.288 | 2.700 | 30.000 |
| Productivity | 0.951 | 3.075 | −11.41 | 10.050 |
| Group size | 6.202 | 0.960 | 4.000 | 7.000 |
| Women ratio in group | 0.124 | 0.231 | 0.000 | 0.714 |
| Total group number of turns | 866.547 | 269.640 | 201.000 | 1,438.000 |
| Professional education | 2.062 | 0.364 | 1.000 | 5.000 |
| Years in profession | 10.252 | 5.045 | 3.109 | 27.997 |
| Time variables | | | | |
| Start time of turn | 1,535.373 | 909.692 | 0.000 | 3,908.267 |
| Duration of turn | 4.032 | 5.658 | 0.000 | 220.333 |
| Individual characteristics | | | | |
| Woman (vs. man) | 0.114 | | 0 | 1 |
| Task conflict | 0.000 | 0.164 | −2.041 | 2.160 |
| Relationship conflict | 0.000 | 0.149 | −1.811 | 3.049 |
| Team viability | 0.000 | 0.181 | −4.214 | 2.285 |
| Age | 35.991 | 6.019 | 17.000 | 62.000 |
| Team tenure | 6.876 | 5.204 | 0.000 | 42.000 |
| Organizational tenure | 11.096 | 8.793 | 0.250 | 42.000 |
| Log (total speaker number of turns) | 5.013 | 0.542 | 1.609 | 5.984 |
| Professional education | 2.062 | 0.520 | 1.000 | 5.000 |
| Years in profession | 10.252 | 7.644 | 0.068 | 42.000 |
| Content disagreement starter characteristics | | | | |
| Woman (vs. man) | 0.108 | | 0 | 1 |
| Task conflict | 0.104 | 0.164 | −2.041 | 2.160 |
| Relationship conflict | 0.103 | 0.149 | −1.811 | 3.049 |
| Team viability | 0.209 | 0.181 | −4.214 | 2.285 |
| Age | 38.819 | 6.019 | 17.000 | 62.000 |
| Team tenure | 6.875 | 5.204 | 0.000 | 42.000 |
| Organizational tenure | 11.544 | 8.793 | 0.250 | 42.000 |
| Log (total speaker number of turns) | 4.849 | 0.542 | 1.609 | 5.984 |
| Professional education | 2.039 | 0.520 | 1.000 | 5.000 |
| Years in profession | 10.357 | 7.644 | 0.068 | 42.000 |
| Behavior attributes | | | | |
| Problem-solving behavior | | | | |
| Problem | 0.033 | | 0 | 1 |
| Describing a problem | 0.082 | | 0 | 1 |
| Connections with a problem | 0.033 | | 0 | 1 |
| Solution | 0.035 | | 0 | 1 |

(Continues)

**TABLE 4** (Continued)

| Variable | Mean | *SD* | Minimum | Maximum |
|---|---|---|---|---|
| Describe a solution | 0.063 | | 0 | 1 |
| Argue for a solution | 0.041 | | 0 | 1 |
| Off-task | | | | |
| Complaining | 0.013 | | 0 | 1 |
| Side talk | 0.116 | | 0 | 1 |
| Laughter | 0.071 | | 0 | 1 |
| Other | | | | |
| Agreeing | 0.127 | | 0 | 1 |
| Active listening | 0.084 | | 0 | 1 |
| Expressing feelings | 0.003 | | 0 | 1 |
| Question | 0.066 | | 0 | 1 |
| Organizational knowledge | 0.122 | | 0 | 1 |
| Positivity | 0.013 | | 0 | 1 |
| Visualizing | 0.020 | | 0 | 1 |

(100%). All results discussed below describe the first entry into the multilevel regression model, controlling for all previously included variables.

Contrary to our expectations, the *start of a content disagreement* was not related to *team productivity*, perceived *task conflict*, or perceived *relationship conflict*, showing no support for 1, 2a, or 2b. The task and relationship conflict measures at both the group and individual levels were all nonsignificant.

In line with our expectations, speaker characteristics and behaviors were linked to starting a content disagreement (Table 5, Model 1). After a speaker with one level higher professional education than average, a speaker was 0.2% less likely to start a content disagreement; the corresponding likelihood of at least one less content disagreement than average at each meeting was 78% (computed from the union of the 0.2% greater likelihoods across the 755 turns of talk during a meeting). This result supports 3 regarding the influential role of individual status for igniting disagreements.

Regarding the role of perceived team viability, a current speaker whose perceived team viability exceeded the mean by 10% was 0.5% more likely to start a content disagreement at each turn, thus supporting 6. At the meeting level, if all speakers perceived 10% higher team viability than average, the likelihood of at least one more content disagreement than average at each meeting was 98%.

Lending support to 7, a content disagreement was more likely after the previous speaker (−1) *described a problem* (by +9%) or *connected with a problem* (+17%) and still more likely (+11%) two turns after a speaker *described a problem* (−2). *Problem* was not significant. Lending some support to 9, a content disagreement was also more likely after the previous speaker (−1) proposed a *solution* (+12%). *Describing a solution* and *arguing for a solution* were not significant.

A content disagreement was less likely to start after the previous speaker (−1) *laughed* (−35%), engaged in *side talk* (−30%), *agreed* (−17%) or *actively listened* (−15%). The *laughter* and *side talk* results support 11. Meanwhile, *agreeing* and *active listening* are supportive behaviors that were also unlikely to provoke content disagreements. Altogether, these variables accounted for 21% of the variance in starting a content disagreement.

When turn-level variables are excluded, current speaker's perceived team viability and previous speaker's professional education remained significantly linked to disagreements (Table 5, Model 2). This reduced model accounted for 5% of the variance.

## 4.2 | Resolving disagreements

Characteristics of the disagreement starter, previous speaker, turn duration, and recent behaviors were linked to *ending a disagreement with an agreement* (Table 5, Model 3). Disagreements started by speakers with higher status markers (professional education, age, and more turns of talk) were more likely to be resolved by agreement. Disagreements started by speakers with one level higher *professional education* than average were 17% more likely to have a disagreement-ending agreement at each turn; the corresponding likelihood of at least one more disagreement-ending agreement than average at each meeting was 98% (computed from the union of the 17% greater likelihoods across 21 disagreements of an average meeting). Disagreements started by speakers who were 1 year older than average were 2% more likely to have a disagreement-ending agreement at each turn; the corresponding likelihood of at least one more disagreement-ending agreement than average at each meeting was 29%. Together, these results support 4 regarding the role of individual status for igniting and resolving disagreements.

Disagreement episodes started by content disagreement, problem with a solution, criticizing, or no interest in change were more likely to be resolved by agreement than disagreements started by blame (by 46%, 47%, 45%, and 47%, respectively). Moreover, following a speaker whose *organizational tenure* (a status marker) exceeded the mean by 1 year, the next speaker was 0.4% more likely to agree to end a disagreement; the corresponding likelihood of at least one more disagreement-ending agreement than average at each meeting was 9%. This result supports 5 concerning the influence of an individual's status on the next speaker agreeing, thereby ending the disagreement.

**TABLE 5** Summary of regression coefficients of four statistical discourse analysis models for starting a content disagreement and *ending a disagreement with an agreement*

| | Start content disagreement | | Agree ended disagreement | |
|---|---|---|---|---|
| **Variables** | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
| Explanatory variable | | | | |
| Team task conflict | 0.021 (0.100) | 0.022 (0.098) | 0.016 (0.016) | 0.018 (0.017) |
| Team relationship conflict | 0.137 (0.083) | 0.145 (0.078) | −0.005 (0.007) | −0.005 (0.007) |
| Team productivity | 0.007 (0.007) | 0.007 (0.007) | −0.004 (0.007) | −0.004 (0.007) |
| Disagree starter's team viability | 2.149*** (0.152) | 2.281*** (0.156) | 0.038 (0.021) | 0.134 (0.148) |
| Professional education (−1) | −0.277* (0.135) | −0.286* (0.128) | | |
| Disagreement starter's professional education | | | 0.700*** (0.046) | 3.393*** (0.288) |
| Disagreement starter's age | | | 0.064** (0.024) | 0.638*** (0.158) |
| Log (total disagreement starter number of turns) | | | 1.179*** (0.032) | |
| Content disagreement started disagreement | | | 3.213*** (0.138) | |
| Problem with a solution started disagreement | | | 3.506*** (0.150) | |
| Criticizing started disagreement | | | 2.935*** (0.142) | |
| No interest in change started disagreement | | | 3.625*** (0.154) | |
| Duration of turn | | | −0.158*** (0.003) | |
| Organizational tenure (−1) | | | 0.017*** (0.002) | 0.041* (0.019) |
| Problem solving behaviors | | | | |
| Describing a problem (−1) | 0.375* (0.172) | | 0.167* (0.076) | |
| Describing a problem (−2) | 0.440** (0.169) | | | |
| Connections with a problem (−1) | 0.688** (0.225) | | | |
| Solution (−1) | 0.472* (0.239) | | 1.135*** (0.115) | |
| Describing a solution (−1) | | | 0.212** (0.081) | |
| Arguing for a solution (−1) | | | 0.378** (0.115) | |
| Off-task behaviors | | | | |
| Complaining (−1) | | | 1.608*** (0.155) | |
| Side talk (−1) | −1.407*** (0.373) | | −0.543*** (0.108) | |
| Laughter (−1) | −1.719*** (0.493) | | −2.414*** (0.121) | |
| Other | | | | |
| Agreeing (−1) | −0.724** (0.235) | | | |
| Active listening (−1) | −0.625* (0.294) | | −0.853*** (0.087) | |
| Positivity (−1) | | | 0.798*** (0.200) | |
| Organizational knowledge (−1) | 0.651*** (0.149) | | 0.457*** (0.064) | |
| Visualizing (−1) | | | −2.063*** (0.183) | |
| Question (−1) | 1.039*** (0.160) | | | |
| Expressing feelings (−1) | | | 2.233*** (0.356) | |
| Explained variance | | | | |
| Level of variance Team | 4% | 0.268 | 0.059 | 0% | | |
| Turn (behavioral level) | 96% | 0.210 | 0.049 | 100% | 0.887 | 0.819 |
| Total variance explained | | 0.213 | 0.050 | | 0.887 | 0.819 |

*Note*. Each model included a constant term. Standard errors in parentheses. Nonsignificant explanatory variables were removed.
*$p < .05$. **$p < .01$. ***$p < .001$.

A disagreement-ending agreement was also more likely after the previous speaker (−1) *described a problem* (+4%), proposed a *solution* (+26%), *described a solution* (+5%), or *argued for a solution* (+9%), thus lending support to 8 and 10, respectively.

Moreover, a disagreement-ending agreement was less likely after the previous speaker (−1) *laughed* (−42%), engaged in *side talk* (−13%), *actively listened* (−20%), or *visualized* (−39%). The *laugh* and *side talk* results provide some support for 12 by showing that after these off-task behaviors, the resolution of disagreements was less likely. Yet disagreement-ending agreements were actually more likely after the previous speaker *complained* (+33%).

Three control variables were significant. Disagreements started by speakers who spoke 10% more than average were 6% more likely to have a disagreement-ending agreement at each turn; the

corresponding likelihood of at least one more disagreement-ending agreement than average at each meeting was 70%. Also, turns of greater duration were less likely than other turns to end a disagreement with an agreement. Finally, disagreement-ending agreements were more likely after the previous speaker *expressed feelings* (+40%). Other control variables were not significant.

Altogether, these variables accounted for 88% of the variance in ending disagreements with agreements. The explanatory model with no turn variables showed similar results with larger regression coefficients for the remaining variables (Table 5, Model 4). This reduced model accounted for 82% of the variance. All other variables were not significant, and residuals showed no significant outliers.

## 5 | DISCUSSION

Content disagreements can enhance team learning and effective problem solving (e.g., Kellermanns et al., 2008; Paletz, Chan, & Schunn, 2016). However, disagreement is a complex phenomenon embedded in temporal interaction dynamics and influenced by attributes of behaviors, individuals, and teams. Using coded videotape data from workplace team meetings in two Germany companies, this study tested a multilevel, time-series, explanatory model of episodes of content disagreements and their resolutions. Our results show that team conflict and productivity were both unrelated to starting disagreements or ending them with agreements. In contrast, members' perceptions of team viability were positively linked to starting content disagreements. Furthermore, team members' individual status, problem-solving behaviors, and off-task behaviors were meaningfully related to both starting and ending disagreements.

### 5.1 | Theoretical implications

Our findings have several implications for understanding disagreement as an important team phenomenon and for modeling temporal team dynamics in workplace interactions more broadly. First, we tested the influences of specific team attributes, individual characteristics, and previous behaviors on the likelihood of disagreements—and their resolution—at the behavioral event level, applying SDA to a data set that combined data from static survey responses and coded videotapes of dynamic team behaviors. This combined data set both preserved the temporal sequence of the observed team behaviors and accounted for individual characteristics (individual member status), individual attitudes (individual perceptions of team viability), and team context variables (state conflict and productivity). Preserving the temporal sequence of behaviors is paramount for examining how specific behaviors emerge during social interactions (for an overview, see Chiu, 2008b) and for generating meaningful new insights into the temporal dynamics at the core of most team processes (e.g., Cronin et al., 2011).

Second, we disentangled emergent conflict states from disagreement behaviors within temporal team interactions, which aligns with the conceptual distinction between a team's emergent properties and its interaction processes—the "cognitive, motivational, and affective states of teams, as opposed to the nature of their member interaction" (Marks et al., 2001, p. 357). Although many researchers described disagreement as a defining component of conflict (e.g., Weingart et al., 2016), our findings indicate that distinguishing discrete disagreement occurrences from emergent perceptions of intragroup conflict can improve both theoretical clarity and empirical analysis. Still, our finding that existing team conflict was unrelated to the likelihood of disagreement (and its resolution) is somewhat at odds with the notion that existing emergent states can affect future interaction episodes through feedback loops (e.g., Mathieu et al., 2008). However, emergent states such as intragroup conflict may fluctuate over time, and it was measured only once, so we suggest interpreting this finding cautiously (e.g., Kozlowski et al., 2013).

Third, unlike team productivity, perceived team viability was an important precursor to content disagreements, which underscores the need to consider multiple criteria for team effectiveness (Hackman, 1987) and addresses calls for research on team viability as one such criterion (Bell & Marentette, 2011). This result suggests that the additional future orientation of team viability (over team productivity) might serve as added incentive for team members to share ideas, flaws, and alternatives, as the benefits of improving long-term mutual understanding and performance might outweigh potentially face-threatening disagreements (Chiu, 2008a). Moreover, our finding that existing perceptions of team viability as a context factor were linked to content disagreements aligns with input–mediator–output–input models of team processes and effectiveness (e.g., Ilgen et al., 2005).

Fourth, the results suggest that even in groups without explicit leaders, status (team members' professional education, age, and organizational tenure) has strong influences on starting and ending disagreements. Team members were less likely to begin a disagreement after a team member with more professional education spoke, possibly because the latter was more likely to be correct (Chiu, 2008a), because their higher status inhibited others from disagreeing, or both (Chiu & Khoo, 2003). Future studies can clarify the extent to which one or both possible explanations apply across various contexts. In this study, the correlation matrix shows that professional education was not significantly linked to turns that included identifying problems or proposing solutions, indicating no greater likelihood of problem finding or problem solving. If a person is inhibited from disagreeing with team members with more professional education, flaws and errors might not be reported (Chiu, 2000), harming the team's overall understanding and stifling collective learning in teams and organizations (for detailed arguments regarding the complications of status as an obstacle to organizational learning more broadly, see Bunderson & Reagans, 2011).

Moreover, disagreements started by people with higher status (specifically, professional education or age) were more likely to be resolved by agreement, which suggests the greater value of their disagreements compared to others' disagreements, their superior incentive, or their stronger social skills for resolving them. People with higher status might have greater knowledge or experience that helps them identify issues of greater importance (Chiu & Khoo, 2003) when they ignite a disagreement; in this study, however, participants who were older or had more professional education were not more likely than others to find problems or propose solutions (bivariate correlations), which does not support the claim that their disagreements were more valuable. Regarding social skills, those with above median professional education were more likely than others to listen actively (+18%) and less likely to complain (−82%),

but older workers (above median) were slightly more likely than younger workers to complain (+1%) and slightly less likely to listen actively (−1%). These correlations suggest that those with more professional education might have better social skills that facilitate resolution of disagreements via agreements. Although the current data show no support to warrant deference to older participants, future studies can examine the impact of differential valuations of disagreements by status and their relation to facilitating consensus.

Team members were also more likely to resolve a disagreement by agreeing with others who held greater organizational tenure, and the latter were slightly more likely to proffer a solution. These findings suggest that team members with greater organizational tenure might create higher quality solutions or receive more favorable evaluations of their solutions or both. Future studies can determine the extent to which one or both possible explanations apply across various contexts. Overall, future research can determine the degree to which status effects are harmful or simply reflect stronger problem finding, problem solving, or social resolution skills.

Fifth, the positive effect of problem-solving behaviors on igniting and resolving disagreements point to the importance of disagreements when completing these tasks and suggest the need for a supportive team culture. When team members engage in problem-solving behaviors, they share information and perspectives that might not only contribute to problem finding and problem solving but also serve as grist for disagreements. In safe, supportive team cultures that value people and ideas, individuals can share their views and disagree without concern about losing face or harming their interpersonal relationships. Thus, these results suggest the importance of cultivating a climate of psychological safety (e.g., Edmondson & Lei, 2014) that facilitates sharing of ideas and nonthreatening disagreements.

In contrast, off-task behaviors, such as laughing and side talk, offer distractions and hence no task content with which to disagree. Although they reduce the likelihood of disagreement, they apparently do not contribute toward completion of the task. Interestingly, although none of the off-task behaviors ignited disagreement, complaining facilitated rather than inhibited resolution of disagreements (see Table 4). Although we can only speculate about a complaining mechanism, previous research seems to suggest that complaining statements can shift the conversational focus away from the problem solving and toward a shared experience of feeling helpless or even victimized, which triggers agreement by others and can trap teams within a complaining loop (Kauffeld & Meyers, 2009).

In addition to igniting content disagreements, problem-solving behaviors can also resolve them. Describing problems, proposing solutions, describing solutions, arguing for solution, and sharing organizational knowledge were all linked to resolving disagreements via agreements. Hence, many of the same behaviors that help ignite content disagreements also help resolve them. In contrast, off-task behaviors, such as laughing and side talk, reduce the likelihood of resolving a disagreement with an agreement. These results are consistent with the view that team members who share ideas increasingly have similar information sets, understand one another better, and share sufficiently overlapping understanding to reach agreement (Dennen & Wieland, 2007). These results also reinforce the importance of a supportive team culture to continue sharing ideas after a disagreement to resolve it, rather than avoiding sharing of additional ideas for fear of inflaming the disagreement, which instead hinders its resolution by agreement.

Sixth, our fine-grained SDA allowed us to model the ignition and resolution of content disagreements during actual turns of talk across time using explanatory variables at multiple levels, thereby reducing omitted variable bias and accounting for much of the variance. Rather than relying solely on survey proxies about members' views of how disagreements began and ended, we captured both their team interactions and survey responses to show how perceptions and actual behaviors are related to one another (see also Baumeister, Vohs, & Funder, 2007). Moreover, our analysis enabled testing of hypotheses regarding how behaviors within a sequence are related to one another across time. Specifically, we showed how attributes of earlier turns of talk (e.g., *describing a problem* [−2] and *solution* [−1]) were related to the next turn of talk (e.g., *starting a content disagreement*). As such, our findings align with previous work on the temporal dynamics of team conversations and illustrate how the social and temporal microcontext influences disagreements in teams (e.g., Chiu, 2008b; Chiu & Lehmann-Willenbrock, 2016; Van Oortmerssen et al., 2015).

Our results suggest that a comprehensive theory of team disagreements must include attributes of teams, individuals, and turns of talk. As such, our temporal approach to disagreement episodes also aligns with prior work on the social embeddedness of workplace behavior more broadly (Dutton, Workman, & Hardin, 2014; Spreitzer, Sutcliffe, Dutton, Sonenshein, & Grant, 2005). As explanatory variables at multiple levels were significant, ignoring all variables within any level sharply increases the danger of omitted variable bias, in part because correlations between variables at the same level are typically higher than those between variables across levels (Chiu, Molenaar, Chen, Wise, & Fujita, 2013). Hence, modeling the temporal embeddedness of the observed behaviors reduces the likelihood of biased conclusions (e.g., Chiu & Khoo, 2005; Chiu & Lehmann-Willenbrock, 2016). Beyond team processes, these considerations also apply to organizational behavior more generally. Studying disagreements and their resolutions during team interactions, and modeling the influence of individual and team characteristics at the behavioral event level where these phenomena happen, addresses the call to study "what happens rather than what is" (Roe, 2008).

Lastly, the finding that explanatory variables at the behavioral event level accounted for much more of the variances in disagreements and their resolutions compared to static individual or group attributes is consistent with past studies of temporal interaction processes in groups and teams (Chiu, 2008a, 2008b; Lehmann-Willenbrock et al., 2017; Molenaar & Chiu, 2014). Our multilevel analysis showed that most of the variance occurred at the turn level (over 96%), not at the individual or group level—probably not surprising as a single person can express extremely different thoughts across turns of talk. This variance result highlights the importance of modeling behaviors as the basic unit of analysis. In contrast, behavioral data aggregated to the individual (or team) levels (e.g., by counting the overall frequency of each individuals' disagreements and resolutions) waste most of the data; hence, analyses of aggregations of similar data that purport to explain most of the variance actually account for little of it (e.g., a model accounting for 80% of the individual variance accounts for only 3% of the total variance in these data [3.2% = 80% * (100% − 96%)]).

## 5.2 | Practical implications

Our findings suggest several implications for organizational practice. First, sequences of dynamic behaviors (not stable individual or team characteristics) largely ignited and resolved content disagreements. Hence, disagreement is more about conversational context than overall team conflict, which can help teams appreciate the value of content disagreements and welcome them rather than avoid them. Specifically, team development initiatives can promote the value of content disagreements, explain the benefits of problem-solving communication, and cultivate supportive team cultures. To educate teams about the necessity of content disagreement, team developers can highlight how it helps teams improve their problem solving, enhance the quality of their ideas, help them understand one another better, and enjoy more effective collaborations. Furthermore, team development can also emphasize how problem-solving behaviors both ignite and resolve content disagreements, in contrast to off-task diversions. The link between problem-solving behaviors and disagreements also suggests the importance of creating and maintaining a safe team context, in which team members can express their ideas without concern about loss of face or harming their relationships.

Second, individual status effects might interfere with content disagreements, even in groups without explicit leaders. As team members were more likely to agree with (and less likely to disagree with) a high-status person (e.g., senior team member), they might defer to the latter's judgment too quickly; thus, they might be less likely to (a) publicly identify flaws in the latter's proposals, (b) share superior alternatives, or (c) spend enough time to ensure that all team members understand the proposal. Furthermore, a high-status team member's content disagreements were more likely than those of low-status team members to be resolved with an agreement, possibly indicating that the former were more valued than the latter, but further research is needed on this issue.

Although greater differences in status coincided with stronger effects, creating teams whose members have identical status or even moderately equal status across multiple dimensions (e.g., education, age, and tenure) is difficult and likely impractical as teams typically consist of members with complementary skills and experiences needed to complete a joint task. Instead, teams can aim for an open and welcoming culture in which all members are invited to share their ideas without fear of embarrassment or harm to their social relationships. For example, a team leader could ask all members to list their ideas without their names in a first round (nominal group technique, e.g., Thompson, 2003) and then to ask for advantages and disadvantages of each idea in a second round to help focus criticisms on the ideas rather than the people.

Third, our findings point to team viability as an important context factor for promoting content disagreement, which can also be leveraged to improve teamwork. Importantly, team viability is an experience that team members develop over time and that may fluctuate depending on the team processes and outcomes. Hence, team training activities aimed at fostering members' sense of the sustainability and growth of their team (Bell & Marentette, 2011) should be continuous in design rather than one-shot team workshops. For example, regular short team reflexivity interventions (e.g., Gurtner, Tschan, Semmer, & Nägele, 2007) could help teams and their leaders identify how members feel about the viability of their team, about their team interactions, and about how to improve this experience.

## 5.3 | Limitations and future research directions

Our study has several limitations that can provide avenues for future research. First, the particular study context and sample (i.e., leaderless team interactions in industrial worksites, with predominantly male members in two firms in Germany) limit the generalizability of our findings to teams in other fields, with other gender compositions, with a leader present, or across different cultural settings. The context investigated here is prototypical for team interactions in industrial settings where leaderless problem-solving meetings are regularly implemented as part of the continuous improvement process in factory organization design (e.g., Imai, 2012). Nevertheless, future research should investigate whether our conclusions regarding the initiation and resolution of disagreement episodes will be replicated in different team settings. Future research should also pay particular attention to gendered differences in the context of disagreement in team interactions, which may pertain to both the expression of and the responses to disagreement. Moreover, future research can illuminate the role of the surrounding organizational culture for disagreement episodes in teams. Whereas we did not find an effect of the surrounding organization on the observed disagreement episodes and their resolution in our data, organizational culture may constitute a macrolevel influence on behavioral norms and conversational patterns in other samples.

Second, our finding that state conflict was unrelated to disagreement episodes might differ for teams that have shorter histories than the teams in our sample. In particular, when examining zero-history teams, state conflict has yet to emerge (cf. Kozlowski et al., 2013), and future research can investigate how disagreement episodes might contribute to this emergence process. Moreover, future research can investigate additional team context variables, such as psychological safety climate, that may facilitate voicing disagreement and help overcome inhibitions to disagree with higher status individuals (Bunderson & Reagans, 2011; Edmondson & Lei, 2014).

Third, other individual characteristics aside from status and perceptions of team viability might be linked to igniting or resolving disagreements during team interactions. Future studies can test how individual dispositions (e.g., positive or negative affectivity; Kaplan, Bradley, Luchman, & Haynes, 2009) might affect the ignition or resolution of disagreements. Moreover, future research can explore how the power orientation of higher status individuals (for an overview, see Bunderson & Reagans, 2011) might moderate the effects of status during disagreement episodes.

Finally, we focused on content disagreement here because of its benefits for team and organizational learning as discussed earlier (e.g., Ellis et al., 2003; Garvin et al., 2008), but other types of disagreements might emerge through different temporal patterns and multilevel influences. Hence, future research could utilize SDA to investigate when and why other types of disagreements (e.g., criticizing or rudely disagreeing; Chiu, 2005) are ignited or resolved during dynamic team interactions at work.

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## APPENDIX A

## ANCILLARY TABLES AND RESULTS

**TABLE A1** Sample size and statistical power

| | Effect size | | | |
|---|---|---|---|---|
| **Level** | **0.1** | **0.2** | **0.3** | **0.4** |
| (3) Team | 0.06 | 0.27 | 0.51 | 0.77 |
| (2) Episode | 0.85 | 1.00 | 1.00 | 1.00 |
| (1) Conversation turn | 1.00 | 1.00 | 1.00 | 1.00 |

**TABLE A2** Correlations, variances, and covariances along the lower left triangle, diagonal, and upper right triangle of the matrix

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **0.01** | 0.01 | 0.00 | 0.00 | 0.02 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.55 | **0.02** | −0.03 | 0.00 | 0.04 | 0.06 | 0.11 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | −0.04 | **28.82** | 0.00 | 0.03 | 0.05 | 0.06 | 0.00 | 0.01 | 0.00 | 0.53 | 0.08 | 0.01 | −0.01 | −0.01 | −0.02 | −0.03 | 0.00 | 0.01 | −0.07 | −0.02 | 0.04 | −0.08 | 0.06 | −0.02 | 0.01 | −0.07 | 0.03 |
| 4 | 0.08 | −0.01 | 0.00 | **0.03** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | −0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.60 | 0.86 | 0.02 | −0.03 | **0.11** | 0.16 | 0.27 | 0.02 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | −0.01 | 0.00 | −0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.57 | 0.83 | 0.02 | −0.04 | 0.93 | **0.27** | 0.40 | 0.02 | 0.02 | 0.01 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | −0.01 | 0.00 | −0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.62 | 0.88 | 0.01 | −0.01 | 0.97 | 0.94 | **0.68** | 0.04 | 0.03 | 0.01 | 0.03 | −0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | −0.01 | 0.00 | −0.02 | 0.01 | −0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | −0.01 | 0.49 | 0.01 | 0.03 | 0.53 | 0.47 | 0.52 | **0.01** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | −0.01 | 0.40 | 0.01 | −0.10 | 0.45 | 0.48 | 0.47 | −0.01 | **0.01** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | −0.01 | 0.24 | 0.01 | −0.04 | 0.27 | 0.28 | 0.28 | 0.00 | 0.00 | **0.00** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 0.00 | 0.00 | 0.01 | −0.03 | 0.01 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 | **77.34** | 0.02 | 0.04 | 0.06 | 0.07 | −0.02 | 0.02 | −0.01 | −0.01 | −0.12 | −0.08 | −0.04 | 0.17 | −0.04 | 0.03 | −0.03 | 0.18 | −0.04 |
| 12 | −0.02 | −0.02 | 0.05 | −0.01 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | 0.00 | 0.01 | **0.08** | 0.00 | 0.00 | 0.00 | −0.01 | 0.00 | 0.00 | 0.00 | −0.01 | 0.00 | −0.01 | −0.01 | −0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 13 | −0.01 | 0.02 | 0.01 | −0.01 | 0.01 | 0.02 | 0.01 | −0.01 | 0.03 | 0.00 | 0.04 | −0.03 | **0.01** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | 0.02 | 0.01 | −0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.02 | 0.04 | −0.04 | 0.01 | **0.03** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | 0.00 | 0.01 | −0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 | −0.01 | 0.00 | 0.04 | −0.05 | −0.02 | −0.01 | **0.04** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | 0.02 | 0.01 | −0.02 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.02 | 0.00 | −0.01 | −0.07 | 0.01 | 0.09 | −0.04 | **0.08** | 0.00 | 0.00 | 0.00 | −0.01 | 0.00 | −0.01 | −0.01 | −0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| 17 | 0.00 | 0.02 | −0.02 | 0.00 | 0.02 | 0.01 | 0.02 | 0.02 | 0.00 | 0.00 | 0.01 | −0.06 | −0.02 | −0.02 | 0.09 | −0.04 | **0.06** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | −0.01 | −0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| 18 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | −0.01 | −0.01 | 0.01 | 0.02 | 0.00 | 0.03 | −0.01 | **0.00** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | −0.01 | 0.01 | −0.01 | −0.02 | −0.01 | 0.00 | 0.01 | 0.00 | 0.02 | 0.02 | **0.01** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | −0.02 | −0.04 | −0.05 | 0.00 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.01 | −0.06 | −0.08 | −0.03 | −0.05 | −0.05 | −0.08 | −0.07 | −0.01 | −0.03 | **0.07** | 0.00 | −0.01 | −0.01 | −0.01 | 0.00 | 0.00 | 0.00 | −0.01 |
| 21 | 0.04 | 0.00 | −0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | −0.01 | 0.00 | −0.04 | −0.06 | −0.02 | −0.04 | −0.04 | −0.04 | −0.04 | −0.01 | −0.02 | −0.07 | **0.06** | −0.01 | −0.01 | −0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | −0.02 | −0.05 | 0.02 | 0.00 | −0.06 | −0.06 | −0.06 | −0.03 | −0.03 | −0.02 | −0.01 | −0.11 | −0.02 | −0.03 | −0.04 | −0.06 | −0.05 | −0.01 | −0.02 | −0.10 | −0.08 | **0.11** | −0.01 | −0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| 23 | 0.03 | 0.03 | −0.05 | 0.01 | 0.03 | 0.02 | 0.03 | 0.01 | 0.00 | 0.01 | 0.06 | −0.09 | −0.01 | −0.02 | −0.03 | −0.05 | −0.06 | 0.00 | −0.01 | −0.10 | −0.06 | −0.09 | **0.11** | −0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| 24 | −0.03 | −0.04 | 0.03 | 0.00 | −0.04 | −0.04 | −0.04 | −0.03 | −0.02 | −0.01 | −0.01 | −0.11 | −0.03 | −0.06 | −0.06 | −0.10 | −0.09 | −0.02 | −0.04 | −0.10 | −0.09 | −0.13 | −0.12 | **0.10** | 0.00 | 0.00 | −0.01 | −0.01 |
| 25 | 0.01 | 0.03 | −0.02 | 0.00 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.00 | 0.02 | −0.04 | −0.01 | 0.00 | 0.09 | −0.02 | 0.12 | −0.01 | 0.02 | −0.05 | −0.03 | −0.05 | −0.03 | −0.06 | **0.03** | 0.00 | 0.00 | 0.00 |
| 26 | 0.01 | −0.02 | 0.01 | 0.00 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.03 | −0.03 | −0.01 | −0.01 | −0.01 | −0.03 | −0.01 | −0.01 | −0.01 | −0.04 | −0.02 | −0.04 | −0.02 | −0.05 | 0.00 | **0.02** | 0.00 | 0.00 |
| 27 | −0.01 | 0.00 | −0.03 | −0.02 | 0.01 | 0.00 | 0.00 | 0.01 | −0.01 | −0.01 | 0.04 | 0.03 | −0.03 | 0.01 | 0.01 | −0.01 | 0.01 | −0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.04 | −0.05 | 0.01 | 0.03 | **0.27** | 0.00 |
| 28 | 0.02 | −0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | −0.01 | 0.01 | 0.00 | −0.02 | 0.06 | 0.01 | 0.04 | −0.03 | 0.10 | −0.03 | 0.00 | 0.00 | −0.07 | 0.02 | 0.06 | −0.04 | −0.08 | 0.00 | −0.01 | −0.03 | **0.08** |

*Note*. 1: content disagreement start; 2: agreement end; 3: duration of turn; 4: disagreement starter's team viability; 5: disagreement starter's professional education; 6: disagreement starter's age; 7: log (total disagreement starter's number of turns); 8: problem with a solution started disagreement; 9: criticizing started disagreement; 10: no interest in change started disagreement; 11: organizational tenure (−1); 12: active listening (−1); 13: complaining (−1); 14: connection with a problem (−1); 15: connect with a solution (−1); 16: describing a problem (−1); 17: describing a solution (−1); 18: expressing feeling (−1); 19: positivity (−1); 20: laughter (−1); 21: question (−1); 22: support (−1); 23: organizational knowledge (−1); 24: side talk (−1); 25: solution (−1), 26: visualizing (−1); 27: professional education (−1); 28: describing a problem (−2).