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ESMT Working Paper

THE UPWARD SPIRALS IN TEAM PROCESSES

EXAMINING DYNAMIC POSITIVITY IN PROBLEM SOLVING TEAMS

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Abstract

The upward spirals in team processes: Examining dynamic positivity in problem solving teams

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Positivity has been heralded for its individual, social and organizational benefits. Although past studies have shed light on how positivity reinforces itself in individuals, researchers have not shown how positivity dynamically occurs and unfolds within the flow of team interactions. We address this research gap by integrating existing knowledge on team processes with the notions of emotional cycles and team coordination as energy-in-conversation. We coded and analyzed the meetings of 43 problem solving teams and their 43,139 utterances. Using statistical discourse analysis to model multi-level dynamics over time, we found that early positivity and solution-focused interactions increased the likelihood of subsequent positivity. Dynamic speaker switches increased the likelihood of positivity both directly and by magnifying the positive effects of early positivity and solution-focused interactions on subsequent positivity. Greater overall positivity is also linked to greater team performance.

Keywords: Dynamic positivity, team processes, team interaction, team problem-solving, dynamic multi-level modeling, statistical discourse analysis

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“Feeling joy in the pleasures of life, as depicted here in Marc Chagall’s Festival in the Village, offers rewards beyond those of simply experiencing the moment.” - Barbara L.

Fredrickson

“If you have zest and enthusiasm you attract zest and enthusiasm. Life does give back in kind.” - Norman Vincent Peale

Introduction

Being positive, joyful, optimistic, and constructive (i.e., *positivity*), produces both intrapersonal and social benefits. For example, positive emotions broaden individuals’ attention and thinking (e.g., Fredrickson & Branigan, 2005; Rowe, Hirsh, & Anderson, 2007; Schmitz, De Rosa, & Anderson, 2009; Wadlinger & Isaacowitz, 2006), which, in turn, helps discover and build personal resources, such as mindfulness, resilience, social closeness, and even physical health over time (Cohn et al., 2009; Fredrickson et al., 2008; Waugh & Fredrickson, 2006).

Although research on positivity has largely focused on individual experiences, positivity exists in a broad range of organizational settings and can be affected by mutual social influence. As organizations increasingly rely on streamlined team structures to accomplish critical goals (e.g., Kozlowski & Ilgen, 2006; Mathieu, Maynard, Rapp, & Gilson, 2008), the degree of positivity in teams and its antecedents become especially important. Remember the pat on your back from your team members for helping the team project succeed? In return, you reciprocated the accolades. Or, recall how the whole team cheered up and became more agile and resilient after several of you displayed a "can-do" attitude despite demanding tasks. For example, when the service module in space shuttle Apollo 13 exploded, Eugene Krantz and his Tiger Team safely led the team back to Earth. They fostered a culture of optimism to solve problems in a high-pressure, time-sensitive, emergency environment (James & Wooten, 2010).

Positivity can have substantial behavioral and social consequences in the workplace, but few organizational researchers have examined the social dynamics behind positivity (i.e., how positivity occurs and is sustained in teams). Although most of us work in some kind of team setting (e.g., Kozlowski & Ilgen, 2006; Mathieu, Maynard, Rapp, & Gilson, 2008), research on positivity has largely focused on individual experiences rather than positive experiences embedded in team processes. The paucity of this type of research limits our understanding of the antecedents and consequences of positivity in the workplace in general, and within team processes in particular. We attempt to fill this gap by conceptualizing positivity as a dynamic process preceded by a sequence of team member actions, and by investigating its antecedents and consequences. In doing so, we integrate existing knowledge on team processes with the theories of emotional cycles (Hareli & Rafaeli, 2008) and energy-in-conversation (Quinn & Dutton, 2005).

As we develop a dynamic, process-based conceptualization of positivity in teams, we extend previous research in two ways. First, we conceptualize positivity as a team process, thereby extending the static, favorable features of positive emotional and psychological states to a dynamic context consisting of reoccurring member interactions. Our definition of positivity as actions distinguishes it from the individual-level concepts of positive personality or traits (e.g., positive affect; Watson et al., 1988) or positive psychological states (e.g., Luthans, Lebsack, & Lebsack, 2008). Second, positivity, like other human emotions, is not only an intra-psychic experience (Frijda, 1988) but is also subject to social influence from others (Hareli & Rafaeli, 2008). As such, we propose that team processes and member interactions influence the likelihood of a person's positivity.

Because problem solving constitutes a fundamental team task and entails intensive interactions between team members, in this paper, we examine 43,139 coded individual utterances by 259 technicians from 43 teams in two organizations meeting to solve problems. After defining several key constructs and outlining our theoretical model, we analyze our

longitudinal data to explore the temporal dynamics of positive affective experiences, their antecedents and consequences.

Defining positivity as a dynamic process

Positivity (experiencing positive, joyful, optimistic, and constructive emotions; Fredrickson, 1998; 2001; 2004; Walter & Bruch, 2008) has also been described as a particular form of energy, in terms of an affective experience described variously as energetic arousal (Thayer, 1989), emotional energy (Collins, 1993), subjective energy (Marks, 1977), positive affect (Watson, Clark & Tellegen, 1988), vitality (Ryan & Frederick, 1997), and zest (Miller & Stiver, 1997). Employing an operational definition suitable for analyses, we define positivity in teams as one's expressed and observable statements or acts during team interactions that are constructive in intention or attitude, show optimism and confidence, and express or imply affirmation, agreement, or permission (Oxford English Dictionary, 1989). These positive acts include enthusiasm for ideas, positive support for solutions, or a positive spirit toward change. We emphasize positivity as an *observable, behavior-manifested* concept in this paper, beyond the notion of individual internal states and a purely affect-based conceptualization. As such, we posit that positivity is not limited to established, fixed, or static individual feelings and experiences. Rather, positivity is a dynamic process that may involve a set of interdependent behaviors and acts of team members that build upon one another and change during member interactions. Just as Weick (1979) suggested that we should think more about “organizing” than “organizations” – more about verbs and less about nouns – we propose viewing positivity as an adverb: any behavior and act can be carried out positively or negatively. Hence, positivity is a dynamic team process rather than an individual state.

Theoretical building blocks of modeling positivity

Fredrickson's broaden-and-build theory (Fredrickson, 1998; 2001; 2004) provides an overarching theoretical underpinning of individual positivity. The premise of the broaden-

and-build theory holds that positivity broadens and builds individuals' cognitive repertoire and personal resources (e.g., Fredrickson & Branigan, 2005; Rowe, Hirsh, & Anderson, 2007; Schmitz, De Rosa, & Anderson, 2009; Wadlinger & Isaacowitz, 2006), increasing psychological wellbeing and physical health over time (Cohn et al., 2009; Fredrickson et al., 2008; Waugh & Fredrickson, 2006). Importantly, the upward spirals of personal resources triggered by positivity also endure at the interpersonal level, inducing positive emotions that increase people's trust (Dunn & Schweitzer, 2005), shared purpose and empathy with others (Waugh & Fredrickson, 2006). The present study extends research on individual positivity by modeling the effects of social interaction processes on positivity within teams and examining how these processes influence one another.

We draws on three research literatures to investigate positivity as upward spirals embedded within team social interactions: (1) the social-influence-based view of emotions, (2) a theory of coordination as energy-in-conversation, and (3) team process models.

Social influence model of emotions and emotional cycles

The emotional cycles theory (Hareli & Rafaeli, 2008) suggests that human emotions in organizational contexts have interpersonal and social influences on organizational members because people recognize and inevitably react emotionally to one another's emotional displays in social and work settings. For example, research on emotional labor and leadership demonstrates that emotions (e.g., joy, gloom, anger) displayed by individuals as part of their work role (e.g., sales employees, team leaders) can influence others (e.g., customers, subordinates; Ashforth & Humphrey, 1993; Ashforth & Tomiuk, 2000; Sy, Côté, & Saavedra, 2005.). Similarly, many recent studies on collective affect and emotional contagion have shown that an individual's visible emotions influences those of team members (e.g., Barsade, 2002; Bartel & Saavedra, 2000; Kelly & Barsade, 2001). Moreover, displayed emotions can interact and create reciprocal "emotional cycles" or emotional episodes that influence people in social settings (Hareli & Rafaeli, 2008). For example, a person's (let's say Anna's)

emotions can influence the emotions, thoughts and behaviors of others, which in turn influences their future interactions with Anna and impact Anna's future emotions and behaviors (Weiss & Cropanzano, 1996; De Dreu, West, Fischer, & MacCurtain, 2001), thereby creating on-going emotional cycles.

Team coordination as energy-in-conversation

Quinn & Dutton (2005) describe how positive emotions can shape individual and collective experiences (i.e., how energizing or positive the experience is) during team-situated interactions aimed at managing resources and dependencies to accomplish team goals (*coordination*). Drawing from the communication literature (e.g., Cooren, 2006), Quinn and Dutton (2005) contend that coordination occurs in conversations and that the way conversations unfold, along with the effort that people invest in these coordinated activities, depend in part on the energy people generate or deplete as they talk. Hence, we posit that positivity, a particular form of emotional energy, plays an important role in team processes and coordination and therefore deserves an in-depth examination. Our study thus potentially addresses theoretical and empirical gaps concerning the affective and dynamic aspects of team coordination and interactions (e.g., Kozlowski & Bell, 2003; see Cronin, Weingart, & Todorova, 2011, for a review).

Moreover, the energy-in-conversation perspective of team coordination places primary importance on conversations (e.g., speech acts, narratives); thus we use an utterance as the unit of analysis. A focus on team conversations is critical for understanding team interactions and effectiveness because these conversations reflect how team members coordinate collective effort and cognition, solve problems and complete tasks. To our knowledge, little research has explicitly focused on conversation utterances as the unit of analysis (see Metiu & Rothbard, in press, for an exception; their study however was qualitative by nature). We thus take a first step toward a more fine-grained analysis of team processes in general and positivity in particular (e.g., Kozlowski & Bell, 2003; Cronin et al., 2011).

A contemporary perspective of team processes

An increasing number of team researchers argue for a central focus on temporal team dynamics unfolding in a proximal task and social context as the team works toward task accomplishment (e.g., Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Bell, 2003, 2008; Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996; Kozlowski, Gully, Nason, & Smith, 1999; Marks, Mathieu, & Zaccaro, 2001). In particular, Marks and colleagues' influential temporal model of team task performance suggests that teams iterate between task work phases and transition phases as they progress toward goal attainment. Their model is silent, however, regarding the nature of such transitions for teams that need to shift between different affective phases, or emotional cycles. Furthermore, while Marks et al.'s model (2001) suggests that successful affect management might help a team vent frustrations, stay focused during difficult times, and otherwise maintain a positive work atmosphere, research that explicitly investigates the micro-processes of affect management and how these micro-processes lead to positive upward spirals in teams is rare. We aim to fill this research gap by focusing on the task processes of problem discussion and solution suggestion, two fundamental tasks of interest for problem solving teams.

Taken together, we adopt a process-based approach to examine dynamic relationships between team task processes and positivity. Because conversations manifest as a form of team interaction and are often charged with energetic arousal (i.e., positivity) to affect team dynamics and outcomes (Quinn & Dutton, 2005), we also focus on notable features of social conversations in this study – namely speaker switches, which may indicate social influences on team interactions and task advancement (Gibson, 2005).

Positivity

Integrating and building on the theoretical perspectives outlined earlier, we delineate two propositions that serve as important bases for our hypotheses. Consistent with emotional cycles theory (Hareli & Rafaeli, 2008), we first propose that earlier instances of positivity

increase the likelihood of subsequent positivity. For example, the positive emotions of a team member (“Anna”) may elicit admiration or joy in another member (“Ben”), who then is friendlier to Anna; seeing this, Anna may respond with more friendliness and openness, which in turn can create positive feeling in other team members (“Cate” or “Dan”) and improve overall team interactions. This proposition also follows the notion of emotional contagion in the team literature, a process by which, over time, a person’s emotions tend to converge to those of his or her teammates (Barsade, 2002; Hatfield et al., 1994).

Our second proposition is that positivity can substantiate itself through dynamic social interactions and conversations. This proposition is centrally derived from emotional cycle theory, according to which, the “original emotion of an agent may arise from external conditions or individual dispositions, but the ensuing emotions will be a product of the interpersonal emotion cycle” (Hareli & Rafaeli, 2008: 41). In line with the theories of emotional contagion and energy as conversation, the display of positive emotions by some team members not only leads others to “catch” these emotions (Barsade, 2002; Hatfield et al., 1994), but also impacts people’s sense-making or interpretation of felt energy, emotion and expressive gestures (Quinn & Dutton, 2005), which leads back to the course of team interactions and conversations. We thus highlight the reciprocal interpersonal influence of positivity in teams – an idea originally mentioned, albeit briefly, by Fredrickson (2000).

Together, these two propositions suggest that team member interaction is not a static property or attribute, but emerges from a series of ongoing processes and social interactions that constitute recurring temporal cycles (McGrath & Gruenfeld, 1993). As such, we expect that initial positivity has temporal and recursive effects on team interactions at a later stage. In other words, initial positivity begets more positivity over time, forming positive upward spirals in the team that otherwise occur within persons according to Fredrickson and Joiner (2002). Indeed, research has shown that early mimicry of positive emotions sets a cooperative tone and produces benefits in negotiation settings (Swaab, Maddux, & Sinaceur, 2011).

Moreover, research on team interaction processes shows that emotionally charged verbal behaviors occur in a recursive manner (Kauffeld & Meyers, 2009; Lehmann-Willenbrock, Meyers, Kauffeld, Neining, & Henschel, 2011). These recursive patterns suggest that earlier positive behaviors will affect the likelihood of later positivity in the team (cf. Arkes, Herren, & Isen, 1988). This should apply to the micro-processes during team interactions in a similar manner. Therefore, we pose the first hypothesis:

H1: Earlier positivity increases the likelihood of subsequent positivity.

Positivity in the team problem-solving process

Team task processes are behaviors and interactions aimed at team members to do work (Philip & Dunphy 1959; Kozlowski & Bell, 2008), and these team task processes are linked to team performance (Goodman, Ravlin, & Schminke, 1987). For example, problem solving is a task process that strongly influences how teams process information and perform (McGrath, 1984; Hinsz, Tindale, & Vollrath, 1997). The literature on small groups suggests that problem solving teams engage in specific types of problem solving actions, such as identifying and clarifying the problem, proposing solutions, and evaluating proposals, to find a viable solution (Ellis & Fisher, 1994). Accordingly, we specify team interactions in the problem solving process as problem-focused or solution-focused interactions. For example, a team might pursue its work by identifying the problem and its causes in a linear way, demonstrating a problem-focus in their task processes. In contrast, a team might focus on its objectives (e.g., providing a certain number of solutions) and center its tasks on generating possible solutions and outlining action plans, implying a solution-focused tendency.

Our specification of team interactions as either problem- or solution- focused is similar to the notion of differentiating team adaptation as process- or outcome-focused (Woolley, 2009). Such a distinction is important because early team interactions can send problem solving teams down a path of emphasizing either task outcomes or “ends” (i.e., finding and deciding the solutions), or work processes or “means” (i.e., identifying and

discussing problems), with consequences for performance and positivity. Recent research indeed shows that team performance, in terms of the level of action identification and ability to adapt, points to an advantage for outcome-focused teams over process-focused teams in dynamic environments (Woolley, 2009). Extending this line of research to our discussion of positivity, we posit that solution- focused interactions may lead to more positivity in teams, whereas problem-focused interactions may inhibit positivity within the team interaction process.

Consider teams beginning to discuss the problems and root causes necessary for solutions. Problem-focused actions often identify difficulties that are less likely to yield positive emotions, especially if the problem does not lend itself to a simple solution procedure and raises doubts about finding a solution. However, teams often need to identify problems and their specific causes before they can find a good solution. For example, imagine that Anna identifies a problem that Ben and Cate elaborate (“also, it’s leaking,” “can’t tell if hazardous chemicals are inside”). In contrast, solution-focused interactions often yield potential solutions which raise hope, allow for task advancement and likely help teams to experience positivity. This positive potential of solution-focused interaction increases as team members endorse a solution and map out a plan to implement it. Imagine that Anna shares an idea that Ben and Cate endorse (e.g., “Yes, let’s do it,” “Absolutely”). These team members experience positivity, show more of it and invite more of it. Taken together, we expect that problem- and solution- focused interactions have different impact on positivity.

H2a: Problem-focused interactions reduce the likelihood of subsequent positivity.

H2b: Solution-focused interactions increase the likelihood of subsequent positivity.

Positivity and dynamic speaker switches

One important reason why we expect that positivity and task processes have recursive, temporal effects on team interactions is that team conversation is distinguished by ever-renewed uncertainty as to who will speak and, relatedly, who will be addressed in the

following turn (Gibson, 2003, 2005). During team coordination and task processes, participation shifts or switches of speakers, whereby people are moved into and out of the positions of speaker, target (addressee) and unaddressed recipient, shape team members' mood, experiences, responses, and expectations for future interaction patterns or experiences (Gibson, 2003, 2005). The number of times that a speaker gives up the floor to another speaker (switches between speakers) during team interactions can differ and have differential effects on positivity. Some interactions have many switches between speakers, indicating a dynamic and free flow of information –especially if many team members actively engage and contribute to the conversation. Such autonomy and participation elevates energy levels (Quinn & Dutton, 2005). When receiving interesting input, positivity, or energy from other team members' contributions during the conversation, one's desire to participate increases. As Metiu and Rothbard (in press) showed, the frequency of interactions between team members is both an indicator and a source of high levels of mutual focus of attention, which in turn, leads to shared positive emotions, motivation, thought stimulation, and synergy. In contrast, other interactions have fewer switches, indicating more longer turns of talk (conversation turns). In the extreme case, a single, long turn (monologue) may indicate a strict power hierarchy, an organizational silence (Morrison & Milliken, 2000), lack of trust or psychological safety (Edmondson, 1999), less participative communication, or less member engagement. In these cases, fewer switches could indicate less autonomy and less participation, yielding less positivity. In contrast, multiple speaker switches in a team interaction episode suggest that many team members take turns to contribute dynamically and that they are actively engaged in the conversation, which may be more helpful to generate positivity in the team.

The idea of embracing more speaker switches also aligns with the energy-in-conversation metaphor (Quinn & Dutton, 2005), according to which energy is often enacted and elevated by dynamic team interaction. When receiving interesting input, positivity, or

energy from other team members' contributions during the conversation, one's desire to participate increases. Dynamic, rather than monologous, interaction patterns then enable one to experience more positive emotions, thought stimulation, and synergy. In fact, recent qualitative research by Metiu and Rothbard (in press) shows that the frequency of interactions between team members is both an indicator and a source of high levels of mutual focus of attention, which, in turn, leads to shared emotion and motivation. Based on the assumption that positivity is a team phenomenon that evolves via dynamic—rather than static—interaction patterns, we predict the following:

H3: Speaker switches increase the likelihood of positivity.

Interaction effects

The interaction of speaker switches with team task processes might further influence positivity. Consider the substantive behaviors people demonstrate in dynamic conversations, such as asking and answering questions, elaborating one another's ideas, stating opinions and objecting to the opinions of others, and so forth. This dynamic process captured by participation shifts (Gibson, 2003) or speaker switches can engage team members, develop positive shared feelings among them, generate energy (Collins, 1993), and raise the likelihood that team members will appraise subsequent events positively (Arkes et al., 1988) — energy often begets more energy. From this perspective, we argue that speaker switches, as a proxy of highly dynamic team interactions, amplify the positive upward spirals within the team over time; dynamic speaker switches amplify initial positivity to further increase positivity.

H4: Speaker switches strengthen the positive relationship between earlier positivity and later positivity.

Furthermore, the interaction between speaker switches and task processes might influence subsequent positivity. When multiple team members take turns to discuss problems and concerns on a problem-focused path, they may experience more negative feelings (e.g., anxiety, frustration) and less positivity. In contrast, positivity may be enhanced when team

members take turns to share suggestions and fine-tune solutions, celebrate success, and enjoy their sense of efficacy (Bandura, 1986; Thayer, 1989; Haidt 2000). When team members walk away with a sense of achievement and confidence, they are more likely to feel emotionally pampered (Metiu & Rothbard, in press). We thus predict the following:

H5: Speaker switches moderate the relationship between problem solving interaction and later positivity, such that speaker switches amplify: (a) the negative link between problem-focused interaction and later positivity, and (b) the positive link between solution-focused interaction and later positivity.

Positivity and overall team performance

Finally, also fundamentally, we underscore the need to study positivity in the workplace because it might impact team performance. While scholars still debate whether happiness leads to better performance (see Staw & Barsade, 1993, for a review), there is evidence that positive affect is associated with greater cognitive effort and ability to engage in more complex logical reasoning and problem solving (e.g., Sullivan & Conway, 1989; Isen, 2003). Moreover, positive affect has been linked to greater motivation and superior individual performance (Judge, Erez, & Bono, 1998). Forgas (1998) found that negotiators in positive moods were more effective than those in negative moods (see also Forgas & George, 2001). Furthermore, positive links between individual positivity and performance outcomes have been shown in the healthcare context (Luthans et al., 2008), in the sales setting (Seligman, 1998), and in the context of leadership (Avey, Avolio, & Luthans, 2011; Gooty, Gavin, Johnson, Frazier, & Snow, 2009).

At the team level, positive affect increases perception of better performance and higher self-efficacy on a variety of team tasks (Barsade, 2002; Heath & Jourden, 1997). We expect a similar positive relationship between overall positivity in a team and their performance. We hypothesize a positive effect of positivity on team performance for at least three reasons. First, positivity may motivate individual team members to engage more deeply

in team tasks and to commit to team goals, which in turn can promote team performance. Second, experiencing positivity both establishes an overall pleasant team experience (e.g., through positive emotional contagion) and creates a positive environment in which team members can broaden and build (Frederickson & Joiner, 2002). Similar to brainstorming principles (Osborn, 1963), positivity may enhance team members' support for each other's ideas initially, regardless of idea quality. Accepting ideas, elaborating them further, and building on each other's contributions can then lead to "breakthroughs" in the team interaction. Finally, positivity in teams might improve a number of other team processes, such as conflict management or safety monitoring (Barsade, 2002), which in turn help reap better team performance outcomes. Therefore, we posit:

H6: The overall amount of observable positivity during team interaction is positively linked to team performance.

Method

Sample

The data for our study were drawn from a multi-study longitudinal research program designed to examine team interaction processes and meeting effectiveness. The participants in this study were 259 line technicians from 43 problem-solving teams in two medium-sized German companies. These teams were formed to participate in the Continuous Improvement Process (CIP) program of their respective company and to solve everyday problems during frontline production. There were 28 teams from one company in the electrical industry and 15 teams from a second company belonging to the automotive supply industry. Their team meetings were composed of five to seven co-workers ($M = 6.19$, $SD = .97$). 90% of the team members were male, which is typical for this particular field of factory work. Employees' 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 (range: 4 months to 42 years; $SD = 6.27$).

Procedure

Our data included both meeting videos and survey responses. First, all demographic data were obtained via self-report surveys prior to the recorded CIP meetings. Behavioral variables were obtained by videotaping regular team meetings, which occur approximately once a month in each organization. Supervisors were not present during these team meetings, and all participants were at the same level of the company hierarchy. Their meeting discussions, lasting between 40 and 70 minutes, focused on CIP topics such as improved frontline operation and processes and essentially dealt with finding better solutions to solve problems, such as developing new work processes (e.g., reorganizing the layout of work stations to improve workflow) and solving complex quality control and client problems (e.g., generating ideas to reduce complaints by internal or external customers). Participants were advised to ignore the videotaping and to discuss the topic as they would under normal circumstances. Although videotaping team meetings might have somewhat influenced the social interactions between team members (Wicklund, 1975), this was less of a concern in our study because CIP team members were familiar with the research team who were present to record their meeting. These teams were highly engaged in their demanding and pressing tasks of solving realistic problems at work and showed no visible signs of being influenced by the videotaping. Indeed, after the team meeting, participants' questionnaire responses described the meetings as typical. After the team meetings, all supervisors of the participating teams completed a survey assessing team characteristics (e.g., size, tenure) and team performance outside the CIP meetings.

Data coding and variables

We coded the 43 recorded meeting videos, comprising a total of 43,139 utterances. We used a subset of the act4teams coding scheme for team meeting interaction, a procedure shown to be valid and reliable (e.g., Lehmann-Willenbrock & Kauffeld, 2010; Kauffeld & Lehmann-Willenbrock, 2012), to code the utterances and measure the variables of interest. In

order to preserve the temporal order of the individual utterances within the meeting conversation, we used INTERACT software (Mangold, 2010). We used this software to cut the entire meeting conversation into individual utterances, or so-called sense units (Bales, 1950) and to assign a behavioral code from the act4teams scheme (e.g., problem, solution, or positivity behavior) to each sense unit.

We intensively trained a pool of five coders on evaluating meeting behaviors with the act4teams coding scheme, but intentionally kept them unaware of the purpose of the study. Any discrepancies between the coders were resolved by discussions. Afterwards, we established inter-rater reliability. To do so, all meeting interactions were coded by two coders (out of five) on the dimensions of positivity, problem-focused behavior, solution-focused behavior, and speaker switches. We obtained a satisfying inter-rater reliability (Fleiss' $\kappa = .81$; $p < .01$; Fleiss, 1971).

A positivity statement in this context refers to an utterance that is constructive in intention or attitude, showing optimism and confidence. Sample statements could be: "This sounds great"; "This could really work"; or "I'm really looking forward to this". Statements about identifying, describing and explaining problems were coded as problem-focused behavior (e.g., "We have communication issues when people come back from vacation and don't know what's been going on"). Statements that suggest a new idea or solution to a problem, endorse a solution, and explain advantages and consequences of implementing a solution were coded as solution-focused behavior (e.g., "One thing we could do is use some kind of log, to document what's going on" or "We could use that log to write down any incidents that occur, so people can get informed quickly when they come back"). A positivity statement following this solution might be: "That sounds like a good plan."

A speaker switch occurs when adjacent utterances are spoken by different speakers (e.g., a person describes a problem and a different team member follows with a solution). By the nature of our coding procedure, speaker switches do not automatically occur whenever a

new behavior was coded. For example, a speaker might first state a problem and then immediately offer a solution himself, without a speaker switch in between. As questions were raised frequently during the conversations and were by-products of problem solving, we also coded questioning utterances and used them in our analysis.

In the survey to the supervisors of the participating teams, we adapted four items from Kirkman and Rosen (1999) to measure team performance on a 7-point scale, ranging from 1 (completely disagree) to 7 (completely agree). The items were: “The team reaches its target performance”; “The team produces high quality products/service”; “The team exceeds its target performance”; and “The team continuously improves its productivity.” We calculated the average across these four items to obtain a team performance score. Cronbach’s Alpha for this scale was $\alpha = .65$.

Analysis

Data structure and analytical specification. Our analysis was aimed at predicting positivity, which might occur at any time during a meeting. To do so, we included explanatory variables at several levels: utterances occur in different time periods, were nested within participants, and nested within teams. Specifically, each utterance in a meeting (a) was spoken by a person with individual characteristics, (b) occurred within a micro-time context of recent utterances, (c) within in a specific time period, (d) during the meeting of a particular team with its own team characteristics, and (e) within a specific company. As the outcome variables (i.e., positivity statements) can differ across time (including serial correlation) and across teams, they require identification of distinct time periods, modeling of time differences and modeling of team differences (Chiu & Khoo, 2005). Furthermore, infrequent outcomes can bias the results of a Logit regression, so this bias must be removed (King & Zeng, 2001). To model dynamic positivity within this nested structure, we used statistical discourse analysis (SDA, Chiu & Khoo, 2005; Chiu, 2008), which incorporates multilevel models.

SDA calculates a multilevel, cross-classification regression (hierarchical linear

modeling, Bryk & Raudenbush, 1992; Goldstein, 1995) and enjoys several advantages in analyzing series of sequential events (or time-series data) during team interactions. For example, time-series data based on team interactions have previously been modeled with conditional probabilities (e.g., Parks & Fals-Stewart, 2004; Woods, Rapp, & Beck, 2004), sequential analysis (e.g., Han, 2004; Koester, 2004; Lehmann-Willenbrock et al., 2011), Logit regressions (e.g., Pevalin & Ermisch, 2004; Silverstein & Parker, 2002), or pattern analysis (Stachowski, Kaplan, & Waller, 2009). However, these methods do not adequately model differences across teams, across individuals, across time (Mercer, 2008; Reimann, 2009) or across characteristics of recent utterances (Chiu & Khoo, 2005). In contrast, SDA allows explanatory variables at the company-, team-, individual-, time period-, or utterance-levels and computes the explained variance at each level (which accounts for the interdependency among team members or within time periods, Chiu & Khoo, 2005; Cress, 2008). Thus, characteristics of recent utterances, time periods, individuals, teams, and companies can be combined to model changes at the micro-level of behaviors within a team meeting.

Explanatory model. We modeled team members' positivity during the team meetings with multilevel cross-classification model at multiple levels: utterance, time period and individual (Goldstein, 1995). The following equation was used to estimate the probability of positivity behavior within the team interaction process:

$$\Pi_{ijk} = F(\beta + f_{jk} + g_k) + e_{ijk} \quad (1)$$

The probability (Π_{ijk}) that the outcome *Positivity*_{ijk} occurs at unit utterance *i* of time period *j* in team *k* is the expected value of *Positivity*_{ijk} via the Logit link function (F) of the overall mean β , the time period and team deviations (f_{jk} , g_k), and utterance-level residuals e_{ijk} . We then added explanatory variables at the following five levels: team context, time period, individual, and utterance-level.

$$\begin{aligned} \Pi_{ijk} = & F(\beta + f_{jk} + g_k + \beta_u \mathbf{TeamContext}_k + \beta_{vk} \mathbf{Time_period}_{jk} + \beta_{wjk} \mathbf{Individual}_{ijk} + \\ & \beta_{zjk} \mathbf{Lag1_Speaker}_{(i-1)jk} + \phi_{zjk} \mathbf{Lag2_Speaker}_{(i-2)jk}) + e_{ijkl} \end{aligned} \quad (2)$$

First, we entered a vector of u team context variables: company, team size, number of women in the team, and total utterances per team meeting. Each set of predictors was tested for significance with a nested hypothesis test (χ^2 log likelihood; Kennedy, 2008). Next, we tested for interactions among significant variables within the same level. Afterwards, we entered time period variables: initial time period (**Time_period**). Then, we entered a vector of w individual variables: gender, age, team tenure, and total individual number of utterances (**Individual**). Wald tests identified significant effects (likelihood ratio tests are not reliable for multilevel analysis of binary data, Goldstein, 1995).

Next, we added a vector autoregression (VAR) of previous speaker variables (Kennedy, 2008). More recent actions might have stronger effects (Slavin, 2005), so previous speaker variables were added in reverse order, first at lag 1 (previous utterance): speaker switches (–1), problem-focused utterances (–1), solution-focused utterances (–1), questions (–1), and positivity (–1) (**Lag1_Speaker**). We also tested the interactions of the above significant lag1 variables with speaker switches (–1). Then, we applied the procedures of **Lag1_Speaker** to z variables at lag 2 (**Lag2_Speaker**), and so on until the last lag had no significant variables.

If the regression coefficient of an explanatory variable (e.g., $\beta_{zjk} = \beta_z + f_{zjk} + g_{zk}$) differs significantly across time periods ($f_{zjk} \neq 0?$) or across teams ($g_{zk} \neq 0?$), then a cross-level moderation (interaction) effect might exist. In that case, the regression coefficient was modeled with time period or team-level variables (e.g., $\beta_{zjk} = \beta_z + \beta_{zjk} \mathbf{Time_period}_{jk} + \beta_{zk} \mathbf{Team}_k$). Finally, the odds ratio of each variable's total effect (direct plus indirect) was reported as the increase or decrease (+X% or –X%) in the outcome variable (Kennedy, 2008). To reduce multi-collinearity, non-significant variables were removed, using a .05 alpha level. To control for type I errors, the two-stage linear step-up procedure was used (Benjamini, Krieger, & Yekutieli, 2006),

Results

Table 1 provides the means, standard deviations and intercorrelations of all variables at the utterance level.

Team- and individual-level variables

Company and total individual number of behavioral units were linked to participant positivity. Participants in company 1 showed 13% more positivity than those in company 2 (13% is the odds ratio computed from the regression coefficient from Table 2, model 1; Kennedy, 2008). Meanwhile, participants who showed 10% more overall involvement in the meeting were 2% more likely to show positivity (Table 2, model 2). Together, these variables accounted for 8% of the variance of positivity in these utterances.

Earlier and later positivity

Consistent with Hypothesis 1, the results showed that earlier positivity increased the likelihood of subsequent positivity. Specifically, positivity in the previous utterance (positivity[-1]) was positively linked to the likelihood of positivity in the current utterance ($\beta = 1.50, p < .01$; see model 3 in Table 2). Note that in Logit regressions, regression coefficients greater than one indicate large effect sizes. Expressed in terms of odds ratios, after a team member showed positivity, the next speaker was 17% more likely to show positivity than otherwise. Positivity two utterances ago (-2), also significantly increased the likelihood of further positivity by 8% ($\beta = 1.37, p < .01$; see model 4 in Table 2). Similarly, positivity (-4) increased the likelihood of positivity four utterances later by 12% ($\beta = 1.37, p < .01$).

In the final model with all explanatory variables (model 8, Table 2), positivity (-1) and positivity (-4) remained significant positive predictors of later positivity ($\beta = .1.37, p < .001$, and $\beta = .827, p < .01$, respectively). Together, these findings support H1.

Positivity and problems vs. solutions

Our second hypothesis posited that positivity should be more likely after solution-focused interaction, and less likely after problem-focused interaction. Indeed, the results showed that after a team member identified a problem, the next speaker was 33% less likely

to show positivity ($\beta = 1.44, p < .05$; see model 3 in Table 2). Similarly, positivity was 12% less likely after a problem statement four utterances ago ($\beta = -.57, p < .01$; see model 7 in Table 2). Meanwhile, after a team member identified a solution, the speaker three utterances later was 8% more likely to show positivity ($\beta = .53, p < .05$; see model 6 in Table 3). In addition, utterances to endorse a solution four lags earlier were linked to increased positivity by 8% ($\beta = .52, p < .05$; see model 7 in Table 2). All of these links remained significant in our final model (model 8, Table 2). Together, these findings support H2a and H2b.

In addition, we found effects of questions. If a question occurred two utterances ago, positivity was 23 % less likely ($\beta = -1.00, p < .01$; see model 4 in Table 2). This negative effect remained significant in our final model.

Speaker switches and positivity

In our third hypothesis, we expected that dynamic interactions, characterized by a higher number of speaker switches, would increase the likelihood of positivity. In support of H3, we found significant positive effects of speaker switches on positivity across several lags. Immediately after a speaker switch (-1), positivity was 9% more likely ($\beta = .57, p < .001$; see model 3 in Table 2). If a speaker switch occurred two utterances ago, team members were 5% more likely to show positivity ($\beta = .34, p < .01$; Table 2, model 4). If a speaker switch occurred three utterances ago, positivity was 4% more likely ($\beta = .24, p < .05$; Table 2, model 6). These effects remained significant in our final model (model 8 in Table 2). The small negative effect of speaker switches at lag4 (4 utterances ago; $\beta = -.24, p < .05$ in our final model 8 in Table 2) is an artifact of the much larger regression coefficient of the interaction term, speaker switch(-4)*Solution(-4).

Interaction effects

Hypothesis 4 posited that the positive link between earlier and later positivity would be stronger when speaker switches were present. Moreover, we hypothesized interaction effects between earlier problem- vs. solution-focused utterances and speaker switches (H5).

Although we did not find such interaction effects across all possible lags, we did obtain significant interaction effects at lag 2 and lag 4 respectively. We followed Aiken and West (1990)'s suggestion for depicting moderated effects in regression analyses and plotted these interactions in Figure 1. As seen in Figure 1a, positivity became significantly more likely when there had been earlier positivity 2 utterances ago, with a speaker switch at the same time ($\beta = 1.25, p < .01$; see model 5 in Table 2). In other words, if a new speaker rather than an old speaker showed positivity, the speaker two utterances later showed an extra 16% more positivity. This interaction effect remained significant in our final model, thus lending support to H4.

Contrary to our expectations, we did not find significant interaction effects between earlier problem-focused utterances and speaker switches. H5b was therefore rejected. However, we did find significant interactions between earlier solution-focused utterances and speaker switches. At lag 4 (four utterances before a positivity utterance), we identified an interaction effect between endorsing solutions and speaker switches ($\beta = 1.34, p < .01$). As shown in Figure 1b, when a new speaker rather than an old speaker endorsed a solution, the speaker four utterances later was 17% more likely to show positivity (Table 2, model 8). This finding thus supports H5b. The final explanatory model predicting positivity is depicted in Figure 2.

Overall positivity and team performance

To test our final hypothesis, we used the overall amount of positivity behavior observed in a team (per 1-hour period, to account for differing lengths of the meetings) to predict team performance rated by the supervisors. As hypothesized, the link between overall positivity and team performance was positive ($\beta = .29; R^2 = .08; p = .05$). This finding supports H6.

Discussion

Although most employees of contemporary organizations work in some kind of team

setting, research on positivity has largely focused on individual experiences rather than positive experiences evolving within team processes. This study took a step toward addressing this gap by examining how positivity, characterized as a form of “energy-in-conversation,” naturally occurs and dynamically unfolds during team member interactions in their natural context. Our results show that early positivity raises the likelihood of subsequent positivity. Our findings also indicate a positive relationship between solution-focused interaction and positivity, and a negative relationship between problem-focused interaction and positivity. Moreover, we found that dynamic speaker switches increase the likelihood of subsequent positivity. In addition to this direct link, speaker switches interact with solution-focused utterances to further raise the likelihood of subsequent positivity. Finally, we found that teams with greater positivity had better team performances compared to other teams.

Theoretical implications

Our findings deepen our understanding of how the micro-process of positivity occurs and is sustained in teams, extending the theorizing on a team’s coordination, effectiveness and affective dynamics. Team outcomes partially depend on the amount of positive emotions and experiences team members share (Quinn & Dutton, 2005). However, extant research that explicitly focuses on this affective feature of team interactions is rare. Thus, we add to the body of work concerning the effects of affect and emotions on team processes by pinpointing positivity as a distinct phenomenon in dynamic team interactions.

Furthermore, our findings add an emotional dimension to the impact of earlier events during a team meeting on its later events (e.g., Ericksen & Dyer 2004; Gurtner, Tschan, Semmer, & Nägele, 2007; Hackman & Wageman 2005). Previous work on groups and teams showed that team members’ early interactions can establish influential and lasting norms (e.g., Gersick & Hackman, 1990). As teams progress through their tasks and experience transitions (Gersick, 1988; Okhuysen, 2001), the expansiveness of team member interactions shape the nature of task processes and set them on a trajectory toward different outcomes

(e.g., high versus low performance, positive versus negative experiences). While past research has shown how task and process norms are quickly established and how they influence subsequent team interactions (Gersick, 1988; Okhuysen, 2001), the current study offers a complimentary perspective by highlighting the importance of recent affect (positivity), which impacts subsequent affect.

Our findings point to the complexity of catching energy-in-conversation or positive upward spirals in teams, an area which has received limited research attention. First, our analysis shows that positivity is more likely to follow solution-focused behavior than problem-focused behavior. The findings show that different task processes have different impacts on the positivity of team experience. Second, we also found that speaker switches, a prevalent characteristic of social interactions, increase and sustain positivity in teams. These results suggest that shorter conversation turns involving different team members enhance positivity. For instance, compared to team interactions dominated by a single individual, speaker switches in team conversations may loosen conversational strictures somewhat, engaging team members to contribute. Moreover, essential to the interaction effects of solution and speaker switches is the instrumental or enabling effect of speaker switches on team emotional experiences. This is consistent with the energy-in-conversation metaphor (Quinn & Dutton, 2005) and the structural form of what sociologists call “piggybacking” (e.g., Nielsen, 1984), whereby a team member readdresses the prior speaker as a way of showing support and build affiliation, and energy is thus enacted and elevated through the course of dynamic interactions. Together, our results point to a potential enabling condition of positivity in teams, providing an important extension to existing research on team interactions and effectiveness. Beyond the *enabling* condition (e.g., speaker turns) identified in the study, a research agenda on specifying the *constraining* conditions of positivity in teams may further advance our understanding of positivity in teams and team effectiveness in general.

A second key contribution concerns our conceptualization of positivity as a recurring

process in teams. By using utterances as the unit of analysis (except H6), we extend the literature on team processes and effectiveness in several important ways. First, teamwork and coordination is a dynamic course of action that emerges from a series of ongoing processes and actions that constitute recurring temporal sequences (McGrath, 1993). The recurring phase model of team processes suggests that teams repeatedly cycle between team action (e.g., team coordination and monitoring progress toward goals) and transition periods (e.g., goal specification and action planning; Marks et al., 2001). Our analysis of episodic team interactions reflects the rhythmic nature of problem solving teams as they go through a ride of identifying and clarifying the problem, proposing solutions, evaluating proposals, and planning implementation (Ellis & Fisher, 1994; Chiu, 2008). Future work on team processes, and on team effectiveness more generally, will profit from our approach of taking a more deliberately dynamic stance toward team member interactions.

Finally, we also add to the recent theoretical framework of team coordination as energy-in-conversation. Both communication and organizational theories recognize that affective expressions play an important role in how conversations unfold (Capella & Street, 1985) and that the sequencing of turn taking in conversations affects the structure of social arrangements (Boden, 1994). Yet there is little research that explicitly tests this important theorizing. Empirically, our findings provide initial support for energy-as-conversation in dynamic team interactions. We show that positive energy that emerges early on in conversations and interactions can often have prolonged effects as the positivity of these interactions feeds into future interactions. On a broader theoretical level, the finding that speaker turns can be an enabling condition for collective upward spirals raises important questions that must be asked about the social processes of team member conversations and, by extension, team processes. Although communication and organization scholars highlight the importance of paying attention to speech narratives, acts, “texts” and turn takings in theorizing, they tend to overlook the socially constructed nature of positivity in teams. Our

successful attempt to include both task and social team processes, and to integrate various explanatory factors across different levels—(i.e., utterances, individuals, teams), points to a more systematic approach in future research on team positivity and coordination.

Practical implications

Our investigation of dynamic positivity in teams has implications for team leaders as well as team members. First, all team members should recognize the important role of positivity for promoting team engagement and performance in general. If team leaders and their members manage the coordination process in ways that increase their own and others' energy, this process might also increase the effort that team members invest in subsequent team activities. As such, the upward spirals in teams should not only lead to better team performance, but also increase the well-being of the members who participate (Frederickson, 1998; 2001; 2004). Some organizational cultures, notably sales cultures, use positive emotions as a conscious corporate culture strategy. For example, the AMWAY Corporation not only uses positive emotions to further its business practices, it even has a name for it: "positive programming." This positive programming involves the company constantly exhorting its members to stay positive and to transfer that positivity to others (Pratt, 2000). Our findings show that this positive transfer is not just a corporate strategy, but an everyday phenomenon in teams that can be fostered in team interactions.

Second, this research has clear implications for managers and team leaders interested in structuring the processes of teams engaging in highly interdependent work. Team leaders would be well advised to pay particular attention to how they structure early team interactions, especially in terms of placing a relative emphasis on work processes versus outcomes. For teams working on problem solving tasks, reaffirming issues and having an in-depth discussion of what went wrong is often important, but it generally does not help generate positive energy. In contrast, when teams focus on solutions, they are more likely to experience positive attitudes and experiences, reap their benefits and ultimately generate

desirable outcomes. Finally, the synergistic effects of team interactions seem to operate through the role of speaker turn taking. For a team that has already experienced positive interactions and outcome-focused routines, team leaders can sustain and prolong such positive experiences by eliciting contribution from more than one team member, thereby improving its team dynamics.

Limitations and future directions

Our research has some limitations that provide opportunities for future research. First, our sample consisted of production teams charged with problem solving tasks from two manufacturing companies in Germany. Thus, the results may not generalize to other kinds of teams such as cross-functional teams or managerial teams. As the majority of participants were male, which represents this particular field of manufacturing, the results could differ for teams with a more balanced gender distribution. Moreover, our teams were rather homogeneous in terms of training and educational background. Our results might have looked different had we used more diverse teams, as perceived diversity in teams impacts team processes and outcomes (Zellmer-Bruhn, Maloney, Bhappu, & Salvador, 2008). Future research should investigate whether the results of this study generalize to different teams, organizations, or cultural settings.

Second, we used videotaping as the main method to collect information, which may have somewhat influenced the social interactions between team members (Wicklund, 1975). On the other hand, the demanding and pressing task of solving realistic problems can reduce the impact of videotaping as participants stay highly focused. We believe low reactivity to the videotaping was evident as some participants were openly criticizing their (absent) supervisors, cell phones were answered, and side conversations occurred freely and sometimes quite noisily (see also Kauffeld & Lehmann-Willenbrock, 2011). Nevertheless, future research might add self-reports of affective experiences to the objective observation of positivity behavior, to paint a more complete picture of dynamic positivity in teams.

Third, the present study is limited to include a few task and social process variables without considering other important individual and contextual factors. Individual variables such as positive psychological capital, disposition, expertise, or intelligence, and status might affect one's positivity during social interactions with others (Grant & Ashford, 2008). Team climate characterized by open communicative exchange reciprocity and psychological safety (Edmondson, 1999) likely affect the extent team members become cognitively, emotionally and behaviorally engaged and demonstrate positivity. Future work should include additional explanatory variables both at the individual and team level.

Finally, although we found that positivity was beneficial for overall team performance, there may be contingencies. Theorizing on motivated information processing in groups suggests that prosocial behavior—which may result from positivity expressions—can promote sharing consistent information, at the expense of sharing unique insights (De Dreu, Nijstad, & Van Knippenberg, 2008). Although our results suggest that positivity is promoted by novel ideas or solutions (rather than already shared knowledge) earlier in the interaction process, we cannot rule out the possibility that positivity might encourage biased information sharing in other settings. Moreover, the stereotype content model suggests that only individuals perceived as warm and competent elicit positivity in others (e.g., Fiske, Cuddy, & Glick, 2007). Although our current findings show that earlier positivity begets later positivity regardless of specific individual characteristics, we did not explicitly measure perceived individual competence. Future research might address this by measuring advice networks (e.g., Klein, Saltz, & Mayer, 2004) in addition to team interaction processes, in order to examine whether individual positivity behavior within the team process relates to competence as perceived by the other team members.

Conclusion

Our study advances the understanding of positivity, moving this concept from the individual level to dynamic team interaction processes. By applying statistical discourse

analysis, we show that positivity is not only an individual state, but a dynamic phenomenon embedded in team processes that evolves over time. Our findings underscore the importance of including a temporal perspective when studying affective experiences in teams, and suggest that dynamic positivity impacts team performance. Finally, by offering a novel methodological approach to untangling dynamic team processes, our study paves the way for future research on the temporal dynamics of affective experiences in teams, including the way positive upward spirals emerge within team processes and drive team outcomes.

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Table 1

Means, standard deviations, and intercorrelations of all variables included in the study at the utterance level

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Positivity	0.01	0.10	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2 Company	0.34	0.47	.03	.22	-.01	-.01	.00	.00	.00	.01	.00	.00	.00	.00	.01	.00	.00
3 Log (total utterances)	5.35	0.61	.01	-.03	.37	.04	.00	.00	.04	.00	.00	.05	.00	.04	.00	.00	.00
4 Speaker switches (-1)	0.25	0.43	.03	-.04	.16	.19	.00	.00	.01	.00	.00	.03	.00	.02	.00	.00	.00
5 Problem (-1)	0.07	0.26	-.01	.02	.01	.06	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
6 Positivity (-1)	0.01	0.10	.06	.03	.01	.02	-.02	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00
7 Speaker switches (-2)	0.25	0.43	.02	-.01	.16	.05	.02	.00	.22	.00	.00	.02	.00	.04	.00	.00	.00
8 Question (-2)	0.05	0.22	-.01	.06	.00	-.01	.01	-.01	.02	.05	.00	.00	.00	.00	.00	.00	.00
9 Positivity (-2)	0.01	0.10	.05	.03	.01	.01	.00	.06	.02	-.02	.01	.00	.00	.00	.00	.00	.00
10 Speaker switches (-3)	0.25	0.43	.02	-.02	.17	.17	.02	.01	.09	.01	.01	.20	.00	.02	.00	.00	.00
11 Solution (-3)	0.05	0.22	.01	-.03	.00	.01	.00	-.01	.01	.00	.00	.02	.03	.00	.00	.00	.00
12 Speaker switches (-4)	0.25	0.43	.00	-.02	.16	.12	.00	.00	.21	.01	.01	.08	.01	.20	.00	.00	.00
13 Problem (-4)	0.07	0.26	-.01	.11	-.01	.01	.01	.01	.02	.00	.00	.01	.00	.04	.06	.00	.00
14 Solution (-4)	0.05	0.22	.00	-.02	.00	.01	.02	.00	.01	-.01	.01	.02	.00	.02	-.05	.03	.00
15 Positivity (-4)	0.01	0.10	.03	.03	.00	.00	.00	.02	.01	.00	.05	.00	.01	.01	-.03	-.02	.01

Notes. Correlations are in the lower left triangle, variances along the diagonal, and co-variances in the upper right triangle of the matrix. Time lags are indicated by numbers in parentheses (-1, ..-4). As we have 43,139 data points (i.e., utterances), all the bivariate correlations are significant.

Table 2

Regression coefficients of three-level cross-classification logit regression models predicting positivity

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Company 1 (vs. 2)	.86*** (.21)	.92*** (.22)	.89*** (.21)	.87*** (.20)	.87*** (.20)	.87*** (.20)	.91*** (.20)	.91*** (.20)
Log (total individual number of utterances)		.39*** (.10)	.29** (.10)	.22* (.10)	.22* (.10)	.19 (.10)	.21* (.10)	.21* (.10)
Speaker switch (-1)			.57*** (.10)	.57*** (.10)	.57*** (.10)	.53*** (.10)	.54*** (.10)	.55*** (.10)
Problem (-1)			-1.44* (.58)	-1.45* (.58)	-1.45* (.58)	-1.44* (.58)	-1.44* (.58)	-1.44* (.58)
Positivity (-1)			1.50*** (.20)	1.37*** (.20)	1.37*** (.20)	1.37*** (.20)	1.38*** (.21)	1.37*** (.21)
Speaker switch (-2)				.34** (.10)	.27** (.10)	.26* (.10)	.29** (.10)	.29** (.10)
Question (-2)				-1.00** (.34)	-1.00** (.34)	-1.01** (.34)	-1.01** (.34)	-1.01** (.34)
Positivity (-2)				1.31*** (.21)	.57 (.39)	.56 (.39)	.47 (.39)	.49 (.39)
Positivity (-2) * Speaker switch (-2)					1.25** (.46)	1.24** (.46)	1.30** (.47)	1.28** (.47)
Speaker switch (-3)						.24* (.10)	.25* (.10)	.25* (.10)
Solution (-3)						.53* (.24)	.53* (.24)	.51* (.24)
Speaker switch (-4)							-.17 (.11)	-.24* (.11)
Problem (-4)							-.57* (.23)	-.56* (.23)
Solution (-4)							.52* (.23)	-.09 (.36)
Positivity (-4)							.81** (.26)	.82** (.26)
Problem (-4) * Speaker switch (-4)								-.63 (.53)
Solution (-4) * Speaker switch (-4)								1.34** (.47)
Explanatory variable:	1	2	3	4	5	6	7	8
Explained variance at each level								
Team (34%)	.33	.26	.37	.43	.42	.42	.44	.44
Utterances (66%)	.00	.00	.00	.01	.01	.01	.01	.01
Total variance explained	.10	.08	.12	.15	.15	.15	.16	.16

Notes. * $p < .05$; ** $p < .01$; *** $p < .001$. Standard errors in parentheses. In Logit regressions, coefficients greater than one indicate large effect sizes.

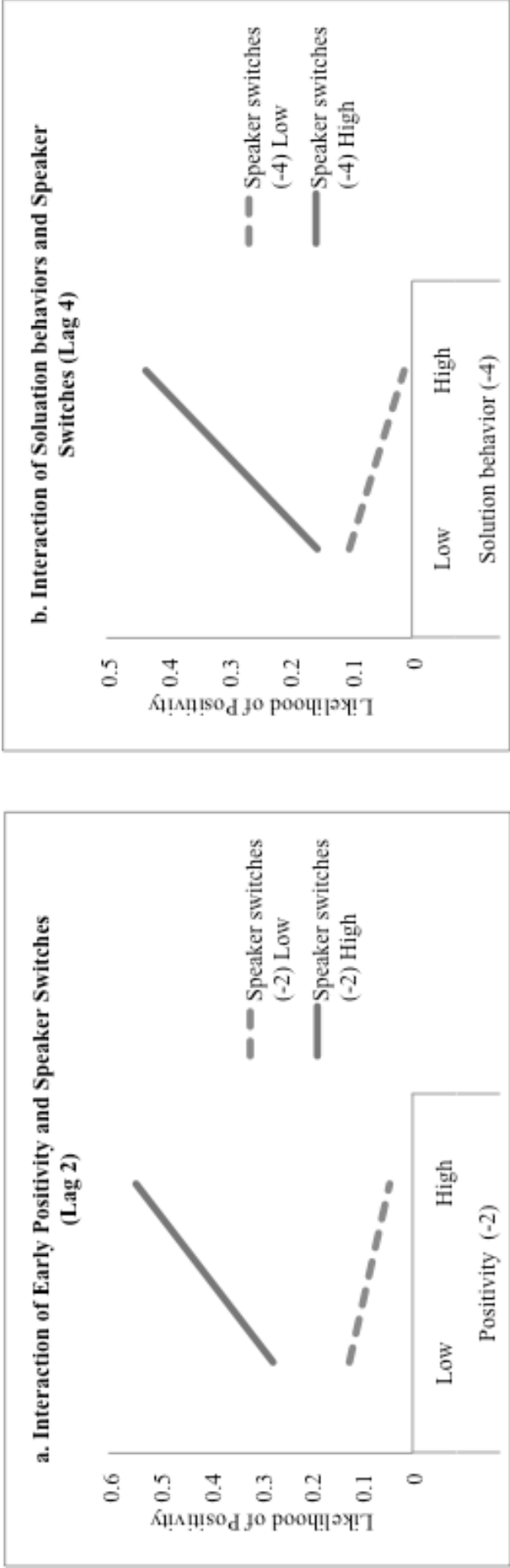


Figure 1. Interaction effects of speaker switches on positivity. Numbers in parentheses show the lags within the interaction episodes.

Examining dynamic positivity in problem solving teams

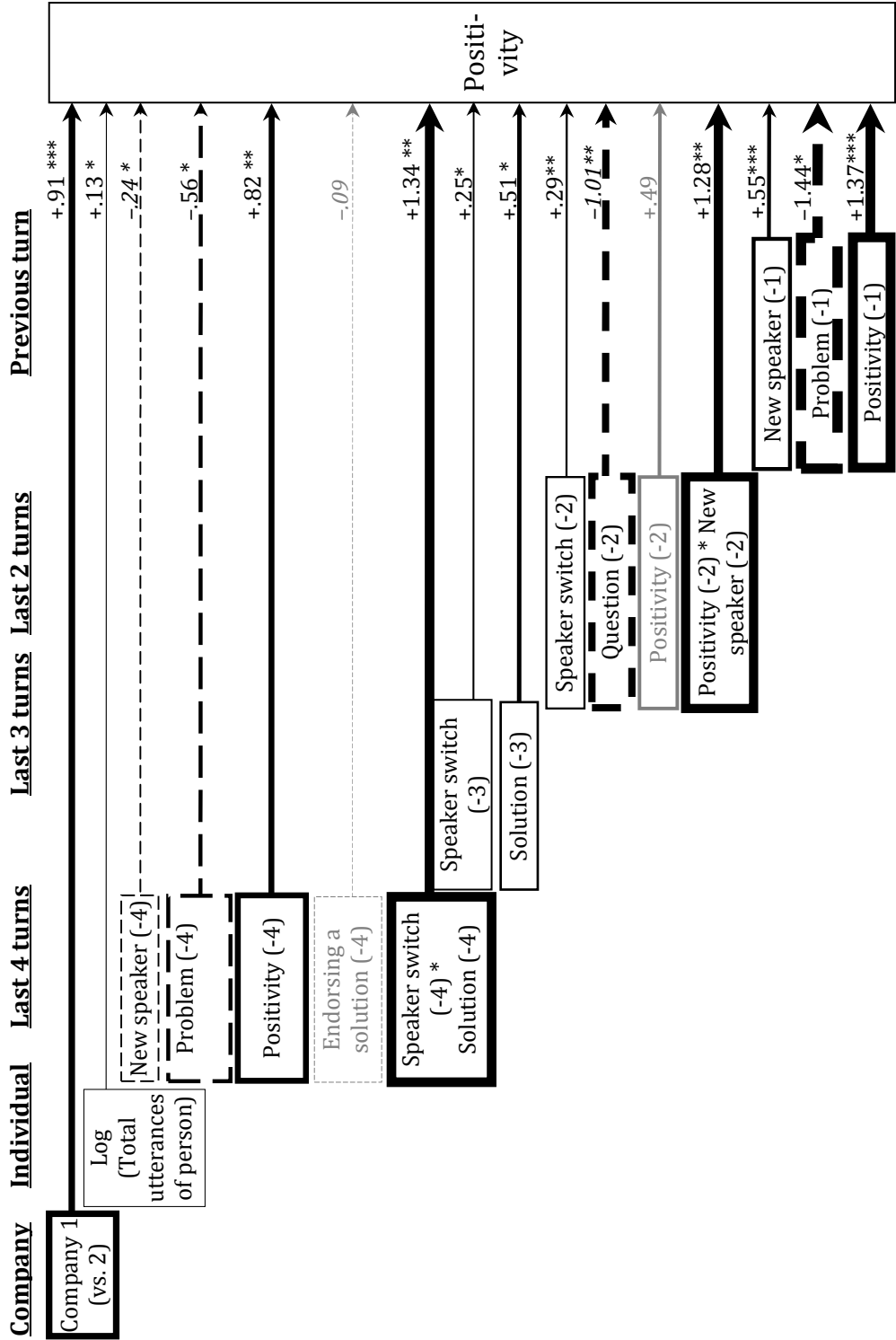


Figure 2. Path diagram of final multi-level model predicting positivity. Solid lines indicate positive effects. Dashed lines indicate negative effects. Thicker lines indicate larger effect sizes. Gray lines indicate significant effects at time of entry but non-significant effects in the final model. * $p < .05$, ** $p < .01$, *** $p < .001$

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