Team Coordination in High-Risk Circus Acrobatics

Abstract

To advance understanding of the mechanisms allowing for team coordination (TC) in complex motor actions, we conducted a qualitative study with eight elite hand-to-hand circus acrobats. Data collection consisted of field observations, an open-ended interview with the participants' head coach, and focus group interviews with all acrobats. Data analysis yielded three higher order themes: TC, collective efficacy (CE), and TC-CE linkage. Teammates' shared and complementary mental models, as well as implicit and explicit communication dynamics, emerged as formative sub-themes of TC; self- and other's-efficacy emerged as reflective sub-themes of CE. Our findings also suggest that TC is likely inter-related to CE in a systemic fashion. Practitioners should encourage the development of both shared and complementary models of thinking, while promoting verbal and non-verbal communication skills. Finally, increasing teammates' confidence in themselves and in their teammates can help in the development of CE as well as the enhancement of TC.

Keywords: team coordination; shared mental models; group dynamics; collective efficacy; dyadic teams.

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Whether the unit of analysis is an atom, the human brain, or a sports team, scholars concur that coordination occurs when two or more agents are in the "right place", at the "right time", doing the (most likely or expected) "right thing" (see Eccles, 2010; Kelso, 2012; Wood, 2003). Put plainly, coordination pertains to "space-time-action" synchrony (see Eccles, 2010). Despite interdisciplinary agreement on the operational definition of coordination, the underlying mechanisms that allow for "space-time-action" congruence remain unclear at least within the Sport, Exercise and Performance Psychology literature (see Carron & Spink, 1993; Filho, Tenenbaum, & Yang, 2015a; Klimoski & Mohammed, 1994; Peterson, Mitchell, Thompson, & Burr, 2000; Reimer, Park, & Hinsz, 2006). This ambivalence might arise from the fact that team coordination (TC) is a multi-layered process that requires in-depth qualitative exploration. To put it another way, although scholars agree on the definition of TC, the underlying mechanisms (formative and/or reflective indicators) that lead to TC remain unclear. This might be due to the fact that team processes, such as cohesion and collective efficacy, are intertwined, akin to the notion of *reciprocal determinism* or *many-to-many basis relationship* interactions in applied psychology (see Bandura, 1997; Cacioppo, Tassinary, & Berntson, 2007).

Within this complex research scenario, we focused our "exploration ground" on acrobatic dyadic teams, wherein "space-time-action" congruence is essential for optimal performance and safety (Ménard & Hallé, 2014). To this extent, research on team processes has relied on nomothetic methodologies guided by "regression to the mean" arguments (see Hiller, DeChurch, Murase, & Doty, 2011). Accordingly, it is paramount to advance idiographic research aimed at eliciting knowledge from skilled individuals involved in

interactive teams (Filho & Rettig, 2016). Our initial theoretical map was the Conceptual Framework of Coordination in Teams (see Eccles & Tenenbaum, 2004), which has informed research on TC in Sport, Exercise and Performance Psychology in recent years (see Collins & Durand-Bush, 2015; Filho & Tenenbaum, 2012).

Conceptual Framework of Coordination in Teams

The main tenet of the Conceptual Framework of Coordination in Teams is that TC is dependent on shared mental models (SMM). SMM has been defined as "teammates' shared understandings about team tasks, task context and strategies, team interaction patterns, and teammates' traits" (Xinwen, Erping, Ying, Dafei, & Jing, 2006, p. 598). In this context, Eccles and Tenenbaum (2004) purport that TC is dependent on SMM such that an increase in the quality and quantity of shared knowledge within a team facilitates division of labor among teammates, which in turn promotes team performance. In discussing coordination in teams, Eccles and Tenenbaum (2004) also noted that SMM, and TC in turn, can be improved through verbal and non-verbal communication prior to (i.e., pre-process coordination), during (i.e., in-process coordination), or after team actions (i.e., post-process coordination).

Although previous research supports the thesis that TC is linked to SMM and communication processes (see Gershgoren, Filho, Tenenbaum, & Schinke, 2013; Giske, Rodahl, & Høigaard, 2015; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Reimer et al., 2006), there remains a need to clarify the unique nomological roots of TC. Some scholars have contended that a view of TC based on SMM is somewhat limited, as it does not account for idiosyncratic knowledge within the team (Arrow, Poole, Henry, Wheelan, & Moreland, 2004; Mohammed, Ferzandi, & Hamilton, 2010). In other words,

"group thinking" and thus TC breakdowns are more likely to happen if divergent thinking patterns are not present in working teams (Filho & Tenenbaum, 2012; Salas, Rosen, Burke, Goodwin, & Fiore, 2006).

The discussion of TC extends beyond the socio-cognitive approach, and has also been examined within a dynamic systems view. In particular, some scholars have posited that TC might not rely primarily on SMM but rather on "affordances", which are unique to the teammates performing a given task within a specific context (see Marsh, Richardson, & Schmidt, 2009; Silva, Garganta, Araújo, Davids, & Aguiar, 2013; Vilar, Araújo, Davids, & Button, 2012). In this regard, Silva et al. (2013) have noted that it is the ability to perceive "collective affordances" – or the dynamic relationships among teammates, their opponents, and environmental pressures – that allows teammates to establish coordination in interactive team tasks. Also noteworthy, within this dynamic systems view, there are scholars who compare TC to "chemical reactions" or "team chemistry" (see DeLong et al., 2011; Gershgoren et al., 2016), thus adding further nomological confusion to research on group dynamics in applied psychology (see Filho, 2015).

The Present Study

The *unique nomological roots* of TC need to be clarified if applied psychologists are to develop a parsimonious, evidence-based understanding of how myriad team processes are inter-related within a systemic (i.e., *reciprocal determinism*; Bandura, 1997; *many-to-many basis relationship*; see Cacioppo et al., 2007) and integrated view of team dynamics (Filho et al., 2015a; Klimoski & Mohammed, 1994; Mohammed et al., 2010; Short, Sullivan, & Feltz, 2005). Accordingly, to deepen the understanding of TC, we conducted an exploratory focus group study with professional hand-to-hand circus acrobats

at a world-leading circus school. Our purpose was to explore circus artists' understanding of how TC is developed in dyadic hand-to-hand acts. Specifically, our research question was: "How is team coordination developed between elite flyers and catchers in high-risk circus acts?" No hypotheses or propositions were formulated a priori, as the study was framed within a constructivist stance in general (Mills, Bonner, & Francis, 2006; Patton, 2002). The participants were invited to construct (and re-construct) their understanding of TC in common hand-to-hand acts during a series of interviews.

Method

Participants

We purposefully recruited high-skilled hand-to-hand acrobats from a circus school in northeast Canada. The school is geared towards high-performing circus artists in their later stages of development (see Bloom, 1985). Performers come to the school from around the world and the school is renowned for developing world-class circus artists who desire jobs in premier circus companies, such as Cirque du Soleil (Filho, Aubertin, & Petiot, 2016). This sampling strategy is consistent with the importance of targeting "information-rich cases" in qualitative inquiry (see Patton, 2002). Our choice for this particular circus modality is in agreement with the concept of cognitive team task analysis (see Klein, 2000), which purports that specific working teams can be used as platforms to advance knowledge of team processes. Eight circus acrobats (seven males, one female) from four different dyads participated in the study, including four catchers and four flyers. The participants were 20.87 years old on average (SD = 2.76) and had extensive experience in their respective circus domain. Institutional review board ethical approval was obtained prior to

the commencement of the study. Each participant signed an informed consent sheet after being informed of the purpose, rationale, and methodological procedures for the study.

Data Collection

The leading author, who has experience leading workshops on performance psychology for circus artists, and has published academic manuscripts on expert performance in circus, conducted the data collection. His previous research and applied experience in the circus domain helped to facilitate the opportunity to gather data from high-skilled circus acrobats. To this matter, focus group interviews were the main tool used to gather data on the circus artists' understanding of how TC is developed in dyadic hand-to-hand acts. Focus group interviews were deemed the most appropriate strategy to collect data from the performers as they had rigorous daily schedules, including multiple practices and shows, which limited their availability. To this extent, focus groups have been established as an ideal tool to generate concentrated amounts of data on a topic of interest (Vaughn, Schumm, & Sinagub, 1996). In addition to two focus group interviews, a peer-debriefing interview with the head coach and a series of naturalist observations were also conducted. This is consistent with the importance of triangulation in qualitative inquiry (Patton, 2002), particularly with the notion that observations and individual interviews can add supplementary information to focus group studies (Bruun et al., 2014; Vaughn et al., 1996; Willig & Stainton-Rogers, 2007).

Focus group interviews. The focus group interviews were conducted under the moderation of the leading author. The first interview involved five performers from three dyads and the second involved eight performers from four different dyads. These numbers are congruent with recent guidelines on qualitative inquiry, which suggest that focus group

interviews should consist of 4-8 interviewees (see Sparkes & Smith, 2014). To maximize participation in both interviews, the acrobats were seated at a round table and given the opportunity to speak in turns.

The first interview lasted approximately 45 minutes and was conducted as an exercise, akin to previous qualitative studies (see Bruun et al., 2014; Simons et al., 2012). Thus, the first interview served as a pilot in the development of a structured interview guide for the ensuing main focus group. The resulting interview guide included two main topics: (a) development of "space-time-action" congruence, and (b) TC breakdown. The second interview lasted approximately 75 minutes. Congruent with the interview guide, the opening interview question was conceived to reflect the conceptual basis of TC; that is "space-time-action" congruence. The specific probe was: "How do you develop team coordination in your dyads? For instance, what do you do as a catcher and as a flyer to be at the right spot, at the right time, and making sure you are doing the right thing?" Each participant was given the opportunity to answer the initial question and was subsequently asked to elaborate on his/her ideas while commenting on other's responses and insights. The follow-up comment and question from the moderator was "I found it interesting to hear your thoughts on team coordination, communication, trust... In this second round I will give you a chance to add whatever you want to add, okay? Let's start from here." Finally, the moderator asked additional follow-up questions (e.g., "One person said, and I noticed while I was watching the shows that one of you calls the trick. So how does that work? How do you decide who calls the trick?"), and allowed all participants to respond as desired.

Coach interview. The purpose of the coach interview was to elicit additional information about the core components of action proper to hand-to-hand acrobats. During

this interview the leading author gained clarification on the specific roles of the catcher and flyer in the acrobatic act and gathered further information regarding practices and shows. The interview was tape-recorded, lasted approximately 45 minutes, and was conducted in a meeting room at a time chosen by the coach.

Field observations. The leading author conducted six observations as a *complete observer* (i.e., without taking part in the social setting but literally observing from the audience; see Gold, 1958; Willig & Stainton-Rogers, 2007) in order to gain a better understanding of the coordination dynamics established by flyers and catchers. To allow maximum variation, the interviews were conducted at varying circumstances. Of the six observations, two occurred during practices and four were conducted during live performance shows (two from a backstage perspective and two from an audience perspective). Each observation lasted approximately 75-90 min. Unstructured reflexive notes were maintained by the leading researcher, as the intention was to study TC from a broad naturalistic observation paradigm rather than subscribe to a controlled observation script (see Willig & Stainton-Rogers, 2007).

Data Analysis

The focus group interview data was coded using inductive thematic analysis, as our goal was to identify the acrobats understanding of TC in hand-to-hand acrobatics. A deductive approach, through direct content analysis, was employed to analyze the coach interview and observation notes according to the themes previously identified in the focus groups.

Inductive thematic analysis. The focus group interview data were analyzed inductively based on Braun and Clarke's (2006) theoretical thematic analysis which

consists of six steps: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. Accordingly, in the first step of the data analysis, both authors read the transcription of the focus group interviews until they became familiar with the data. The first author then organized the transcription into meaning units of text and subsequently grouped these units into themes and sub-themes. In the fourth step, the last author independently reviewed all meaning units as coded by the first author. Meaning units that needed recoding were identified and discussed until consensus was reached among the authors. The fifth step involved defining names for the themes and identifying quotes capturing the essence of each theme and sub-theme. Finally, the results were presented in the manuscript and described in terms of coherence. A thematic map was generated to visually illustrate the results.

Direct content analysis. The data gathered from the coach interview and the reflexive notes were analyzed deductively through direct content analysis. In the present study, the predetermined categories used for the direct categorical analysis consisted of the themes and sub-themes identified from the focus interview data. In this regard, there is a general agreement that direct categorical analysis should be used to complement the main data collected in a given study, thus increasing the overall trustworthiness of the findings (Elo & Kyngäs, 2008). The coding process followed the steps outlined by Hsieh and Shannon (2005). Initially, the first and last author independently read and re-read the verbatim transcripts of the coach interview and the field notes until they became familiar with the data. Subsequently, they independently searched for meaning units reflecting the pre-defined codes (i.e., themes and sub-themes from the interview data). Lastly, they

discussed their independent categorization until consensus was reached, and selected quotes to be presented in the manuscript write-up.

Results

The analysis yielded three higher order themes: team coordination (TC), collective efficacy (CE), and TC-CE linkage. TC and CE emerged as unique team processes underlined by different factors. Moreover, TC and CE seemed to co-evolve, thereby being intrinsically inter-related (i.e., TC-CE linkage). These higher order themes are illustrated in Figure 1 and discussed next.

Team Coordination

Our analysis suggests that TC is a multi-layered process involving four sub-themes: shared mental models, complementary mental models, verbal communication, and non-verbal communication.

Shared mental models. To achieve TC, the acrobats developed shared knowledge about team tasks and teammates' actions. To this extent, one of the acrobats noted that over time they learn to "feel" where each other will be within a specific movement:

> Let's say my flyer is doing a one-armed handstand on my head. I can't see him and we can't really talk and I have to balance him. I found that with time you just "feel" each other. I feel his hand, I feel his weight, and I know where he is going and I just respond to that and try to stay under him. (Catcher-2)

Complementary mental models. TC also seems to rely on the partners' idiosyncratic complementary knowledge about team tasks. In this regard, one of the catchers highlighted that over time they learn how to "adjust" to each other's movements:

> We are standing up and she swings and I throw her and that feeling [of throwing] for me, just by the hands. I don't know how but I can feel when she is biking [leg movements in the air], or giving the kick. Even if she is in the bike, and I can't see her, I can adjust if I feel she is too late or too early and she can feel the same if I miss my swing. (Catcher-4)

Verbal communication. Our results suggested that verbal communication appears to be related to the development of TC, particularly during practice sessions when time pressure is not an issue and partners are able to discuss, together with their coaches, how complex movements should be executed:

> I think the only time that it [coordination] ever becomes an issue is if you think the trick is like "this" and they [the catchers] think the trick is like "that", and when you don't agree. And when you have a really good coach who tells you how it [the trick] is, you have to just accept that and kind of figure out the way that it [the trick] works for you. I think the trick works like "this" so when we try it and it always fails, I'm not committing to it because I think you [the catcher] should be here, but in fact I don't really know because I've never done the part. But if you keep good communication the other person can start to understand what you are going through. (Flyer-1)

An excerpt from the interview with the head coach also illustrates the importance of verbal communication in solving coordination problems in difficult acrobatic tricks:

> I really believe that good partnerships are about communicating very well. And they [the acrobats] both need to work as a team to see how they can do it

> [the trick] ...what am I doing wrong or what I can do differently to solve the problem. (Head Coach)

Non-verbal communication. Pre-rehearsed trigger signals, as well as on-the-fly mimicry of each other's somatic responses (e.g., breathing), are likely paramount to TC especially under time-pressure situations, such as live shows:

> There are very specific cues to signal that you are ready and it's usually non-verbal, and it's very specific timing that you practice. For me, almost every trick he calls, basically when he does this one where he throws a leg, I know he is ready. When he goes like this, and he stops moving, I know he is ready. I don't have to wait for him to say anything. (Flyer-3)

> It is all based on breathing and timing and just waiting the exact amount of time, because if one person is pushing a little early or a little late then it's [trick] going to be off. So I keep moving until I find a calmness and then I just kind of stop breathing and then as soon as I become still he knows I am ready. (Flyer-1)

Field notes, documented following the field observations, were congruent with the notion that non-verbal communication is important to develop on-stage coordination:

> Sometimes it is like eye coordination: "Okay, I look at you and you tell me if you are ready, when I should go". And sometimes it is on the music beat, and then they [the acrobats] will do some sort of choreography. (Back-Stage Observation 2)

Collective Efficacy

Collective efficacy (CE) has been defined as, "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainment" (Bandura, 1997, p. 4). Without a shared belief in each other's abilities, partners would be unable to perform successfully while meeting the specific demands proper to hand-to-hand acrobatics:

> When you are throwing the flyer up, you don't really know what is going to happen in the air. It is kind of a thing of faith. They trust that you will catch them but you trust that they are going to know what to do in the air and you will catch them no matter what. (Catcher-1)

The head coach alluded to the notion of CE, albeit in colloquial terms, by mentioning the importance of developing "trust" between the two acrobats:

> It takes a huge amount of trust to do this [hand-to-hand acrobatics] because you are giving your body fully to somebody else in a way. But trust is also a big part of taking responsibility for everything. If you are working with somebody else, it is not one person's fault, and this is a misconception that people have. Often they will point the finger at somebody else and say "oh, you're not doing this right, you are not…" It's easy to do that, rather than to say "okay, what can I do differently". So it's important for people to understand. It's like tango. It takes two people. (Head Coach)

CE is a task-specific process and antecedents may differ across domains of human activity (Bandura, 1997; Feltz, Short, & Sullivan, 2008). In the case of hand-to-hand acrobatics, CE appeared to be the by-product of self-efficacy and other's-efficacy.

Self-efficacy. Self-efficacy has been defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura 1997, p. 3). The self-belief that one could perform his/her part in the hand-to-hand act was an important part in building a shared efficacy belief and in the development of TC:

> Once I feel that I am strong enough to hold something, especially with my flyer because he is not afraid of anything, that is when I know that I can hold him and then we usually just go for it. (Catcher-2)

Other's-efficacy. A belief in the partners' ability to execute an acrobatic trick also emerged as related to the development of a collective sense of efficacy. To this extent, a catcher noted, "He is a good acrobat and he knows his body and that gives me confidence." Two flyers respectively stated, "I've started to learn the way to 'just let go' and trust him." and "He trusted me and that helped me to overcome my fear and trust myself."

Team Coordination and Collective Efficacy Linkage

Our analysis suggested that the development of TC is intrinsically related to the development of CE and vice-versa. Acrobatic partners would be unable to develop TC without a shared sense of CE. In turn, according to the acrobats, the development of TC also enhanced CE beliefs:

> Coordination and trust go together. If you don't trust your partner then the coordination goes bad. If I trust him I won't fall because I am letting him control me. So it goes together. If you trust your partner you are going to be more coordinated. (Flyer-3)

Discussion

Our purpose was to explore circus artists' understanding of how TC is developed in dyadic hand-to-hand acts. This circus modality requires "space-time-action" congruence between a flyer and catcher and, as such, represents an epistemologically valid task to study TC. Our findings suggest that TC is dependent on teammates' knowledge (shared and complementary) and communication dynamics (verbal and non-verbal). Perhaps more importantly, our findings advance research in interactive team tasks by revealing that TC in high-risk acrobatics cannot be reduced to mono-causal explanations. Rather, TC is bounded to *reciprocal determinism* with collective efficacy, which in turn is reflected by the acrobats self- and others' efficacy. The intricacies of these findings are elaborated upon next.

Underlying Factors of Team Coordination

Our findings suggest that TC depends on SMM, complementary mental models, verbal communication, and non-verbal communication. These four factors seem to be formative rather than reflective indicators of TC. That is, TC is not merely reflected by these sub-themes but seems to be dependent on them (see Hoyle, 2011 on the difference between reflective and formative indicators). In other words, our interpretation is that without shared and complementary mental models, as well as verbal and non-verbal communication exchanges, TC in circus acrobatic might not occur.

In low-risk team tasks, coordination might rely on SMM only. However, in complex team tasks, such as high-risk acrobatics, only shared knowledge is likely not enough to ensure coordination. To this extent, recent research on team cognition in circus suggests that the importance of complementary mental models increases with task difficulty (Filho, Bertollo, Robazza, & Comani, 2015b). Specifically, Filho et al. (2015b) have noted that juggling dyads in circus tend to show both integrative (shared) and segregative

(complementary) intra-team psychophysiological patterns. Noteworthy, the argument that complex tasks, such as high-risk acrobatics, require both shared and complementary knowledge resonates beyond psychology. From swarms of bees to packs of wolves, to cooperative human teams, researchers across domains have noted that the success of complex cooperative tasks relies on both communal and specialized division of labor (Bietti & Sutton, 2015).

There is robust evidence indicating that the information-processing capacity of different species is linearly related to their ability to establish complex cooperative social groups (see Dunbar, 2009). Thus, a theoretical understanding of TC should consider both shared and complementary mental models. In practice, fostering the development of shared and complementary affective-cognitive-behavioral states and patterns in teams might enhance organization of labor in complex tasks across disciplines (e.g., music, sports, and military). If teammates hold communal and complementary feelings (affective), thoughts (cognitions), and behavioral patterns, coordination losses in team tasks are less likely to happen (Filho, Gershgoren, Basevitch, Schinke, & Tenenbaum, 2014; Gershgoren et al., 2016).

With respect to communication dynamics, our findings extend previous work in applied psychology (see Eccles & Tenenbaum, 2004; Gershgoren et al., 2013) by suggesting that verbal communication is essential to the development of *pre-process coordination actions* (i.e., when time pressure is not an issue; e.g., practices), whereas non-verbal communication is key during *in-process coordination actions* (e.g., athletic competitions or artistic shows) in high-stake situations. Furthermore, our results support the

notion that head coaches are essential in facilitating communication exchanges that foster the development of TC in interactive teams (see Hackman & Wageman, 2005).

Our findings expand previous research by suggesting that TC in circus acrobatics is established through the communication of different types of socio-cognitive knowledge (see Garud, 1997). Acrobats verbalize "know-how" (tacit procedural knowledge) and "know-what" (declarative knowledge) information during practices and shows. However, "know-when" (temporal information) seems to be a tacit corporeal exchange established between the acrobats during live performances. Together, knowing "how to do what and when" might help to explain coordination of high-risk dyadic circus acts. In effect, embodied information exchanges among performance artists in other domains, such as music orchestras and sport teams, have also been found to rely on different types of knowledge (Atik, 1994; Filho et al., 2014).

The importance of embodied communication in interactive tasks has been emphasized by different streams of research in psychology, sociology, and anthropology. To this effect, Streeck (2015) has observed that "haptic communication via the torsos, arms and hands (p. 425)" of moving bodies is at the core of in-motion coordination of human bodies. To put it another way, the communication of kinesthetic knowledge seems to be an important "means to the end" of space-time-action synchrony in circus acrobatics. The coordination of joint action in other motor tasks, such as in Aikido, has also partially attributed to moment-by-moment whole body information exchanges (see Lefebvre, 2016). More generally, linguist theorists have noted that in-sync moving bodies suggest in-sync moving minds (McNeill, 2008). Furthermore, shared and complementary thoughts are

revealed through body gestures, and body gestures are revealing of thoughts (see also McNeill, 1992).

It follows that an alternative explanation to our findings is that verbal and non-verbal communication exchanges are part of team members' mental models. Indeed, language (from *langue*) means shared competence that can be expressed through multiple channels including, but not limited to, kinesthetic non-verbal and spoken verbal means (McNeill, 2008). Overall, the role of communication in shaping TC deserves further attention, as human beings can communicate in novel and infinite ways ("the infinite use of finite means"; see Chomsky, 2014). The limitless capacity of human communication, together with the ever-growing evolution of technology, may continuously alter how communication influences TC in both low- and high-risk team activities.

The Role of Collective Efficacy

In the thematic analysis, self- and other's-efficacy emerged as key factors in the establishment of "we" efficacy beliefs. Self-efficacy, other's-efficacy, and CE seem to be intertwined as confidence in oneself, in one's partner, and in the team are likely conditional on one another. Our findings extend previous research by revealing that interactions between the self and another teammate form the basis of CE in dyadic acrobatics. Put differently, self- and other's-efficacy are likely more important in dyadic teams than in teams with more than two members, wherein "effort" and "preparation" have been found to be major predictors of CE (Short et al., 2005). Indeed, team size has been suggested as a moderator of myriad team processes (for a review see Carron, Eys, & Burke, 2007), including collective efficacy beliefs (Feltz et al., 2008). Overall, as Bandura (1997) has

long noted, CE is a task and situation specific construct that changes across domains of human activity.

Team Coordination and Collective Efficacy Linkage

Our findings also suggest that TC is likely inter-related to CE. As such, TC cannot be understood in isolation but rather should be considered in a systematic view, similar to the notion of *reciprocal determinism* and the *many-to-many basis relationship* in applied social psychology (see Bandura, 1997; Cacioppo et al., 2007). This finding reinforces the notion that an integrated view of team dynamics can be advanced by examining the unique underlying mechanisms of higher-order team processes, such as TC and CE (Collins & Durand-Bush, 2015; Filho et al., 2015b). In fact, CE has been described as an emergent state in the sense that it develops through reinforcing dynamic interactions with other team processes, such as TC (Marks, Mathieu, & Zaccaro, 2001).

In light of these findings, we reiterate the importance of advancing a parsimonious nomological network linking inputs, throughputs, and outputs in team dynamics research. In this regard, many theorists have vouched for studies examining the systemic linkage among team processes. More recently, Filho and colleagues (2015b) have noted that team members' mental models and CE are inter-related processes and together influence performance in teams. Accordingly, exploring, through different methodological approaches, how team members' shared and complementary mental models relate to TC and CE could allow for a better understanding of team development, team functioning, and team resilience. Altogether, a parsimonious and systemic view of team dynamics would allow for the development of clear applied guidelines for practitioners.

To the practitioner, our findings suggest that systemic interventions targeting team processes simultaneously may be more beneficial than fragmented interventions aimed at solving intra-group conflict (e.g., social cliques), for instance. Interventions targeting both TC and CE, as well as other team processes (e.g., cohesion, leadership), may yield better results, as more confident teams will likely suffer from fewer coordination breakdowns, and better coordination will further enhance CE.

Limitations

The present study is not without limitations. First, our qualitative inquiry is limited in scope and, thereby, our findings should not be taken as factual "windows to the truth". Rather, our findings represent one of many alternatives to the understanding of TC, its sub-themes, and related team processes. In addition to methodological triangulation, future studies should abide by the idea of "interpretative pluralism" (Coyle, 2010). While methodological triangulation pertains to the use of multiple methods, interpretative pluralism consists of applying numerous analytical outlooks to a given phenomenon (Kincheloe, 2005).

Second, our study relied primarily on group interviews. Although focus group interviews are valuable in eliciting a shared understanding of a given phenomenon, individuals that are more vocal tend to participate more than those who are reserved. Although every effort was made to allow for equal participation, individual interviews would likely have allowed for additional data and findings. We were unable to collect additional data in the form of individual interviews with the acrobats, consistent with the understanding that access to high-skilled performers is usually limited. Further qualitative studies, based on a maximum variation sampling strategy and a grounded theory approach,

might help to advance knowledge on the nature of TC in other acrobatic and sport modalities, and across performers of different skill levels.

Third, given that the majority of our participants were male acrobats, a factor outside of our control, we were unable to qualitatively analyze potential differences in same-gender dyads compared to co-ed dyads. Accordingly, future studies analyzing potential gender effects on the development of TC, and on the observed TC-CE linkage, are warranted as previous research suggests that gender moderates team processes and performance in working groups (Carron et al., 2007; Feltz et al., 2008). Studies on diverse gender and ethnographic populations are particularly important in the field of Sport, Exercise and Performance Psychology, wherein the majority of studies have been on college-aged, Caucasian, male performers (Filho & Tenenbaum, 2015).

Future Research and Applied Implications

From a theoretical standpoint, scholars should continue to strive for the development of an integrated theory of team dynamics, wherein the linkage among TC, CE, cohesion and other team processes (e.g., leadership; motivational climate) is addressed in a parsimonious fashion. To this extent, it might be fruitful to continue studying whether TC and CE coevolve or whether TC leads to CE, or vice versa. More research on a dynamic systems view of TC is also warranted. The emergence of affordances at the team-level of analysis is dependent on the number of degrees of freedom (see Marsh et al., 2009; Silva et al., 2013; Vilar et al., 2012). Dyads are different than larger teams as there is no chance for subgrouping or coalition development. Furthermore, in dyadic circus acrobatics all movements are practiced and rehearsed exhaustively and thus minimal adaptation to the environment is needed. It follows that the role of knowledge (shared and complementary)

and communication (verbal and non-verbal) in promoting TC may differ in teams with more than two members, as well as in open sports where movements are less rehearsed and predictable in comparison to closed sports, such as acrobatics.

From a methodological standpoint, the present findings echo the notion that TC can be measured using different tools (Mohammed et al., 2010). Self-report questionnaires on team cognition, measuring both shared and complementary knowledge, might be useful in advancing knowledge of TC. The degree of similarity (e.g., in-phase coupling) or complementarity (e.g., anti-phase coupling) of physiological responses may also be used as a proxy to understand TC in interactive tasks (Kelso, 2012). Future research should continue to advance this idea by focusing on tasks that allow for the use of position monitoring technology (e.g., GPS, accelerometers) or portable multi-subjects physiological monitoring that can be synchronized in real-time. Furthermore, capturing verbal and non-verbal communication (e.g., verbal, such as voice tone and turn talking; and non-verbal behavior, such as mirroring and mimicry posture) may also yield insight into the understanding of TC. In light of our findings, we highlight the importance of considering the linkage of TC with both "we" (e.g., CE) and "I" factors (e.g., self- and other's-efficacy), and controlling for such effects.

From an applied standpoint, our findings suggest that TC can be developed through myriad ways. Practitioners should promote the development of both shared and complementary models of thinking, while promoting communication skills through both verbal and non-verbal channels. SMM and complementary mental models might be achieved through cross-positional training among teammates (e.g., flyers working as catchers, and catchers working as flyers), the development of pre-performance routines, and

the assignment of unique roles to each team member. Active listening (e.g., direct one's attention to the person communicating) and mindfulness (e.g., defer judgment in decoding the message transmitted) training are possible ways to improve communication in cooperative teams. Finally, boosting teammates' self-efficacy and other's efficacy, through goal-setting and modeling, can help not only in the development of CE but also in the enhancement of TC in dyadic acrobatics.

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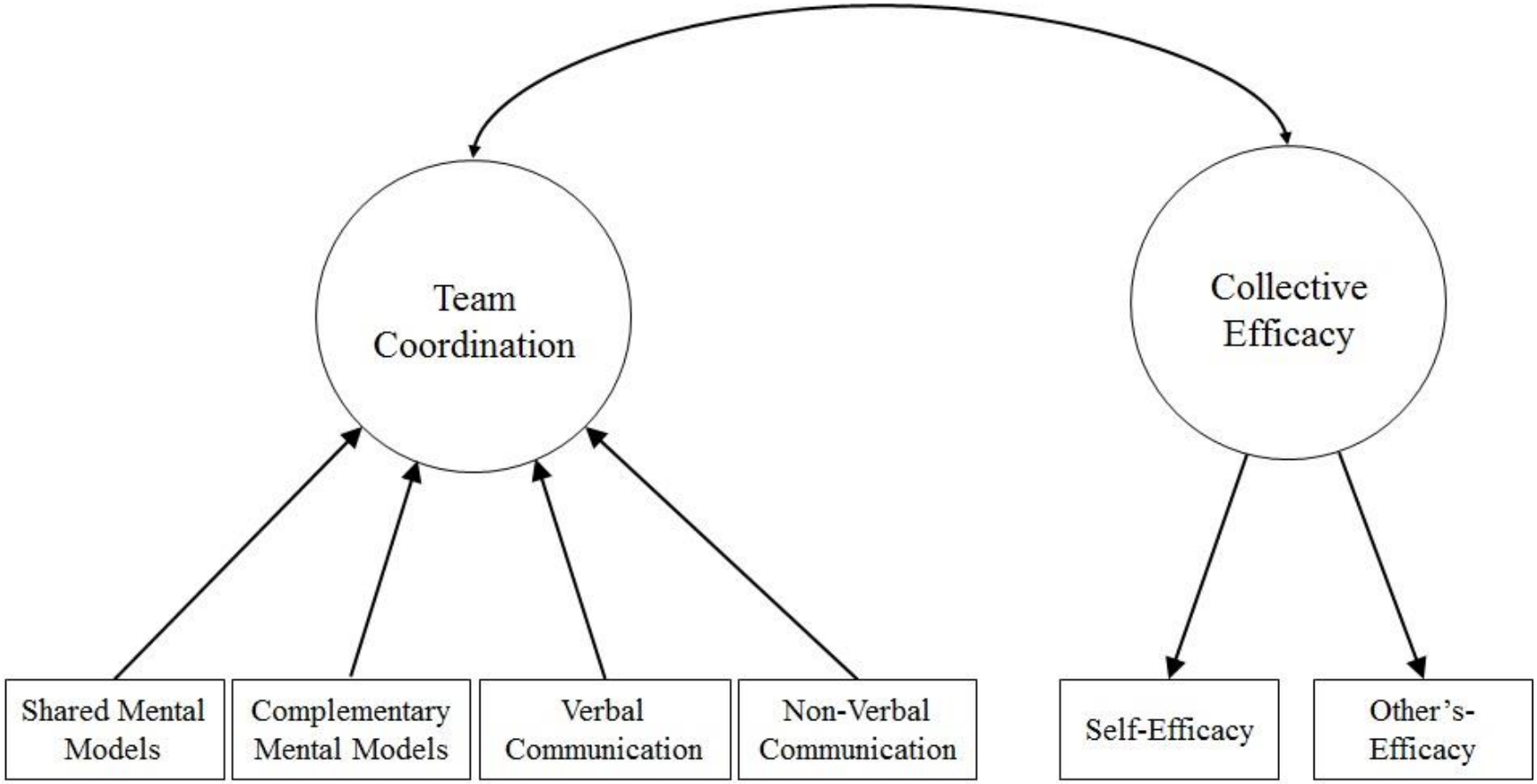

Figure 1. Formative Sub-themes of Team Coordination and Reflective Sub-themes of Collective Efficacy.

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