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LEADERS, TEAMS, AND THEIR MENTAL MODELS

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As we go through our daily lives, work, learn, and perform, we have an unseen mechanism guiding our actions and thoughts. Mental models are an internal representation of our views of the world and include the information we know. As our knowledge grows, we update our internal mental model. These models are useful ways to understand the world, and metacognitively to represent thinking. Mental models are powerful depictions of our place in life and our perspective on society. Essentially, we experience life through mental models, as they provide a framework for new and old experiences, our conversations with others, and our information that drives our choices and outlook on our inhabited domain (Goldvarg & Johnson-Laird, 2001).

Mental models are the building blocks to interactions. They are an integral component to everyday decisions and actions that serve to maintain the effectiveness of teams and organizations (Forrester, 1971). Change-related functions are considered one of the main components of leadership behaviors (see Yukl, Gordon, & Taber, 2002), and leaders' mental models play an important role in these functions. For example, the survival of liberal arts colleges in America in the 1970s and 1980s is partially credited to changes in the leadership's mental models. During this era and the preceding decade, American college attendance sharply increased, but students began to prefer degree areas such as the sciences and professional fields (i.e., business, nursing, and journalism). The liberal arts colleges that refused to adopt professional programs were failing at a greater rate than previous years, while many of the schools that brought in new presidents were able to create professional degree tracks and faced better odds of staying in operation. This change was not always welcome, as it declined to follow the philosophy of liberal arts education, but changes in college leadership sometimes helped to change the universities' program offerings, as the incoming college presidents

brought their previous organization's mental model of professional degrees within liberal arts education. Some of these new leaders came from state universities, some migrated from liberal arts colleges that had adopted professional programs, while others moved from non-selective universities. The college presidents from liberal arts colleges with professional programs and from the non-selective universities tended to adopt professional programs at their new liberal arts colleges, thus making their new colleges more competitive for the changing consumer demands (Kraatz & Moore, 2002). While the strategies of liberal arts colleges are not applicable to every organization, one lesson remains: leaders' mental models are important.

A divergent example is the Egyptian revolution, which occurred in 2011. Mohga Badran, management professor at the American University in Cairo credits shared mental models with the success of the Egyptian Revolution; "this was a leaderless revolution. The vision was the leader. Leadership was not a person. It was a feeling, a mental model, and a vision" (Youssef, 2011, p. 226). The article goes on to describe how the people shared a mental model desiring change in their country after seeing a similar regime change in Tunisia. Throughout the course of the revolution, there was a shifting vision and a shared mental model among citizens guiding them through the spontaneous organization and shifts throughout the course of the revolution that made it successful (Youssef, 2011). Change was achieved through a shared mental model, where leadership was shared among a group of citizens. This same process occurs, though much less dramatically, in organizational teams that share leadership. Thus, shared leadership's mental models are not to be overlooked. Individuals and teams possess mental models, including those that serve as designated and informal leaders. The focus of this chapter is on leaders' mental models, how they form, how they affect the leaders themselves, how they affect the leaders' teams, and how leaders can develop a team's shared mental model.

What Are Mental Models?

Theory of Mental Model

Before continuing with our probe into leaders' mental models, it is first important to define mental models, so that we can all have the same understanding as to their meaning and implications. Mental models are "the end result of perception, imagination, and the comprehension of discourse" (Goldvarg & Johnson-Laird, 2001, p. 566). Essentially, they are defined as cause-goal linkages within an action system applying in some domain. The contemporary and generally accepted definition of mental models comes from a theoretical paper about reasoning, as mental models are a foundational aspect of reasoning (Goldvarg & Johnson-Laird, 2001). Notably, mental models do not apply to any information "represented in the mind", as some earlier articles suggest.

Importantly, mental models are not the only way to consider cognition. Transactive memory states are also used to understand cognition, particularly in teams where they are a way to consider who holds what knowledge (DeChurch & Mesmer-Magnus, 2010). They will not be discussed further in this chapter, but the reader should understand there are other ways of considering the cognition of leaders and teams.

Mental Models Across Fields

Mental models find their origins in cognitive science. They are used to comprehend the world and are particularly applicable for drawing inferences (Johnson-Laird, 1983). In the domain of human factors, mental models are descriptors of current states of a system and are used to predict states in the future of the system (Rouse, Cannon-Bowers, & Salas, 1992). In organizational science, where the authors find their academic roots, mental models usually refer to the representation of the employee's knowledge and how it is related to their environment (Klimoski & Mohammed, 1994). These varying definitions are quite similar in nature; their biggest differences are the subjects of the mental model. In human factors, the mental models of interest center on the system that interacts with human users, while in organizational psychology, the mental models refer to the work-related knowledge that a member of an organization possesses and stores for performance. This domain will be the continuing focus of the chapter. Again, mental models are cause-goal linkages that are applied to some system within a domain (Goldvarg & Johnson-Laird, 2001). Here, our domain of interest lies within team leaders.

In organizational psychology, we generally evaluate an employee's mental model based on its accuracy or similarity to a subject matter expert's (SME) mental model of the same topic (DeChurch & Mesmer-Magnus, 2010). Likewise, in team settings, shared mental models are appraised based on the similarity of one member's mental model to the other members' mental models in the team. Ideally, the cognitive content of the individuals' (either the employee/expert or the teammates in question) should be the same (DeChurch & Mesmer-Magnus, 2010).

Leader's Mental Models

By relying leadership as an influence process, the follower must have cognitive change due to effective leadership. According to Lord and Maher, leadership "involves behaviors, traits, characteristics, and outcomes produced by leaders as these elements are interpreted by followers" (Lord & Maher, 1993, p. 11). Therefore, effective leadership must occur within the context of the followers' interpretations and perceptions. It necessarily includes a cognitive component of a leader's influence on the followers' mental models. This is what differentiates mental models of a lay individual from leaders' mental models. Followers' models must

be modified through the leadership process, through the leaders' mental models (Benson, 2016). Leadership is defined in this chapter as an influence process (Jacobs, 1971), which can be accomplished by one formal leader or shared among the team members, therefore shared mental models will also be considered as an important component.

Leader's mental models are important for their performance and the performance of their teams. Their leadership style goes together with their prescriptive mental models, which translates to sensemaking of the environment and then to visions that are disseminated to the followers. For example, charismatic leaders' mental models focus on the future, while ideological leaders' mental models are about failures and pragmatic leaders' mental models center on pragmatics embedded within a complex system. The focus of these prescriptive mental models affects which population that the leader can most effectively influence, resulting in more distal effects on the leader's performance (Bedell-Avers, Hunter, & Mumford, 2008). Thus, leader's mental models guide information search, indicate causes to act on and goals to be sought. Readers should keep in mind that this is only one path for the leader's mental models to result in performance.

How Are Leader Mental Models Acquired?

Mental models are dynamic entities that need to be acquired and consistently updated with new information (Johnson, 2008). This is especially true for leaders operating in the modern world. Today, forces such as globalization, swift technological developments, and shifts from manufacturing to a service-based economy have combined to create a world of work in which leaders and organizations must constantly adapt (Chell, 2001; Ilgen, 1994; Jarvenpaa & Ives, 1994). For this reason, the following section contains information about the acquisition and updating of mental models, as these updates are necessary for models to remain viable.

Theory

For years the prevailing wisdom told organizations that knowledge creates leaders and that leaders would be more effective if they have more information in their relevant mental models. A more popular recent idea is of transformative learning, the process of editing, pruning, and enhancing existing mental models with new information and knowledge rather than creating new mental models. By integrating the new information into existing models, proponents argue that leaders will be more effective (Kegan, 2000; Mezirow, 1991). A study by McCall, Lombardo, and Morrison (1988) asked leaders to rate the most formative experiences for their mental models as effective leaders. The authors found that leaders reported the most important experiences were challenges and hardships experienced on the job, rather than graduate school, conferences, and workshops. This suggests that job rotation and job enlargement may be effective ways to enhance leader

mental models within the transformative learning framework. However, this is not conclusive evidence, as there is also evidence that training can be effective for updating leaders' mental models.

Biological Basis

Thanks to the marriage of neuroscience and cognition, the modern leader can understand that the right hemisphere is largely at play for creating and updating mental models (Filipowicz, Anderson, & Danckert, 2016). Through neuroimaging and lesion overlay analysis, researchers have been able to find evidence that certain brain regions are used for different components of mental models. The anterior insula preserve the individual's current model, the inferior parietal lobe identifies salient information at odds with the model, while the medial prefrontal cortex decides when to examine new or updated models (Filipowicz et al., 2016). According to researchers at the University of Waterloo, there is a simple three-step process for updating mental models.

Three basic components are required to accurately update mental models: (a) current predictions of a model need to be established in some way, (b) new information must be compared against those predictions to determine model efficacy, and (c) some form of hypothesis generation is required when predictions from a current model no longer lead to optimal outcomes. (Filipowicz et al., 2016, p. 207)

This process happens within each person when updating their mental models, something that must happen continuously to ensure that our predictions according to our mental models are consistent with the information given to us through our environment (Johnson-Laird, 1983). For leaders, this is an especially important process, as their predictions and actions have organizational impacts.

Training

Training leaders is one useful way for them to acquire mental models for their jobs. The construction and articulation of mental models is considered an essential process for leader performance (Marcy & Mumford, 2010). Gaining the appropriate mental model can lead to task performance. One common metric for evaluating and training mental models is to use an expert's model as the standard. Research verifies that a more expert-like mental model results in higher performance (Cuevas, Fiore, & Oser, 2002). Examples of an expert-like and a non-expert-like model can be seen in Figure 11.1. Components of training help to build leader mental models. For example, diagrams within training helped to build accurate participant mental models (Cuevas et al., 2002). The use of diagrams in training also helped participants to make connections across parts

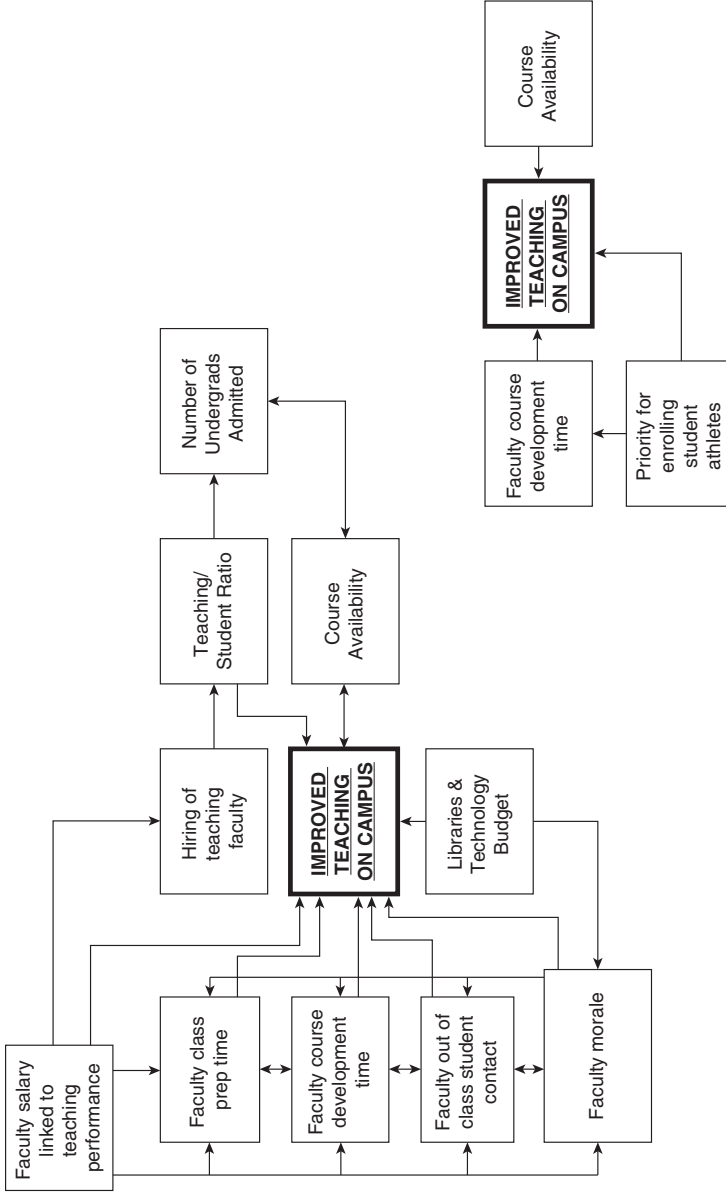


FIGURE 11.1 A More Expert Mental Model (Left) Compared to a More Novice Mental Model (Right); Both on the Subject of Improved Teaching on Campus

Source: Marcy & Mumford (2010)

of a training program in one study, as evidenced by integrative but not declarative knowledge (Fiore, Cuevas, & Oser, 2003). This suggests that individuals, particularly leaders, may unknowingly build their mental models with the help of diagrams within the context of training programs that transfers to other aspects of their work life. This may be particularly important considering that researchers regularly worry that only a small portion of what is trained is applied to the job (e.g., Baldwin & Ford, 1988; Grossman & Salas, 2011; Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012). However, the literature is nuanced. In one study, the results indicate that training directly affects performance measures, actually accounting for the differences between high and low quality models between leaders (Marcy & Mumford, 2010).

Coaching

Similar to double-loop learning, double-loop coaching is used to improve the mental models of leaders (Witherspoon, 2014). It is argued to be better suited for building and altering mental models because of its metacognitive nature. Born from executive coaching, there is some support for this type of leadership development (Witherspoon, 2014; Witherspoon & White, 1997), but it is still in its infancy and needs to be studied more (Gosling & Mintzberg, 2006). The three components to this style of coaching are reflection, reframing, and redesigning. When leaders are asked to reflect during a coaching session, they think about their behavior as leaders and their automatic reactions. This method is based on the reflection-in-action model (Schon, 1984). Coaches ask their clients questions like “What did you or others learn from the situation (e.g., about each other’s perspectives and challenges, their impact on others or the issue itself)?” or “What did you say or do that was particularly important in determining the results?” (Witherspoon, 2014, pp. 4–5). These questions probe into the leader’s thought process, allowing them to consider what happens throughout the course of their leadership and why. Reframing, the next element of this coaching framework, asks leaders to examine their schemas and thoughtfully modify or keep existing ones. This can be intrapersonal, interpersonal, or task-related in nature. Questions like “How do you see yourself/others in this situation—your/their roles and responsibilities, your/their intentions and actions to date, the impact others have on your skills/their skills, what you/they are up against, etc.?” and “How do you see the task at hand—your goals, needs, aspirations, and expectations in the situation you face—simply, what are you trying to accomplish?” help the coach and the leader to understand the leader’s mental models of themselves, others, and the tasks (Witherspoon, 2014, p. 5). Redesigning is the last step in the double-loop coaching process. Here, leaders take the thoughts and behaviors that they identified in the first two steps and implement any needed changes. This culminates to result in modifications to the leader’s mental models and attitudes at work across a potentially wide variety of topics and situations.

Leadership Development

Academics and scholars define leadership based on a variety of theories that have become standards for approaching leadership. Implicit leadership theories (ILT), the models of leadership unconsciously within individuals, are thought to develop throughout childhood (Antonakis & Dalgas, 2009; Ayman-Nolley & Ayman, 2005). By considering these perceptions of one's prototypical "leader", leaders can make their own mental models more explicit. This allows them to know themselves better and develop as leaders in a self-directed manner (Hall, 2004). One of the key components to this process is the use of metaphors as the leader is describing their style. According to scholars, metaphors are useful because they are a distilled version of conceptual understanding, although there is still debate about how they work within the context of cognition (Cairns-Lee, 2015; Lakoff & Johnson, 1980). Metaphors work together with modeling and clean language for the leader to understand their own mental models, and therefore develop those models more thoroughly. Modeling is the actual behavior that is trying to be uncovered, referring to the subconscious following of experiences, lessons or other leaders in a leader's own leadership behavior. Through metaphors, the leader at hand will pay attention to their own perspective and make sense of their view (Lawley & Tompkins, 2000). Then by explaining the metaphors of leadership with clean (non-metaphor) language, the leader discovers their own mental model of leading (Cairns-Lee, 2015). Clean language helps "To acknowledge clients' experience exactly as they describe it, to orientate clients' attention to an aspect of their perception, and to send them on a quest for self-knowledge" (Lawley & Tompkins, 2000, p. 52).

When leaders develop from a novice to an expert, they rely less on working memory, ILT, and heuristics. By practicing their leadership skills, leaders develop domain-specific knowledge and contextualize problem solving. Leadership skill develops as leaders practice, experience, and reflect on their leadership role, thus building their mental models. Both the actions and reflections are important for developing leader's mental models. This results in less time needed for searching for solutions to future problems as leaders become experts; however, expert leaders spend more time than novices on interpreting situations and planning actions. Leaders' mental models contain their problem-solving knowledge, guide interpretation of an environment, and prescribe the skills associated with leadership including task, emotional, social, identity level, meta-monitoring, and value orientation (Lord & Hall, 2005).

Leader Mental Models' Impacts on Leader Performance

Individuals' mental models act as a perceptual filter through which information is passed. The same is true for leaders, however they are in a unique position of power within their organizations. This allows for their mental models to have

widespread effects throughout the organization and interpersonally (Ritchie-Dunham & Puente, 2008). Leaders' mental models are important for vision formation, a step towards planning, goal achievement, and performance. Leaders' mental models affect their performance on all ends of the task spectrum, from guiding information searching to facilitating effective task monitoring (Partlow, Medeiros, & Mumford, 2015).

Leader Level

Vision and Sensemaking

Leaders, particularly top management, are responsible for creating a vision for the organization. This vision serves to set a unified outlook on the future that provides meaning to the organization's work for the employees (Klein & House, 1995; Meindl, 1990; Shamir, House, & Arthur, 1993). Besides guiding the future, a leader's vision also creates a present culture within the organization and helps members face contemporary challenges (Hunt, Boal, & Dodge, 1999; Jacobsen & House, 2001). This is true as related to sensemaking, the process of reducing complexity to understandable mental models (Daft & Weick, 1984; Walsh, 1988). Especially in times of crisis or challenge, sensemaking is vital for organizations (Combe & Carrington, 2015). Leaders first rely on descriptive mental models and then evolve toward prescriptive mental models, which is the foundation of vision formation (Mumford, Friedrich, Caughron, & Byrne, 2007; Mumford & Strange, 2002). This way mental models affect sensemaking during crisis via vision. One study found that leaders' visions were actually more impactful when their mental models were simple, not when they were complex. The authors explain that too much information can be distracting rather than useful (Partlow et al., 2015). They also touch on the cognitive limits of both the leader and followers, which can be challenged by a complex, rather than straightforward, vision (Ericsson, 2009).

Forecasting

Forecasting, an often overlooked leadership skill, is essentially prediction of future events for individuals, groups, or organizations that is specifically not tied to a goal (Mumford, Schultz, & Osburn, 2002; Mumford, Schultz, & Van Doorn, 2001). Forecasts have their roots in leaders' mental models because they are based on information about cause and effect within the leaders' cognition (Goldvarg & Johnson-Laird, 2001). They are also related to leader performance because understanding the current and future state prepares the leader for action. Forecasts are also related to vision, mentioned before, through prescriptive mental models. Figure 11.2 shows the model of forecasting developed by Mumford and colleagues in context with other cognitive processes (Mumford, Steele, McIntosh, & Mulhearn, 2015).

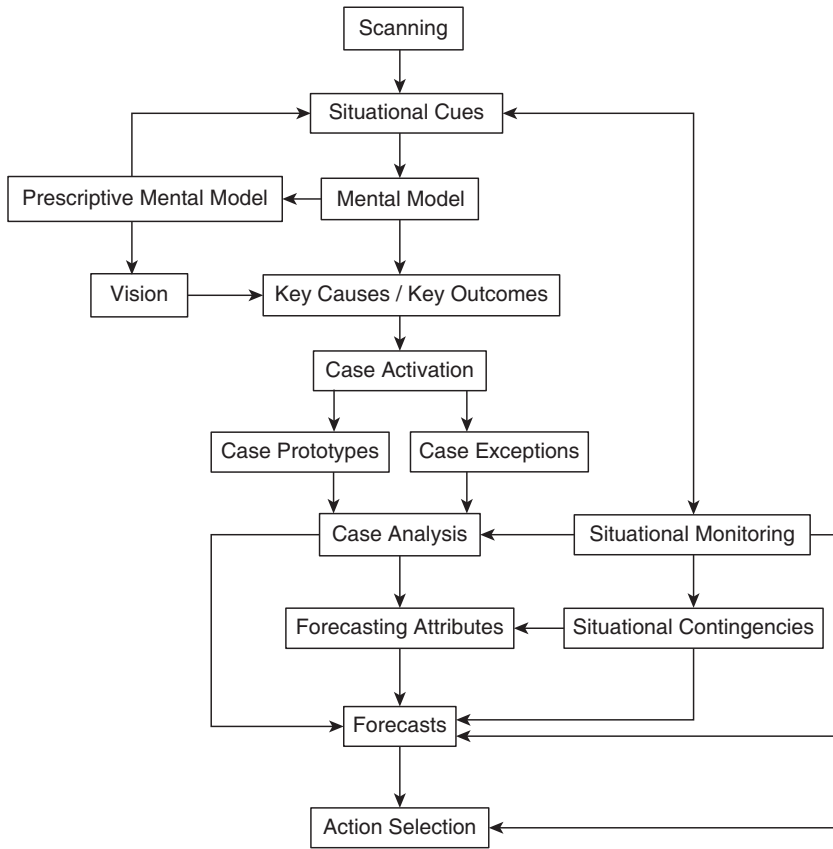


FIGURE 11.2 Model of Forecasting

Source: Mumford et al., 2015, p. 5

Leader–Leader Interactions

Leadership literature established that leaders and their followers tend to have different types of interactions depending on the leaders’ style (Dansereau, Graen, & Haga, 1975). For example, charismatic leaders tend to be more interpersonally driven while ideological leaders tend to be more firm with their values and standards (Strange & Mumford, 2002). Interactions between leaders is largely related to leadership style, which is based on mental models (Bedell-Avers, Hunter, Angie, Eubanks, & Mumford, 2009). These mental models have five distinguishing components based on the style of leadership crisis: condition, sensemaking, type of experience, targets of influence, and locus of causation (Bedell-Avers et al., 2009; Mumford, 2006). One historiometric study of civil rights leaders found that

charismatic, ideological, and pragmatic leaders interact with leaders outside of their mental model of leadership differently compared to their followers.

Charismatic and pragmatic leaders, for example, appear to capitalize on the strengths and weaknesses of other leaders in a manner that better serves their goals. Ideological leaders, in contrast, remain loyal to their beliefs and values and appear to be unfaltering in their vision commitment—despite the best efforts of both charismatic and pragmatic leaders.

(Bedell-Avers et al., 2009, p. 313)

Therefore, leader mental models are the basis not only for the leader's interaction with their followers, but for their interactions with other leaders.

Organizational Level

Organizational Learning Culture

Leaders' mental models shape organizational learning culture. In turn, this can change the direction and mental models of an organization. There are three types of organizational learning cultures, which combine to create or modify mental models at the organizational level (Tran, 2008). Reflexive learning is primarily used by companies in stable markets and by governments, which do not have much need for development or change (Salancik & Meindl, 1984; Starbuck, 1983). Rather, reflexive learning focuses on sustainment through guarding traditions, values, and existing infrastructure. Leaders are imperative to the creation, change, and sustainment of culture, so they therefore also have an impact on the models developed through the context of learning culture (Tran, 2008). Single-loop learning, or bounded learning, refers to the impression of a static organization and context with direct causal arrows between phenomena (Slater & Narver, 1995). Organizations that know their customer base well, follow established rules, and guide innovation with values may fall into this category (Tran, 2008). The last type of organizational learning culture is called second-loop or critical learning; it is distinguished by its willingness to “unlearn” bias from tradition and values of the organization (Hedberg, 1981; Weick & Westley, 1996). This type of learning culture is the most radical and is most useful to organizations who need improvements. Critical learning can be exemplified by IBM's transition from computer manufacturing to consulting for businesses due to the realization that technology service was a growing industry. Their focus on customer service allowed for a successful adaptation of organizational mental models due to leader-directed culture change in a knowledge-based economy, driven by globalization and technological advances (David & Foray, 2003; McGregor, Arndt, Berner, Rowley, & Hall, 2006; Von Krogh, Ichijo, & Nonaka, 2000). In this environment, leaders' mental models

can impede or promote innovation. Simply by living in the past and not understanding the nuances of the global market, leaders can hamper innovation and progress for their organization. By aligning their mental models of the economic and cultural landscape of the contemporary world, leaders can reduce the effects of this potential barrier to innovation (Johannessen & Olsen, 2010).

Ethics

Mental models are not necessarily accurate depictions of the world, as they are subjective in nature. Therefore there is also an element of social construction to these models (Werhane, 2008). The potential incompleteness of these models means that individuals tasked with decision making (especially leaders) may have “blind spots” related to information, particularly ethics (Bazerman & Chugh, 2006). These ethics blind spots within leaders’ mental models can affect those within and outside of the organization. According to one argument, leaders in middle or lower management are particularly vulnerable to these oversights because they are so concerned with looking incompetent that they never question the ethics or morality of their actions at risk of a reduction in performance (Moberg, 2006). One author uses Walmart as an organizational example. The typical stakeholder map of an organization includes suppliers and employees but does not delve further to examine supplier’s sweatshop workers, a relevant ethical concern for consumers. Moral imagination, “the ability to discover, evaluate and act upon possibilities not merely determined by a particular circumstance, or limited by a set of operating mental models, or merely framed by a set of rules” allows leaders to question and expand their mental models to address ethical issues (Werhane, 1999, p. 93). Therefore, mental models can take a systematic approach by including previously forgotten components (e.g., sweatshop workers), and leaders may revise and build their mental models according to moral imagination to reconsider their organization’s role within the broader global society (Werhane, 2008). Leaders are in a unique position to redirect their organization’s path to avoid or amend overlooked ethical considerations.

Relatedly, there has been a cultural shift in organizational expectations in Australia with a push towards corporate social responsibility (Lindorff & Peck, 2010). Leaders of the financial structure had their mental models examined through qualitative interviews with researchers. They discovered that the sample of leaders’ mental models were more closely aligned with the shareholder model rather than the stakeholder model. However, other research suggests that leaders whose mental models support their organization’s social responsibility and fairness have greater engagement, commitment, and satisfaction from their employees (Lindorff & Peck, 2010). This combines “to create an organizational climate for CSR which contributes to a firm’s overall social reputation” (Aguilera, Rupp, Williams, & Ganapathi, 2007, p. 840). Therefore, leaders’ models can hinder and support ethics in an organization.

Leader Mental Models' Impacts on Team Performance

Leaders' mental models impact their teams' performance (e.g., Dionne, Sayama, Hao, & Bush, 2010; Zaccaro, Rittman, & Marks, 2001). Although not specified, topics discussed previously have explicit (vision, sensemaking, innovation, etc.) implications for those working under the leader. So far, the focus has been primarily on designated leaders, but the focus will begin to include information about leadership that is shared rather than given to one member exclusively. This type of team is becoming more common. Self-managed teams, common in fields where innovation is key, sometimes share leadership among members by dividing responsibilities based on expertise (Moe, Dingsøyr, & Dybå, 2010). However, shared leadership is a spectrum for which leader mental models refer to the shared, team mental model, not to one individual's model. Therefore, some teams with shared leadership have high levels of performance while others have lower performance (e.g., McIntyre & Foti, 2013). This was found to be true in a sample of church paid and volunteer leaders, for whom shared task mental models of goals and decision processes were predictors of the church's financial standing, accounting for about 30% of the variance in the church financial well-being (Solansky, Duchon, Plowman, & Martínez, 2008). This study demonstrates the useful, objective organizational outcomes from the team's shared mental models.

One of the pathways for leaders' mental models affecting their teams' performance is through the capabilities allotted to the team. Specifically, leaders who have the power to choose their team members and allocate resources to their team hold the potential to impact their team's performance (Ritchie-Dunham & Puente, 2008). These choices are all based on the leader's model of the team's needs and ideal composition, which may be accurate or less than accurate. Additionally, participative leadership styles, in which the leader and the followers make decisions together, has been shown to increase the team's mental model convergence. This people-focused leadership, which contributes to team mental model convergence, then leads to team performance when combined with members' diversity in expertise and the team's collective confidence (Dionne et al., 2010). One article argues that transformational leadership is a type of participative leadership style, which should increase the team's mental model convergence per Dionne et al. (2010). This study found that followers' perception of the leader's transformation leadership was predictive of the teams' performance (Braun, Peus, Weisweiler, & Frey, 2013). Therefore, it seems there is an effect of leadership style on team performance through shared mental models; in particular, transformational leadership demonstrates this effect in work teams.

Another pathway between leader mental model and team performance is through information exchange. Marks, Zaccaro, and Mathieu (2000) found that the more information given to leaders during a briefing resulted in greater mental model similarity within the team. Their study compared adaptive performance between teams whose leaders had been briefed and teams whose leaders had

not been briefed. In their study, they found that leaders' knowledge was communicated to their teams, which was thought to positively influence team mental model development (Marks, Zaccaro, & Mathieu, 2000). Thus, there is evidence that leaders' mental models may promote adaptive team performance.

Decision Making

Leaders, just like all people, are susceptible to cognitive biases that can result in poor decisions. Given a leader's inherent informal or formal power in the organization, a leader's decision making may be more consequential to the team's performance relative to a follower's decision making. In this way, leaders' mental models have a pathway to affect their team's performance. According to research on expert decision makers, mental models allow for a cognitive simulation of possible outcomes. The quality of the mental model is the key to effective decision making, rather than a trait of the decision maker (DiBello, Lehmann, & Missildine, 2011). This is key information for those looking to improve their leadership abilities. By reducing gaps in information, a leader can bolster their own mental model to make more informed and, presumably, better decisions.

One guide to decision making says that (1) self-awareness, (2) development orientation, (3) systems perspective, (4) emotional orientation, (5) complexity, and (6) generative conversation together produce decisions characterized by discovery and collaboration (Benson & Dvesdow, 2003). Self-awareness helps the leader to understand their own strengths and gaps in knowledge and understand. Development orientation is also referred to as "learning orientation", where the preferred outcome is gaining skills rather than immediate performance. Systems perspective recognizes the world as a "thousand-way interaction" of organizational, cultural, and societal factors (King, 2017). Emotional orientation overlaps with emotional intelligence, or understanding and managing one's and others' emotions (Davies, Stankov, & Roberts, 1998). Complexity considers the roles of a decision's shareholders. Generative conversation stresses a lack of judgment paired with listening and asking questions to understand solutions to the decision at hand. According to theory, these six facets are important for decision making that is holistic and sensitive to multiple perspectives (Benson & Dvesdow, 2003).

According to a qualitative, thematic analysis on collaborative information seeking during team decision making, leadership is an integral part of developing a team's mental model at different parts of the process. One participant discussed the benefits of a leader at the start of a project. The leader encourages the team to come to a shared understanding of the overall goals rather than each member attempting their own part without knowledge of others' roles (McNeese, Reddy, & Friedenber, 2014). The leader's behavior sets the team up for successful coordination throughout the project. The team is able to get a sense that "everything is laid out, everyone's on the same page, you don't really, like you don't waste any time, it's more efficient", per one participant in McNeese et al. (2014).

This efficiency translates to more productive teamwork. This higher performance quality is spurred by the team's leader via the team's mental model. Additionally, the leader also helps manage conflict within the team (McNeese et al., 2014). From meta-analytic evidence we know that conflict management is important for success as a team, as interpersonal conflict and conflict on how the task is completed (process conflict) are negatively related to team performance (O'Neill, Allen, & Hastings, 2013). However, when the team has high psychological safety, or the members feel comfortable for interpersonal risk-taking, then conflict on the task itself can benefit the team's performance (O'Neill et al., 2013). The team leader should harness this knowledge and protect their team's performance from relationship and process conflict while building psychological safety so that task conflict can allow their team's performance to thrive.

Shared Team Mental Models

Leaders are not the only ones on a team that must develop a high-quality mental model; every member of the team should develop a mental model that aligns with one another's, which is known as a shared mental model (SMM), team mental model, or team cognition. Specifically, SMMs are defined as "knowledge structures held by members of a team that enable them to form accurate explanations and expectations for the task, and in turn, to coordinate their actions and adapt their behavior to demands of the task and other team members" (Cannon-Bowers & Salas, 2001, p. 228). In other words, it means that everyone on the team is on the same page, reducing ambiguity and making it easier to anticipate each other's actions.

There are four types of mental models identified by Cannon-Bowers and Salas (2001): (1) task-specific knowledge (i.e., grasping the specific procedures and actions required to perform a task), (2) task-related knowledge (i.e., awareness of team member roles, interdependence, and responsibilities for the task) (3) knowledge of teammates (i.e., understanding information about the other team members such as their skills and preferences), and (4) knowledge of attitudes or beliefs (i.e., familiarity with each other's values and motives related to work). Zaccaro, Rittman, and Marks (2001) explain that the combination of these types are the building blocks to form a team interaction model:

The prescribed roles of team members need to emerge from a consideration of (a) the equipment or other materials that team members will use in completing subsequent collective tasks, (b) the specific task requirements that must be addressed through collective action, and (c) the task-relevant characteristics of team members that help define the contributions each can make to successful collective action. The strategies and tactics that emerge from a consideration of these factors, their moderating contingencies, and specific roles of each task member in particular action plans become

incorporated into the team interaction model. The quality and elaboration of this model is associated with how well team members will be able to coordinate their subsequent activities.

(p. 460)

Cannon-Bowers, Salas, and Converse (1993) identify SMM as one of the main coordinating mechanisms for effective teamwork due to the reduction in overt communication required for performance. That is, a shared understanding of the topic or problem at hand reduces the need for blatant discussion. In addition, extensive research has linked it to improved team performance (DeChurch & Mesmer-Magnus, 2010; Marks, Sabella, Burke, & Zaccaro, 2002; Marks et al., 2000; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Smith-Jentsch, Mathieu, & Kraiger, 2005). DeChurch and Mesmer-Magnus (2010) demonstrated meta-analytical evidence that across a variety of team types, team cognition positively predicts team task-related processes (e.g., planning, goal setting, and coordinating), motivational states (i.e., shared reactions of the interpersonal aspects of the team), and performance.

According to McComb (2007), the process of developing a shared mental model requires that an individual shift from an individual perspective about the team to a team perspective. This involves three phases: (1) the orientation phase, (2) the differentiation phase, and finally, (3) the integration phase. The orientation phase consists of becoming familiar and aware of the team situation and individual ideas and opinions. During the differentiation phase, team members form their ideas of the team and respond to each other's opinions, and then in the integration phase they form a collective focus from their individual perspectives.

The Leader's Role in Developing a Shared Mental Model

The leader plays a crucial role in developing a strong SMM (Dionne et al., 2010). In this section, we describe how a leader is involved in the process of shifting individual mental models to the team level. The leader is involved in influencing, developing, and sustaining an SMM through (1) encouraging effective communication patterns, (2) implementing specific leader behaviors, and (3) providing shared experiences.

Communication

Communication, in general, influences the creation of an SMM a great deal. Specifically, the quality is more important than the frequency (Marlow, Lacerenza, Paoletti, Burke, & Salas, 2018). Team members, including the leader, should share unique information as opposed to common knowledge. Although this seems intuitive, oftentimes team members may feel discomfort sharing information that they think could deviate from what the team already has established, resulting

in groupthink rather than having an accurate understanding of the team's task-related problem and solution (Janis, 1982). The studies described later elaborate on methods of how to communicate effectively.

DeChurch and Mesmer-Magnus (2010) suggested that leadership is probably one of the most instrumental factors in molding a team's cognition. Leaders can use communication to enhance the team's SMM. Marks et al. (2000) empirically demonstrated how leader briefings and team interaction training can do this. Their study on team adaptation to novel environments involved 79 three-person undergraduate teams playing a computer-based tank war-game simulation. Before each round of performance, the teams either participated in an enriched briefing with the leader (i.e., the leader communicated knowledge about aspects of the task environment that were important) or a standard informational leader briefing. This manipulation was induced to compare the quality of a leader's communication on the team members' similarity and accuracy of their mental models about the team task. The teams also received either team-interaction training to teach participants how to effectively interact on a team, or a control video that only addressed the task information. Both interventions (i.e., enriched briefing and the team-interaction training) had a positive impact on the similarity and accuracy of the team's cognition.

Visibly, these findings suggest that a leader should conduct enriched leader briefings that provide contextual information about a new task. But it also implies that the leader should support the practice of training for their teams because leader buy-in and support bolsters the impact of team training on the team (Goldstein & Ford, 2002). The study acknowledges that it only focused on pre-mission communication, but that leaders can continue to be involved throughout the lifespan of a team's task. Therefore, the influence of a leader on SMMs may not stop at briefing prior to a performance episode.

A leader can communicate the team's purpose and specific tasks through one-on-one communication to individual team members or through plenary meetings with the entire team. Sætrevik (2015) found that in emergency response teams, their shared beliefs were associated with their specific team, rather than their specific role. He believes this could have been due to leader behaviors and their communication patterns because the leaders had the role to task the team and share information on their priorities during one-on-one meetings and brief meetings. However, he could not discern whether the one-on-one meetings or status meetings had more of an impact on the team's shared beliefs, and suggests that future research should analyze whether the communication structure makes a difference.

Another example of a leader's indirect impact on establishing an SMM is a longitudinal study on 51 database design teams, by He, Butler, and King (2007), which found that frequency of meetings and phone calls were positively related to the development of SMMs. However, email exchanges did not show any effect. Similarly, Sætrevik and Eid (2014) note from their field studies on emergency

management teams, that even if a leader is well-informed, the team's similarity index score can be negatively affected if they do not effectively communicate their knowledge about the team's work, goals, and priorities, in turn, lowering their SMM. Leaders can draw from the conditions that positively influence the team's cognition and implement it in their own teams. Given the findings from He and colleagues' study, leaders should facilitate face-to-face meetings and phone calls more than emails to convey valuable information.

Zaccaro et al. (2001) emphasize the importance of a leader's ability to effectively communicate their mental model to influence the team's SMM. They point out that first, the leader must execute sensemaking (i.e., comprehend and make meaning of the team's situation; Weick, 1995) and then they need to complete sense-giving processes, which includes determining crucial environmental cues and relating them to the team's context and forming a coherent framework. Then, quite possibly the most critical step is to communicate this knowledge to the team. Providing the teammates with the environmental cues, explaining how they are critical to the team's performance can positively guide the development of the team members' SMM (Burke, 1999; Marks et al., 2000).

After Action Review

Communication must be carried out effectively. If a leader does not fully comprehend his or her own mental model, then the leader cannot properly induce a shared mental model for the team. A simple communication strategy that is highly effective, affordable, and underutilized is conducting a debrief, or after-action, review. When conducted correctly, it can improve team performance by 25% (Tannenbaum & Cerasoli, 2013). Leaders play a large role in the debriefing process. Before the debrief, leaders need to be aware of how employees are performing during the job. They should make note of serious failures or preventable errors so that the most critical areas of improvement are discussed, and constructive feedback can be provided. This is also an opportunity for leaders to point out any successes and express gratitude for hard work. Positive feedback can help employees feel appreciated and recognized by upper management. During the debrief, they should start by covering the team's mission and objectives and then discuss previous performance. Leaders must help guide team members through self-discovery by asking questions rather than talking at them. They should also structure the debrief to focus on issues that are relevant and uncover solutions (Reyes, Tannenbaum, & Salas, 2018). A conditional element that must precede a debrief is having a psychologically safe environment. Psychological safety is the shared belief that it is safe to take interpersonal risks and speak up, even if the idea is unpopular (Edmondson, 1999). Leaders can foster psychological safety by admitting their own faults. These practices can help ensure that the team is all on the same page.

Using strategic communication (e.g., debriefing, planning, and sense-giving) can even foster the development of multiteam system collective cognition. Multiteam systems are two or more teams that work interdependently to accomplish shared goals (Mathieu, Marks, & Zaccaro, 2002). Murase, Carter, DeChurch, and Marks (2014) study on multiteam systems found that leader strategic communication enhanced coordination between teams by helping followers establish accurate mental models. Therefore, a leader's approach to communication can have much larger impacts than just the SMM development of a single team.

Leader Behaviors

Leadership style can also influence the convergence of mental models from the individual to the team level (Dionne et al., 2010). Dionne and colleagues compared leader-member exchange (LMX) theory to participative leadership. LMX suggests that leaders can have either high- or low-quality exchanges with their followers (Graen & Uhl-Bien, 1995). The more effort and loyalty a follower displays, the more valued they are by the leader, in which case the leader provides them with more freedom and influence on the project (illustrating high-quality exchange). Those who do not show the same productivity and efforts have low-quality exchange. Followers with low-quality exchange need more guidance and consequently do not have as much to contribute of their own. The participative leadership approach, on the other hand, is when the leader exhibits the same behaviors toward all team members—treating them equally (Koopman & Wierdsma, 1998). Using an agent-based simulation model of team development processes, Dionne and colleagues (2010) found that the participative leadership approach did a better job of promoting SMM development. Participative leaders encouraged connections for all team members to create a fully connected network, rather than having an “inner circle” with outsiders.

Sætrevik (2015) also suggests that leadership style can influence how teams find motivation, form relationships, and share information to form shared beliefs. Particularly, he noted that transformational leadership (i.e., leaders who inspire followers and lead by example; Eid et al., 2004) styles may have this effect.

In a sports context, Filho, Gershgoren, Basevitch, Schinke, and Tenenbaum (2014) explained that a team leader needs to have open communication about the team's performance, and that she needs to provide her information on her field observations, as well as messages from outsiders of the team (e.g., coaching staff). It is also the leader's responsibility to demonstrate social support and relay efficacy information to motivate the team and elicit shared affective states (e.g., mutual support). Other team contexts can also benefit from a leader exhibiting this kind of behavior. The leader is in a unique position to have a motivational role on the team, which can influence how they motivate each other and find a shared meaning in their team's work.

Shared Experiences

Experience over time can help team members have more similar cognitions about the team and their task. Kivlighan, Markin, Stahl, and Salahuddin (2007) found that in a group leader training program, the trainees' cognitive models become more like the experienced group leaders' over time. Socialization, or interpersonal interactions between team members, can provide experiences for the team to communicate information verbally and nonverbally. This allows team members to become familiar with one another, form the team climate, and facilitate knowledge sharing for the task (Brown & Duguid, 1991).

A survey of research and development teams from high-tech companies in India concluded that internal group communication and mutual cooperation were key factors for developing SMMs and discussed how collaborators' experience with each other over time can help them become familiar with one another and the interdependent task (Misra, 2011). This shared knowledge can facilitate their task and teamwork. Geographically distributed teams can have more difficulty partaking in these developmental experiences because they are not usually in the same place at the same time. Diverse team members from different backgrounds might also have fewer shared experiences when starting out in a team, reducing their common understanding of a task. Although this lack of similarity could initially lead to conflict, once the team has formed, they can participate in shared experiences to resolve any issues or misunderstandings, while maintaining any creative strategies that are cultivated from having diverse perspectives (Skilton & Dooley, 2010).

Coleadership, Shared Leadership, and Shared Mental Models

Organizations are increasingly using teams to solve complex problems that cannot otherwise be solved by a single individual. Teams are made up of two or more people who work interdependently to accomplish a common goal (Salas, Dickinson, Converse, & Tannenbaum, 1992). A common practice in organizations is for teams to have more than one leader (Miles & Kivlighan, 2008). When a team has coleaders, the leaders can be conceptualized as their own pair or team. In which case, the coleaders, themselves, must form a shared mental model. Miles and Kivlighan examined undergraduate intergroup dialogue groups with graduate students, faculty members, and affiliates of the university as coleaders to understand the coleaders' mental models on influencing the overall group's productive group climate (i.e., high member engagement, low avoidance, and unresolved conflict; MacKenzie, 1983). They found that over time, the coleaders had more similar mental models about the group, and that the more similar their mental models were, the more productive group climate was. Also, the similarity of mental models was positively related to immediate increases in group engagement in

following group sessions. They suggest that the required pre-group preparation and discussions between the coleaders may have possibly contributed to the convergence of their mental models. Other researchers also share this idea that allotting time for discussion helps facilitate the development of a shared mental model (Fiore & Schooler, 2004; Yalom, 1995).

Similar to coleadership is the idea of shared leadership. Rather than leadership existing solely as a hierarchy with one person in charge, it can also exist laterally, distributing leadership throughout members (e.g., shared leadership). Shared leadership is a form of team leadership, which is defined as the skill of motivating and developing a team, as well as assessing team performance and guiding the team through their lifespan (Salas, Sims, & Burke, 2005). Yammarino, Salas, Serban, Shirreffs, and Shuffler (2012) identify shared leadership as all members equally contributing to decision and actions. Shared leadership provides members with equally distributed influence on the team (Ensley, Hmieleski, & Pearce, 2006; Mehra, Smith, Dixon, & Robertson, 2006; Pearce & Sims, 2002).

In order for a self-managed team to effectively promote shared leadership, there are a couple of mental model conditions that need to be met. First, the team members must have a shared expectation of what occurs during specific situations and who is supposed to lead at that point (Burke, Fiore, & Salas, 2003; Klimoski & Mohammed, 1994). Then, they must maintain flexibility in their mental model to ensure that they are using the most efficient and effective strategy, rather than just sticking to a norm that might not be the best approach (Burke et al., 2003). Facilitating metacognition, or adapting and monitoring previous interpretations of a team's leadership responsibilities (Garner, 1994), allows the team to modify the current mental models in order to fit the context of their current situation (Burke et al., 2003).

Establishing shared leadership can also have implications for strengthening an SMM among team members. Particularly, shared leadership could possibly lead to more team satisfaction and team effectiveness through the mediation of an SMM. Implementing shared leadership provides an atmosphere that allows all team members to speak up and share unique and useful information. When team members are given leadership responsibilities, they are more likely to express their ideas to contribute to the team's goals (D'Innocenzo, Mathieu, & Kukenberger, 2016). In turn, having more leaders can improve team knowledge distribution (McIntyre & Foti, 2013).

In military ad-hoc teams without an appointed leader, it was found that simply including a brief ten-minute team strategy discussion positively influenced the development of an SMM, team processes, and team performance (Dalenberg, Vogelaar, & Beersma, 2009). The members of these teams, compared to the control teams who did not receive instructions to hold brief team strategy discussions, demonstrated more initiative and leadership. These examples demonstrate how giving team members the freedom to speak up and step up as leaders can foster a strong SMM.

Future Directions

From our exploration into leaders' mental models, we can see that much progress has been made in recent decades to advance our understanding of how leaders, non-leaders, and teams hold and process information in the form of mental models. However, there are still gaps in the literature that future research should address. Specifically, there is room for advancements in methods of studying mental models, replication studies, and empirical advancements.

One method that can be used for future studies is heart rate variability. It was shown to be a good metric of executive function when determining a team's shared beliefs, a highly related construct to SMM (Sætrevik, 2015). Future researchers can make strides by understanding how the brain is able to update mental models with new information. Tools such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) may be useful in this pursuit (Filipowicz et al., 2016). There were also calls for replications of studies. One such request came from a study that used a mostly male sample of Israeli research and development teams to find that high transformational leadership attenuated the relationship between skill heterogeneity on the team and the team's shared mental model. The authors would like the external validity of their finding to be tested in more gender-diverse contexts, particularly those in other cultures (Reuveni & Vashdi, 2015). Another study found that the relationship between learning organization and quality commitment was moderated by LMX, but advises future researchers to investigate this effect in an exclusively manufacturing sample (Choi, Kim, & Yoo, 2016). We would like to add the possibility of replicating this study in other industries, such as the service industry.

Updating mental models can be better understood from an organizational lens, too. There is an opportunity for understanding how knowledge transfer, a precursor to mental model updating, differs according to type and complexity, particularly as it applies to tacit knowledge (Krylova, Vera, & Crossan, 2016). Additional room for literature advancement lies in the team goal mental model domain, where teams with aligned goals should be compared to teams with asymmetrical goals on team learning orientation and team identification. Research will test team learning orientation and team identification's theoretically predicted role in conflicting goals within a team (Pearsall & Venkataramani, 2015). There are important gaps in research to address why leaders choose one model over another. Perhaps organizational culture affects the leader's mental model choice. Lastly, we need to understand why leader mental models might result in team failure. For instance, does a lack of psychological safety affect the follower's willingness or ability to challenge a supervisor's mental model with new information?

Conclusions

Leaders are key components to their workplaces, whether they are operating in a team or group setting, whether they are experts or novices, and whether

they work in a hierarchical or distributed leadership environment. Their mental models, or cognitive lenses to view the world, are drivers of their behaviors and attitudes. These mental models are evaluated via their similarity or accuracy compared to an expert's model. In such examples, an educator with low organizational tenure was compared to an educator with high organizational tenure. Their mental models reflected differences in locus of control, perception of hierarchy, and outcome goals (Ruff & Shoho, 2005). Leaders' mental models are developed through processes such as training, coaching, and leader development (see Marcy & Mumford, 2010). As individuals strengthen their leadership skills, they build and revise the mental models connected to leading. Leaders' mental models have a direct effect on their own performance as leaders. At the organizational level, this performance effect occurs within the context of organizational climate, innovation, and ethic, while the leader's mental model can affect performance via vision, sensemaking, forecasting, and inter-leader interactions. Leaders' mental models affect their team's performance through the leadership style, decision making, and information exchange. We also discussed the role of SMM in the team context. The leader can develop SMM in their team with the extent they participate in information exchange, build relationships with followers, and share experiences with the team. In cases where leadership is shared among two or more teammates, SMM can be fostered through cognitive flexibility and shared expectations. We wrapped up the chapter by noting what areas of the literature could be further augmented by future research endeavors. Leaders' mental models are important for leaders, followers, teams, and organizations.

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