SPECIAL ISSUE: Exploring Cognitive Readiness in Complex Operational Environments: Advances in Theory and Practice, Part I

Cognitive Readiness and the Challenge of Institutionalizing the "New" Versus "News"

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Abstract: As the military begins to formalize training and standards for cognitive readiness, it is fitting to mark potential barriers to its implementation. This article outlines three general challenges associated with the institutionalization of cognitive readiness: (a) that the training and education community must recognize that higher-order cognitive skills development (at least for lower echelons) is fundamentally *new*—not merely a slight deviation from the status quo; (b) that commonly discussed cognitive competencies can (and must) be better operationalized for instruction and measurement purposes; and (c) that achieving widespread cognitive readiness will be possible only if senior leaders recognize the importance of sustained support for these competencies. The critical thesis of this article is this: Military leadership tends to view cognitive readiness as an additive aspect ("news") to what is already known and accepted, instead of as a foundational competency ("new") that requires widespread transformation. Until the institutionalization of cognitive readiness is recognized as a fundamentally novel, leap-ahead innovation, the military community will struggle to accomplish it.

Keywords: cognitive readiness, decision making, higher-order cognitive skills, challenges

Introduction

Although the U.S. military has been at war for nearly a decade, only in recent years have the armed services recognized the importance of formalizing the standards, terms, and instructional foundations associated with "cognitive

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readiness." This lag in institutionalizing systematic development of core cognitive competencies is felt particularly by the two ground forces, the U.S. Army and Marine Corps.

The U.S. Army's former Training and Doctrine Command (TRADOC) Commander General Martin Dempsey described "a campaign of learning" in a series of reflective articles published in fall 2010. In these papers, he urges the army to invest in a host of organizational and human dynamics initiatives, including methods for developing decision-making expertise and adaptability (Dempsey, 2010; see also Dempsey, 2011; Stringer, 2009; Vane & Toguchi, 2010). The Marine Corps' Training and Education Command (TECOM) has likewise been working to define the standards for cognitive competencies in such areas as sensemaking, problem solving, adaptability, mindfulness, and attentional control (Conway, 2008; Gideons, Padilla, & Lethin, 2008; Small Unit Decision Making [SUDM], 2011).

There is an urgency to enhance cognitive competencies throughout the military services (Lynn, 2010). Yet, as the military begins to formalize training and standards for cognitive readiness, it is fitting to mark potential barriers to implementation. In this discourse, we describe three general challenges associated with the institutionalization of cognitive readiness, and we offer corresponding potential solutions for negotiating the hurdles. First, we argue that the training and education community must recognize that higher-order cognitive skills development (at least, for the military's lower echelons) is fundamentally *new*—not merely a slight deviation from the status quo. Second, we posit that commonly discussed cognitive competencies, such as sensemaking or adaptiveness, are too abstract to directly train and instead must be reformulated for instruction and measurement purposes. Last, we argue that achieving widespread cognitive readiness will be possible only if senior leaders recognize the importance of sustained support for these competencies.

Cognitive Readiness

The phrase *cognitive readiness* entered the common military lexicon approximately a decade ago, when it was cited as one of five critical research areas by the Office of the Deputy Under Secretary of Defense for Science and Technology (Etter, 2002). *Cognitive readiness* describes the mental preparation an individual must establish and sustain to perform effectively in the complex and unpredictable environment of modern military operations (Etter, Foster, & Steele, 2000; Foster & Fletcher, 2003; Morrison & Fletcher, 2002). It encompasses a range of intellectual, affective, and psychosocial skills and their successful execution in stressful, ambiguous, and unpredictable conditions at both the individual and team levels (Bolstad, Cuevas, Babbitt, Semple, & Vestewig, 2006). Achievement of cognitive readiness is somewhat akin to developing *coup d'oeil* or an "intuitive sense of the battlefield" (Yancy, 2006, p. 16); that is, effective cognitive readiness ultimately manifests as successful pattern recognition, creative adaptability, and intuitive decision making in the field.

Since cognitive readiness was elevated to a critical research area, the Department of Defense has been addressing aspects of cognitive readiness through a multifaceted approach. This article, however, is primarily concerned with the training and education of cognitive readiness. Before discussing potential barriers for its institutionalization, however, we highlight a few efforts that are beginning to advance cognitive readiness instruction across the military.

TECOM, for instance, is involved in an initiative to codify a meaningful (but not comprehensive) subset of cognitive readiness capacities and to associate them with instructional and assessment approaches (SUDM, 2011). TECOM curriculum developers are designing an instructor-led program of instruction to support such cognitive readiness development for Marine Corps noncommissioned officers (Fautua, Schatz, & Vierling, 2011).

In contrast to the Marine Corps effort, investigators working with the army and navy have taken a bottom-up approach. These researchers have identified a comprehensive set of microcognitive factors that contribute to cognitive performance (Cosenzo, Fatkin, & Patton, 2007; Swann & Schmidt, 2005), and they have developed a corresponding assessment system, called the Army Cognitive Readiness Assessment (ACRA). This computer-based assessment matrix is used to establish a "synthetic performance testing" environment in which operational cognitive requirements can be gauged in a controlled, systematic manner (O'Donnell, Moise, Eddy, & Schmidt, 2010; O'Donnell, Moise, & Schmidt, 2005, p. C25).

Along somewhat similar lines, researchers with Defence Research and Development Canada (DRDC) have argued for the expansion of the concept of operation (individual) readiness to include cognitive readiness aspects as well as a broader range of emotional, motivational, and social factors. The DRDC individual readiness model proposes to holistically define readiness, including a variety of foundational individual traits, trained competencies, and contextual factors related to it (for an overview, see Adams, Hall, & Thomson, 2009).

This section outlined just a few of the cognitive readiness training and education initiatives currently under way (for more details, see May, 2010). However, despite ongoing support from the Deputy Under Secretary of Defense for Science and Technology and successful research initiatives (such as those described previously), more can be done to facilitate the institutionalization of cognitive readiness across the Joint and Coalition Warfighting community. In the next sections, we articulate three remaining challenges to the systematic implementation of cognitive readiness education, training, and assessment.

Challenge 1: "New Versus News"

Achieving armed services–wide cognitive readiness is a potential game changer for military operations (Klein & Weick, 2000). Accessing expertise in sensemaking, reading the environmental and human terrains, establishing a baseline, detecting anomalies, and anticipating threats not only enables proactive decision making but also facilitates other macrocognitive skills, such as intuitive reasoning, adaptiveness, and tactical patience (Fautua et al., 2010;

Spiker, Johnston, Williams, & Lethin, 2010; see also Klein et al., 2003). Foundational as these competencies may be, however, the jury is still out on whether their implementation will be seen as such. That is, there are risks (a) that training and education institutions may misperceive cognitive training, viewing it not as fundamentally "new" but instead as merely additive ("news") to what is already implemented; (b) that cognitive capabilities will be viewed as mere soft skills (i.e., nonkinetic, nontechnical, and nonmeasurable) that do not warrant the same degree of attention as hard skills (i.e., expertise in kinetic, technological destruction of the enemy); and (c) that even if leaders recognize the importance of cognitive competencies, they may mistakenly present their training in a procedural fashion, similar to training for hard skills.

First, consider the phenomenon of "new versus news." This metaphor helps to explain, in part, how and why certain industries are slow to adapt to innovative change despite awareness of the innovation. Examples include Toyota and other Asian car producers marginalizing American auto industries in 1960s and Apple and other personal computer companies surpassing IBM in the 1980s. In each case, the "new" (i.e., profoundly novel) innovation was seen but received as "news" (i.e., an incremental, and therefore less significant, variant of the status quo), causing a lag to adapt (Govindarajan & Trimble, 2010; Kuhn & Masick, 2005; C. C. Miller & Ireland, 2005). In this sense, introduction of foundational (new) cognitive readiness requirements for competencies such as sensemaking and metacognition can be misperceived as simply additive (news) to existing training and therefore written off as mere expansions of more commonly understood concepts, such as situation awareness or critical thinking (Endsley, 1997; Weick, 1995; Coutu, 2003; Stanley, 2010; Baran & Scott, 2010). In other words, practitioners may assume that nuanced recommendations from cognitive readiness researchers are synonyms of (or "just academic language for") already-established training and education approaches. Similarly, some may assume that institutionalization of cognitive readiness methods is simply additive, that it requires merely the addition of a few novel elements into the existing instructional system. Instead, we argue, militarywide institutionalization of cognitive readiness requires foundationally *different* bodies of language, processes, and attitudes. That is, it demands a fundamentally new approach.

Recognizing cognitive readiness as new may be complicated, in part, by the perception of cognitive competences as abstract and, consequently, emotionally inconsistent, unreliable, and achieved mainly through lived experience rather than training. Although rational or "analytical" cognitive abilities (such as proceduralized decision making) may be seen as scientific, measurable, and trainable (Klein, 2003, p. vi), the more complex (or "intuitive") cognitive abilities involved in cognitive readiness are often viewed dubiously by the operational community. Even though leaders at every level across the military and in business organizations often rely on intuitive cognition, especially in stressful conditions, many are hesitant to formalize the training and education of these naturalistic competencies, particularly for less senior personnel (Hayashi, 2001; Seligman & Kahana, 2009).

This discussion should not imply that intuitive (naturalistic) and analytical (rational) cognitive competencies are mutually exclusive or that intuitive skills are inherently "better" than analytical ones. Both categories of skills are important components of cognitive readiness. The challenge lies in convincing military leaders, instructors, and curriculum developers of the value and trainability of the more ambiguous, intuitive capacities involved in cognitive readiness. Although some steps have been taken toward inculcating these capabilities within the military, comprehensive development of sophisticated cognitive readiness capacities requires a more fundamental shift in the military training and education culture.

The army's Field Manual (FM) 5-0, *Army Planning and Orders Production*, for instance, acknowledges the dilemma and tries to reconcile intuitive and analytical decision making. In terms of space and intent, however, FM 5-0 gives obvious preference to the analytical approach. While the manual states that intuitive decision making is appropriate in time-constrained conditions, it also points out that intuitive decision making "does not work well when the situation includes inexperienced leaders, complex or unfamiliar situations, or competing COAs [courses of action]" (Department of the Army, 2005, pp. 1.6–1.7). Yet when commanders in time-constrained environments have to make quick-acting decisions, FM 5-0 concedes that "many of the Army's techniques, such as choosing only one COA, depend on intuitive decisions. . . . Even in the most rigorous analytic decision making," the manual continues, "intuitive decision making helps set boundaries for the analysis and fills in the gaps that remain" (Department of the Army, 2005, pp. 1.6-1.7).

These descriptions suggest more than just a reasoned compromise between the "head" and "gut feel." They, in fact, convey an outmoded notion that expertise in intuitive decision making is not a trainable skill and that it cannot be systematically developed and honed. At best, FM 5-0 intellectually limits the full value of current research, and it discourages the development of instructional training tools to build expertise in intuitive decision making at all ranks, particularly at the small-unit and operational levels. Developing skill sets, such as "cunning" and "patience," for instance, are vital for commanders, as the FM 5-0 emphasizes, but these skills are also critical at the tactical level (as many contemporary authors have pointed out, e.g., SUDM, 2011) and essential for operational battle staffs (Dempsey, 2011). Instead, as long-time army strategist Christopher Paparone explains, one must value creative intuitive thinking as an aspect of the military's planning process, at all levels, to understand, visualize, and describe complex, ill-structured problems and develop approaches to solve them (Paparone, 2010; Paparone & Reed, 2008; see also Vowell, 2004).

The point here is not to cast aspersion. Intuitive decision making is an important reality of decision making and is described as such by the army. The underlying message here is rather that despite being recognized as important, more ambiguous cognitive readiness skills are treated not as foundational competencies (new) but rather as additive (news) to what is already known and accepted. Intuitive decision making, for example, is an essential and learnable skill and is

therefore critical to reliably develop. Intuitive decision making must be valued—and recognized—as more than an adjunct to analytical decision making, or stated more broadly, cognitive readiness must be perceived as more than a marginal add-on to existing procedures.

Another similar challenge of institutionalizing cognitive readiness is that it may be viewed as a "mere soft skill." Soft skills are those abilities that fall into the range of human dynamics rather than combat skills, which are associated with engaging the adversary by fire and maneuver or other kinetic means (hard skills). But just as research psychologists have shown that the divide between analysis and intuition is outmoded, the separation between soft and hard military skills is equally unnecessary. As Columbia University business school professor William Duggan (2005) points out in his review of the army's FM 5-0, "there is no good analysis without intuition and no good intuition without analysis" (p. v). Both approaches have to be used *together*; that is, both intuition and analysis, as well as both soft and hard skills, work together to turn cognition into action.

Possessing competencies in an adaptive stance, mindfulness, and sensemaking (so-called soft skills) creates the preconditions for self-awareness, self-regulation, flexibility, and effective intuitive decision making. The wide range of naturalistic decision making that occurs during combat operations, in turn, directly affects operational performance (hard skills). One such event occurred with certain soldiers at Ft. Carson deploying to Iraq who were able to discern change and, despite being trained to follow one form of battle, adapted to a completely different method to achieve unexpected success. Their experience provides a glimpse of how cognitive readiness can be as critical as hard skills for the irregular missions in full-spectrum operations (Lynn, 2010; Stanley & Jha, 2009).

This was the point that Wilbur J. Scott and his fellow researchers at the U.S. Air Force Academy discovered in their longitudinal study of those Ft. Carson, Colorado, soldiers deploying to Iraq in 2003 and 2005 (Scott, McCone, & Mastroianni, 2006, 2009). Scott's team conducted oral-history interviews and focus-group data collection from two units of Ft. Carson–based soldiers to describe and address, in part, the contentious features of battle between conventional and full-spectrum operations and the responses of particular leaders to the divergence. They explored how the units dealt with a seismic shift in mission and roles from their 2003 deployment, which approximated the force-on-force (e.g., tank-on-tank) conventional warfare they were trained to conduct and the unique skill sets needed to succeed in full-spectrum conditions of their 2005 deployment (see Scott et al., 2006, pp. 316–318; Scott et al., 2009, pp. 461–464).

Full-spectrum warfare calls for ordinary soldiers to possess skill sets that extend beyond conventional combat, such as understanding culture, sensing threats in crowded marketplaces, and conducting stability operations to win the respect and confidence of the local population. However, effective execution of these additional duties requires more than incorporation of additional skills into soldiers' training and education (i.e., the news approach); instead, fundamental adjustments threaded throughout the training and education continuum are required. To support this assertion, consider these soldiers' 2003 deployment:

Conventional tactics were employed to great effect in the opening stages of the war but proved counterproductive in the aftermath, whereby soldiers felt ill prepared to deal with the evolving irregular conditions. Despite these experiences, the dominant cognitive schema for training remained focused on conventional tactics. It was in the 2005 deployment that the researchers noticed a set of naturalistic decisions taking place among key leaders of the 3rd Armored Cavalry Regiment (3ACR) to actually "rescript" against the dominant schema and shift from conventional to full-spectrum training.

Schema refers to a person's knowledge, built from experience and established within a mental framework of how the world works. For the 2005 deployment, the predominant schema remained force-on-force training and preparation. The term *script* refers to how events in a well-accepted framework are likely to occur; scripts provide a basis for guiding behavior and problem solving in a situation. In 2005, the reality of battle in Iraq had changed; however, only the 3ACR was able to sufficiently rescript the prevailing schema to resolve the dissonance between the reality and previous expectations (Scott et al., 2009, p. 464). The 3ACR commander, Colonel H. R. McMaster, completely readjusted the 3ACR's training prior to deployment to develop unique sets of skills suited for the irregular conditions of full-spectrum operations. He canceled armor-based field exercises that were a staple for the 2003 deployment and instead instituted his own training regimen at Ft. Carson, building an Iraqi-style "village" peopled by soldiers and civilians dressed in *dishdashas* to play the role of Iraqis in a range of intense, complex scenarios. The "dilemma-based" training had the effect of building virtual experience for detecting subtle patterns in the human terrain that might indicate threats (i.e., nervousness, fleeting eyes, or a sudden reach for a cell phone as troops approach). More importantly, the training was designed to guard against being enticed by terrorists to overuse force that often would lead to unintended collateral damage of innocents, thereby losing the respect and confidence of the people. The study cited how McMaster had instructed his soldiers that the hard-core jihadist terrorists were a small fraction of the population but were mixed in with the people. The populace, meanwhile, would be fence sitting to see whether the Americans possessed the ability to discern the distinctions described. In essence, McMaster's rescripting enabled the development of key cognitive skills, such as mindfulness, sensemaking, adaptiveness, and intelligent memory, that promoted better intuitive decision making and overall cognitive readiness (Fahle & Poggio, 2002; Gordon & Berger, 2003, pp. xi–xv). These were all skills that would later prove as vital as any traditional hard skill when the regiment eventually deployed to Iraq.

The success of 3ACR in Tal Afar, Iraq, in 2005–2006 is now well documented and is recognized as a model approach to full-spectrum operations (McCone, Scott, & Mastroianni, 2008; Packer, 2006; Scott et al., 2009). Certainly the courage and perspicaciousness of Colonel McMaster was central. More to the point of this essay, however, was what Scott and his research team were able to reveal, namely, just how much of an outlier that success proved to be from the perspective of building cognitive readiness. In contrast to other brigades, the 3ACR was

able to successfully meet the complex cognitive, affective, and psychosocial demands of 2005 Iraq, and it did so because the soldiers (and their leadership) recognized that cognitive skills are as equally vital as hard skills in contemporary military operations (Rosello, 2009, p. 2).

The last challenge of the new-versus-news metaphor involves how training and education institutions might mistakenly interpret cognitive training in a procedural fashion similar to simple psychomotor instruction. The examples noted throughout this article provide a clear sense that an entirely different—updated—approach to training must be instituted. Identifying and then articulating a descriptive body of language for high-level abstract cognitive competencies, such as mindfulness, sensemaking, problem solving, adaptiveness, or metacognition, must be performed before building instructional tools or programs of instruction.

Initiatives are beginning to address this need. For instance, researchers have already begun modifying well-accepted models and articulating a different body of language to mark new paths for cognitive readiness training and education. On the basis of insights gained from their analysis of the 3ACR (described earlier), for example, Scott and his colleagues (2009) iterated John Boyd's famous OODA loop (observe, orient, decide, act) to develop a new common model of military decision making. The researchers adapted and expanded Boyd's OODA loop to offer their own cognitive-based SAPRR model (sense, assess, protect, reflect, respond) to account for the key aspects of cognitive readiness required in full-spectrum operations (Scott et al., 2009, pp. 469–471). Whereas Boyd used *observe* and *orient* as shorthand for getting inside the enemy's decision cycle, the Scott research team added *sense* and *reflect* to describe getting inside the enemy's mind, as well as their own, as a means to continually assess intent and assumptions, respectively. Whereas the object of the OODA loop is to speed decisive actions of warfighters, the SAPRR model might point to slowing the pace of operations (i.e., cunning and patience) to establish a normalized pattern of civil activity (such as baseline patterns of people shopping in a marketplace) to detect anomalies that indicate possible threats (such as a body-bomber attempting to blend in with the crowd).

Interestingly, researchers such as Scott et al. (2009) are not alone in attempting to unleash the power of cognitive skill sets by adapting their insights to the well-used and generally accepted OODA loop decision-making model. In his research of command and control, for instance, psychologist David Bryant observed that the OODA loop is outdated with respect to current theories and concepts within the cognitive sciences. As a consequence, it masks several critical aspects of decision making for better command and control (Bryant, 2006). Bryant's (2006) adapted version, called the critique-explore-compare-adapt (CECA) loop, leverages the simplicity of Boyd's model to emphasize the roles of mental representation and active questioning in planning and conducting operations (p. 184). The trend is not simply to advocate for the importance of cognitive competencies to modern warfare but rather to close a fundamental gap in the model itself, to develop new, commonly accessible models of cognition that more accurately reflect the emergence of cognitive readiness paradigms.

As a second example, consider the typical way in which performance standards are articulated. Specifically, the current "tasks-conditions-standards" model often omits many cognitive, affective, or psychosocial aspects. Although the model does not inherently block inclusion of cognitive readiness facets, its common usage limits its capacity to readily facilitate these more "intangible" skills. Hence, we argue that the traditional tasks-conditions-standards model of measurement needs to be rethought and widened to incorporate a "knowledge-skills-attitudes" model of instruction and measurements. Similarly, innovative instruments to measure trainees' states of knowledge must also be developed and applied prior to training if one is to trace the effectiveness of both cognitive learning and training.

In summary, across the military, there are a number of important initiatives, studies, and projects that are making important headway in moving intuitive decision training and education into the mainstream. Notable leaders, such as Generals David Petraeus, Martin Dempsey, and James Mattis, have championed the cause of cognitive readiness, and their influence has already changed the way the military prepares personnel. Advances in cognitive research, instructional tools, and training programs, such as those of the Marine Corps' Combat Hunter, the army's Think Like a Commander, or the navy's Tactical Decision Making Under Stress, have shown great promise as multipliers for effective decision making in a complex, ambiguous, and dangerous battlespace (Fautua et al., 2010; Johnston, Cannon-Bowers, & Salas, 1998; Schatz, Reitz, Nicholson, & Fautua, 2010; Shadrick & Fite, 2009). Other initiatives, such as the army's training on "improvisational leadership," point to innovative instruction that emphasizes an adaptive stance and mindfulness (Colbert, 2010). Although these programs are important, they represent only a start. A more unified and consistent implementation process is still needed, and as we have attempted to show in this section, institutionalizing these imperative skills will first require an enlightened acceptance of the "new." In other words, military leadership must recognize that cognitive readiness is a game changer, accept its implementation as a cornerstone for successful full-spectrum operations, and embrace the systemwide transformation that institutionalizing cognitive readiness necessitates.

Challenge 2: Operationalizing Cognitive Competencies

Researchers have made great strides in developing new tools for analyzing requisite knowledge, skills, and abilities; and academics have identified means to train and educate these competencies as well as to evaluate their performance. Yet the challenge researchers face today is finding reachable, scalable, and measurable ways to translate the results of this research into easily understood practice. Thus, the second challenge of institutionalization involves development of an operational basis for the training and performance of cognitive readiness.

Cognitive readiness is a complex concept that is difficult to articulate via the military's common vernacular. As mentioned in the previous section, the tasks, conditions, and standards for demonstrating cognitive readiness are hard to define, and metrics for its performance are unclear. Accordingly, before cognitive readiness can be institutionalized, it must first be transformed for real-world use.

Already, attempts to operationalize cognitive readiness can be found throughout the academic and military communities. Typically, such endeavors emphasize deconstruction of cognitive readiness into component subskills. For instance, John E. Morrison and J. D. Fletcher (2002), working for the Institute for Defense Analysis, identified 10 competencies as the basis for cognitive readiness: situation awareness, memory, transfer of training, metacognition, automaticity, problem solving, decision making, mental flexibility and creativity, leadership, and emotion. Published in 2002, Morrison and Fletcher's work offered an important and timely roadmap for discussions on cognitive readiness. However, outlining the components of cognitive readiness will not be enough to support its institutionalization.

In practice, the next steps toward operationalizing a complex topic, such as cognitive readiness, typically involve further deconstruction of its subcomponents and then presentation of exemplars to illustrate the essence of the various pieces. For example, consider the army's conveyance of the complex and abstract concept "leadership." FM 6-22, *Army Leaders*, first breaks leadership into a set of (still-abstract) subskills, such as "leads others, extends influence beyond chain of command, leads by example, communicates" (Department of the Army, 2006, p. 2.4). It then goes on to elucidate these subskills through examples and narratives, such as the two-page story on building trust and acting with courage called "Colonel Chamberlain at Gettysburg" (Department of the Army, 2006, pp. 2.5–2.6).

Using narrative illustrations to describe complex concepts is an effective technique; however, this approach, alone, will likely prove insufficient for the systemization of cognitive readiness. For one reason, it still fails to clearly prescribe training approaches or performance standards, and for another, it may be too esoteric for widespread acceptance. That is, learning about competencies (e.g., memorizing the army's leadership requirements model) and reading narratives about their employment will not necessarily endow the competency. Being told that good leaders possess courage, for example, and even internalizing the meaning of courage, will not necessarily result in the development of courage (Dreyfus & Dreyfus, 1986). Certainly, FM 6-22 is not intended as a program of instruction; however, we feel it serves a useful example of difference between describing an ambiguous skill (courage, in this case) versus being able to engender that capacity in oneself or others.

Thus, to better clarify and structure complex skills, military manuals may attempt to proceduralize them. As discussed earlier, FM 5-0 attempts to define the decision-making process by offering the highly routinized Military Decision Making Process (MDMP). The seven-step MDMP offers a recipe-like procedure by which to make decisions. In practice, this analytical framework is sluggish, inflexible, and often impractical (Paparone, 2001; Williams, 2010); furthermore, and more pertinent to this discussion, the memorization of procedures does not engender higher-order cognitive development. That is, "explicit rule-following takes place at basic, not more advanced, skill levels. More advanced skill levels are characterized by experience-based know-how that cannot be articulated entirely in the form of rules" (Dall'Alba & Sandberg, 2006, p. 387). To build a bridge between today's cognitive development approaches and the "new"

cognitive readiness training and education strategies advocated in this article, we suggest the use of modified abstraction hierarchies. As the next section details, these charts may be useful tools to support the articulation of cognitive readiness skills as well as their instruction and assessment approaches.

Cognitive Skill–Stance Hierarchy

An *abstraction hierarchy* is a multilevel-level diagram that represents some complex system as a series of goal-directed rows and part–whole columns. When they were originally devised by Jens Rasmussen (1986), abstraction hierarchies included five levels that each described the functioning of a power plant. The higher, more abstract levels outlined the plant's purposes and functions, and the lower, more discrete levels depicted its physical implementation. The diagram's leftmost columns represented whole-system components (i.e., course-level descriptions), and the rightmost columns described the individual components (i.e., fine-grain details).

Since their origination in the 1980s, abstraction hierarchies have been applied to a variety of issues, such as work domain analyses (Vicente, 1999) and articulation of biological processes (A. Miller & Sanderson, 2000). In this article, we suggest that abstraction hierarchies be modified and applied to the articulation of cognitive readiness skills, instructional strategies, and assessments (this argument builds on Fowlkes, Schatz, Stagl, & Norman, 2010). We coin the term "cognitive skill–stance hierarchy" (or CSS hierarchy) to describe this reformulation of Rasmussen's (1986) abstraction hierarchy.

First, we modified the labels of the vertical (means–end) levels of Rasmussen's (1986) hierarchy so that they now describe, from top to bottom, the following:

- High-level goals (e.g., commander's intent, broad mission objectives)
- Macrocognitive skills (abstract, aggregate competencies)
- Microcognitive skills (supporting, composite subskills)
- Operational tasks (training and readiness manual–type task descriptions)
- Situated training events (exemplar scenarios or cases that offer contextualized representations of the skills)

Still following Rasmussen's (1986) intentions, the upper levels of the hierarchy specify reasons and more abstract ideas, and the lower levels describe specific forms and contextualized applications. Applied to cognitive competencies, this distinction means that the uppermost rows reflect cognitive *stances* (i.e., cognitive ways-of-being), whereas the lowermost rows outline cognitive *skills* (i.e., learned capacities).

Next, we modified the horizontal (whole–part) axis to convey, from left-to-right, the following:

- Systems-level element (e.g., joint agencies in area of operations)
- Large unit (e.g., army, corps, division, brigade)
- Small unit (e.g., company, platoon, squad)

- Immediate team (e.g., fire team)
- Individual

A rough diagram of these two dimensions is shown in Figure 1. (Additional information on the hierarchy's dimensions, including a detailed discussion on the rationale for these particular dimensions, is offered in Fautua et al., 2011.)

Each level of the CSS hierarchy is then filled with specific concepts and competencies (depicted as boxes), which are linked to their associated parts (depicted as lines). Each concept (box) can then be detailed, including a description of its associated tasks, conditions, standards, assessment tools, and instructional suggestions. In so doing, one can articulate different performance and instruction standards based on the differing degrees of abstraction. For instance, more conceptual ideas (stances) can be described with general outcome goals and educational techniques, and more contextualized components (skills) can be linked to explicit performance metrics and training strategies. Figure 2 illustrates how such components may be depicted.

It is important to note that the upper-level competencies are not mere amalgams of their subordinate skills. For instance, a macrocognitive ability is not merely the sum of its associated microcognitive skills. Instead, each subsequent degree of abstraction (i.e., up the hierarchy) includes emergent properties.

Whole–Part → / Means–End ↓	Systems-Level Element	Large-Unit	Small-Unit	Immediate Team	Individual
High-Level Goals					
Macrocognitive Skills					
Microcognitive Skills					
Operational Tasks					
Situated Training Events					

Figure 1. The two dimensions of the proposed cognitive skill–stance hierarchy, modified from Rasmussen's (1986) abstraction hierarchy.

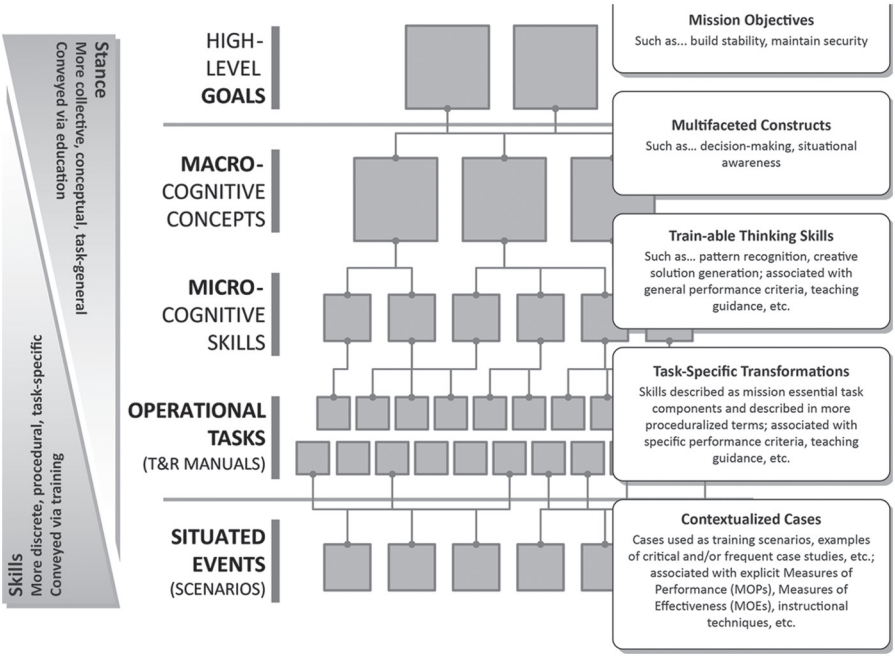

Figure 2. Example means–end diagram of the proposed cognitive skill–stance hierarchy.

To better convey the CSS hierarchy's use, we include a brief example of its population. The content provided in this section is based on working-group discussions held during the Marine Corps' Small Unit Decision Making Workshop, held January 12 and 13, 2010. See Figure 3.

Section Summary

Conveying cognitive competencies through either highly conceptual narratives or overly proceduralized rules will not adequately support the institutionalization of cognitive readiness. On one hand, abstract treatment of cognitive competencies will likely prove intractable to many personnel, particularly at lower echelons, and on the other hand, dilution of higher-order competencies into procedural rules disconnects them from their intended cognitive stances and often yields awkward results. Nonetheless, both abstraction and task specificity are necessary. The CSS hierarchy offers a way to express both, as well as their intervening components and associated details, and helps depict the conceptual transformation of cognitive competencies across levels of aggregation and abstraction: from the less tangible *stances* to the more concrete *skills*. Thus, the CSS hierarchy helps describe both analysis and intuition, both "analytic" and "intuitive" cognition.

The CSS hierarchy also supports advanced education and training by offering a discrete framework with which to show how domain elements are related, to

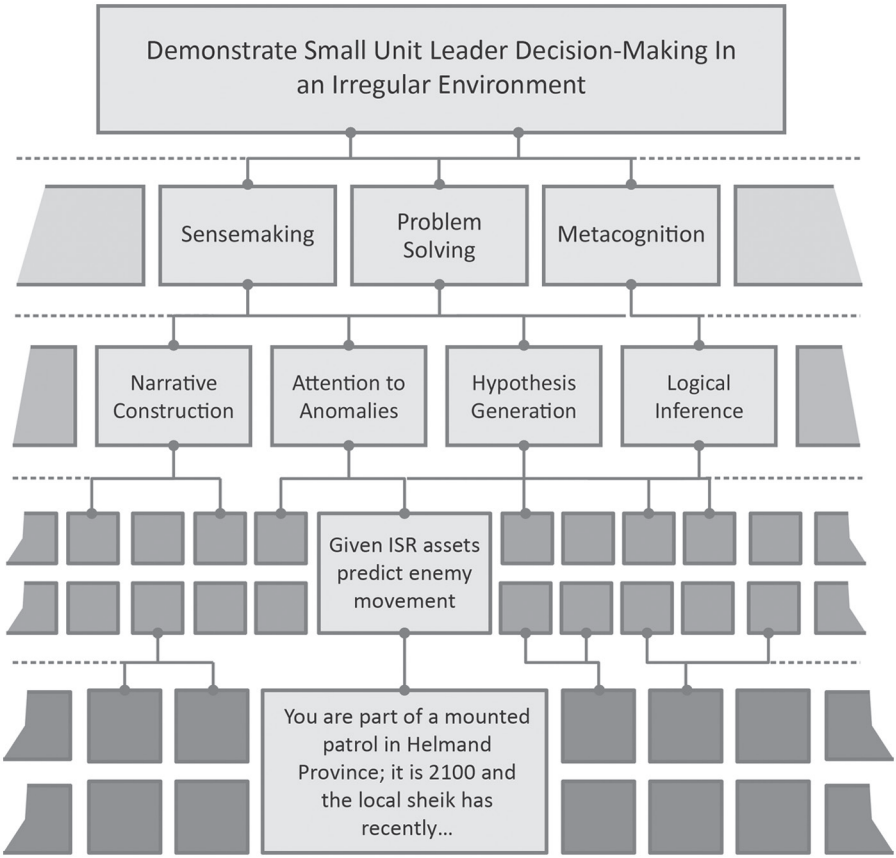

Figure 3. Example application of the cognitive skill–stance hierarchy in the context of small-unit leader (individual) decision making. Sample content provided for explanatory purposes; it is not intended to definitively describe small-unit leader decision making.

show interrelationships among the major facets of a domain, and to help personnel develop an "embodied understanding of practice" (i.e., to understand how idiosyncratic high-level objectives guide behaviors in practice environments; Dall'Alba & Sandberg, 2006). Training and education researchers suggest that such features are especially important for supporting higher-order instruction and development of expertise (e.g., Dall'Alba & Sandberg, 2006; Marshall, 1995), and these features should also better facilitate both vertical and horizontal transfer of training (Kozlowski, Brown, Weissbein, Cannon-Bowers, & Salas, 2000).

Certainly, the systematic decomposition of competencies that the CSS hierarchy supports does not represent a new concept per se. A litany of human performance taxonomies, skill catalogs, and cognitive batteries can be readily found. Even inventories of military cognitive readiness capacities already exist (e.g.,

Bolstad et al., 2006; Fletcher, 2004), and the ACRA efforts described earlier have already articulated a structured breakdown of fundamental cognitive capacities and associated assessments (e.g., O'Donnell et al., 2010). Furthermore, simply using the hierarchy will not engender cognitive readiness. Instead, we argue that cognitive readiness competencies must be articulated in a way that connects more abstract concepts to more actionable microcognitive skills, and these skills must be situated within meaningful scenarios and military standards. In other words, with the CSS hierarchy, we are encouraging military decision makers to use a common, explicit roadmap to help chart the systematic implementation of armed services–wide cognitive readiness standards. Furthermore, through this discussion and description of the CSS hierarchy, we hope to build on best practices of other cognitive readiness efforts, and we believe that the CSS hierarchy expands on those existing initiatives in several ways.

First, development of a CSS hierarchy (e.g., for a particular military occupational specialty) is intended to be an active process in which military curriculum developers can participate, and the resulting hierarchy is intended to be meaningful and readable by a diverse range of stakeholders, including military instructors and trainees. That is, the CSS hierarchy should immediately support the practitioner community, in addition to meeting the needs of academic experts (for more details, see Fautua et al., 2011). Second, in contrast to some other efforts (e.g., Fletcher, 2004; O'Donnell et al., 2010), the CSS hierarchy approach enables the articulation and organization of competences that have differing degrees of granularity and abstraction, and it facilitates clear mappings among individual and collective skills (à la Bolstad et al., 2006) as well as transparent distinctions at the tactical, operational, and strategic levels. Third, competences articulated in the hierarchy are specifically contextualized into scenarios (i.e., the lower level of the framework). Although researchers commonly promote the use of situated learning or scenario-based instruction, we believe that the *explicit* inclusion of contexts (and associated instructional approaches and assessments) better facilitates practitioners' use of these situated instructional methods. Finally, it is important to recognize that these proposed benefits will be validated only through empirical use of the hierarchy. The authors are currently pursuing this goal with the assistance of military training and education practitioners. We are also pursuing opportunities to discover the CSS hierarchy's applicability at the combatant command and joint task force (JTF) levels of training and exercises. The practical results of the tactical-level trials are forthcoming, and the operational-level findings will be in future publications (for initial lessons learned at the tactical level, see Fautua et al., 2011).

By embracing and clearly detailing both abstract and task-specific representations of cognitive competencies as well as the associated goals, employment contexts, instructional strategies, and assessment criteria, researchers should be better able to translate cognitive readiness into a form usable by the operational community. Through this process, a clear operational basis for cognitive readiness training and performance should be more attainable, and accordingly, real-world institutionalization of cognitive readiness may be advanced.

Challenge 3: Enduring Mandates

In a technology-based military, maximizing the full weight of cognitive-based competencies will require a sustained commitment to institutionalize the advances in training and education. Certainly, there is a growing recognition for the inclusion of some form of cognitive readiness into training and education directives and programs, as evidenced in efforts such as the Defense Science Board's adaptability study and the directive of former joint chiefs chairman Admiral Michael Mullen for "psychological fitness" (Bates et al., 2010; Grasso & LaPlante, 2011, pp. 75–82; Lynn, 2010). To the extent that cognitive readiness has been institutionalized along the lines discussed previously, it has improved military decision making in both training and operations (Gideons, 2008; Gideons et al., 2008; Hilburn, 2007; for empirical assessments in training, see Fautua et al., 2010; for anecdotal perspectives, see Gladwell, 2002; Maurer, 2008; Michaels, 2008; Wood, 2009). For example, the Marine Corps' Combat Hunter program is now a standard component of predeployment training for marine operational forces, and the community's understanding in small-unit decision making has also made important advances in the past decade in terms of team training models, instructional tools, and metrics (Kozlowski, 1998; Salas & Cannon-Bowers, 2001; Salas, Wilson, Priest, & Guthrie, 2006). Since 1999, moreover, the Defense Department's Directorate for Human Performance, Training, and BioSystems Research has been a leader in advocating advances in human, social, cultural, and behavioral research—a key aspect of cognitive readiness for irregular operations. Still, raising the priority of this sort of training in a technocentric environment—as Major General Robert Scales (2006), former commandant of the Army War College, noted—remains a "tough sell" for the operational community.

Major General Scales, an experienced observer of trends in warfare, posited that the cognitive powers derived from advances in social and behavioral sciences might now be a decisive factor in warfare. This power will be realized, however, only if the military overcomes its technology fixation to recognize the cognitive capabilities being pioneered by the social and behavioral sciences. Too often, Scales (2006) warned, war is viewed as a contest of technologies, fostering a sort of impatience and detachment for fundamentally "new" capabilities that "don't fit the paradigm."

Heeding Scales' (2006) siren call, the editors of the *Journal of Military Psychology* republished the former commandant's article, in a 2009 special supplement, as a centerpiece to a broadcast supporting insights, observations, and evidence from the "best of science" (Scales, 2009). In that same issue, researchers addressed the effects of battlefield stressors on physical and cognitive performance, decision making, and adaptation in full-spectrum warfare. They also offered how science could help mitigate the stressors with new training techniques in neuroimaging, psychology, kinesiology, endocrinology, genetics, and linguistics (Steinberg & Kornguth, 2009). In all, 14 articles made up the special issue. Articles such as these reveal the maturity of the academic foundations for cognitive readiness

training and education and suggest that this research can readily support real-world application—if the operational community will establish more programs of record for research in cognitive training and education and sustain its support for this movement.

This was the message that Pegasus Professor of Psychology at the University of Central Florida Eduardo Salas had long emphasized and that he applied specifically to the present challenge at the Irregular Warfare Training Symposium hosted by U.S. Joint Forces Command (USJFCOM) in September 2009. With more than two decades of experience as a practitioner, researcher, and academic, Salas expressed a renewed sense of hope that human performance issues were moving to the forefront of what will make a difference in combat and other complex situations (USJFCOM, 2009). He reemphasized, however, that storytelling, patterns, and cues—not technology or the number of pixels—were key for engendering intuitive decision making. Achieving realistic (high-fidelity) training is important, Salas explained, but not at the expense of instructional requirements (i.e., cognitive learning outcomes) and measurement (USJFCOM, 2009; see also Salas et al., 2006; Salas & Cannon-Bowes, 2001, pp. 490–495; USJFCOM, 2010).

Implications

In this article, we have described three challenges to the institutionalization of cognitive readiness: (a) recognizing that cognitive readiness requires a fundamentally new approach; (b) taking the necessary steps to formally operationalize the skills, instructional approaches, and assessment of cognitive readiness for all echelons; and (c) valuing cognitive skills as highly as technological investments. If these challenges are overcome, the implications to training and readiness would be felt at all levels.

The immediate need, of course, is at the tactical level, where the first hurdle is to establish a common or joint curriculum (and associated shared understanding, language, and descriptive models) to consistently institutionalize the cognitive readiness standards, assessments, and instructional methodologies across the services—as well as for related organizations, such as law enforcement agencies. Results from the Border Hunter training experience suggest that the joint and law enforcement communities can benefit from training programs in which cognitive strategies are deepened and proliferated across the government's security communities (Fautua et al., 2010). Viewed from this broader light, the implication is that there is merit to establishing a central resource center to support the range of tactical-level cognitive training, including research and development, for the joint and interagency community.

Meanwhile, the army's *Learning Concept* and *Mission Command* as well as the Office of the Secretary of Defense's *Strategy for the Next Generation of Training for the Department of Defense* point to the way ahead for incorporating cognitive training at the operational and strategic levels. But here, too, the various approaches require more unity of effort to optimize the advances already made. Elevation to a joint perspective of the army's *Learning Concept* and *Mission*

Command must be considered to broaden the reach and relevance of intuitive decision making to the operational level. Given the scope and nature of operations in Afghanistan, Iraq, and Libya, combatant commands and JTFs could better exploit cognitive-based scenarios in their exercises, which would enable their staffs to develop intelligent memory and practice skills in operational cunning and strategic patience. A reasonably comprehensive and well-defined taxonomy of human cognitive abilities, such as a populated version of the hierarchy discussed in this article, could form the basis for cognitive-based inputs to the combatant commands' and JTFs' master exercise scenario event lists. Naturally, more work is required to assess whether models such as the CSS hierarchy can be applied at the operational and strategic levels. Research has nevertheless advanced to a point at which the opportunity to deliver significantly enhanced cognitive readiness instruction to these echelons is more than a possibility. Thus, the implication is that further investigation into cognitive readiness training and education, likely through improved scenario-based instruction, should be investigated at the operational and strategic levels.

Finally, perhaps a key reason that the military has not fully adopted a wider range of research-based training methods is that critical mass has not yet been reached by a partnership among four key stakeholders: human performance experts, technologists, the operational community, and agencies that issue mandates and provide resources (USJFCOM, 2009; Salas & Cannon-Bowers, 2001). As noted earlier, there are hopeful signs that more institutionalized programs of record, such as the Marine Corps' Combat Hunter program, will take root across the services. The challenges are nevertheless formidable. Clearly, an enduring mandate by enlightened leaders from the four key stakeholder communities will be required to institutionalize cognitive readiness and sustain the research. If this mandate can be issued, then perhaps Scales' (2006) assessment of the decisive power of the cognitively prepared warrior may be realized.

Conclusion

The challenges of institutionalizing cognitive readiness may be of a more subtle nature rather than an obvious issue. Picking up the distinctions between "new" and "news"—between current articulations of skills and new CSS hierarchies, or between present levels of support and more enduring mandates—requires more than just an alert mind; it will also necessitate an open one. Seasoned trainers and educators may unwittingly dismiss even the most foundational of cognitive competencies with comments such as "We already do this" or "Those are just soft skills" or "Intuitive reasoning is too iffy." Researchers, meanwhile, must continue to close the gap between the abstractions of macrocognitive terms to provide more practical reformulations of useable and reachable descriptions, instruction methods, and metrics. Finally, senior leaders and experts from the Defense Department as well as the communities of human performance, operations, and immersive technology must value these competencies as much any platform, "hard skill," or material solution if the full weight

of cognitive readiness is to be realized. Cognitive training and education (for all echelons) may seem faddish at present, but with new advances in research and training methodologies, this attitude, too, will fade.

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