The Cognitive Skill–Stance Hierarchy: A "New" Training Framework

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ABSTRACT

This article outlines two general challenges associated with the institutionalization of cognitive readiness: (1) the training and education community must recognize that the institutionalization of higher-order cognitive skills development is fundamentally *new*—not merely a slight deviation from the status quo, and (2) commonly discussed cognitive competencies must be better operationalized for instruction and measurement purposes.

First, the authors consider the phenomenon of "new vs. news," originally conceived by Dr. Alan Kay and presented at last year's I/ITSEC conference. This metaphor helps to explain, in part, how and why certain industries are slow to adapt to innovative change despite awareness of it. In this case, introduction of foundational (new) cognitive readiness requirements for competencies like "sensemaking" and "metacognition" can be misperceived as simply additive (news) to existing training, and therefore dismissed as mere expansion of more commonly understood concepts, such as situation awareness or critical thinking. The authors explain how cognitive competencies are distinct and can be integrated with established training to adequately support the institutionalization of cognitive readiness. Second, the authors articulate a Cognitive Skill–Stance (CSS) Hierarchy that presents a "new" way to express both currently established and emerging cognitive training recommendations. The CSS Hierarchy helps depict the conceptual transformation of cognitive competencies across levels of aggregation and abstraction: from the less tangible stances to the more concrete procedural abilities. 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 interrelationships among the major facets of a domain and help personnel develop an "embodied understanding of practice" (i.e., to understand how idiosyncratic high-level objectives guide behaviors in practice).

By use of this framework, we believe a clearer operational understanding of cognitive readiness training can be attained, and, in turn, this will support efforts to institutionalize cognitive readiness across the Services to enhance performance.

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The nature of contemporary military conflicts places a new premium on personnel's cognitive skills. Each Service member—including first-term Service members with limited experience—now carries increased responsibility to operate more independently in complex, dynamic, and stressful environments. Today's ground forces, in particular, are asked to make rapid decisions in ambiguous and evolving situations, where even seemingly small decisions may have substantial strategic implications (Petraeus, 2006).

Because of these operational demands, development of personnel's cognitive and relational skills has gained greater importance. Leaders from across the Joint community have issued demand signals, urging the Services to identify, acquire, and continually measure their "cognitive readiness" (e.g., Etter, Foster, & Steele, 2000; Morrison & Fletcher, 2002; Fletcher, 2004; Lynn, 2010).

For instance, former Army Training and Doctrine Command (TRADOC) commander General Martin Dempsey recently described "a Campaign of Learning" in a series of reflective articles published last fall. In these papers, he urges the Army to invest more resources in organizational and human dynamics, including methods for developing decision-making expertise and adaptability (Dempsey, 2010; see also, Vane & Toguchi, 2010; Stringer, 2009). The Marine Corps Training and Education Command (TECOM) has likewise made efforts to define and impart key cognitive and relational competencies for commissioned and noncommissioned officers (Conway, 2008; Gideons, Padilla, & Lethin, 2008), and planners at the Office of the Secretary of Defense conveyed a similar sense of urgency in their recently published *Strategy for Next Generation Training* (Lynn, 2010).

COGNITIVE READINESS

The phrase "cognitive readiness" entered the common military lexicon approximately a decade ago. According to Morrison and Fletcher (2002), who offered one of its first definitions, *cognitive readiness* describes the mental preparation an individual must establish and sustain, in order to perform effectively in the complex and unpredictable environment of modern military operations (Morrison & Fletcher, 2002). These two Institute for Defense Analysis researchers also defined ten core cognitive readiness competencies:

- Situation awareness
- Memory
- Transfer of training
- Metacognition
- Automaticity
- Problem solving
- Decision-making
- Mental Flexibility and Creativity
- Leadership
- Emotion

Along similar lines, the current Marine Corps Small Unit Decision Making (SUDM) initiative has identified five skills as the critical cognitive competencies of small unit leaders (SUDM, 2011):

- Sensemaking
- Problem Solving
- Adaptability
- Metacognition
- Attentional Control

Other examples could certainly be described (see Becker & Schatz, 2010, for a review). Yet, despite support from military leaders, the Services have yet to systematically implement cognitive readiness training and education.

Institutionalization of Cognitive Readiness

The institutionalization of cognitive readiness faces several barriers (see Fautua & Schatz, under review, for a more detailed discussion). Key challenges include:

1. The training and education community must recognize that higher-order cognitive skills development requires fundamentally *new* training methods and associated policy—not merely a slight deviation from the status quo.
2. Commonly discussed cognitive competencies, such as those described by Morrison and Fletcher,

must be better operationalized for instructional and measurement purposes.

In this paper, we extend upon our previous manuscript in an attempt to better operationalize approaches for addressing these challenges.

CHALLENGE #1: NEW VS. NEWS

At the 2010 I/ITSEC, in the Adaptability and Complex Decision-Making special event, Dr. Alan Kay described the challenges of recognizing "new vs. news." Using this metaphor, Kay described how the Medieval Catholic Church did not view Gutenburg's printing press as a "new"—i.e., as a foundationally vital—invention. Rather the Church saw the printing press as "news," that is, as an incremental update of the status quo. As a result, the Church was slow to recognize the impact the printing press might have on society. In the end, the printing press became the catalyst for the Renaissance and subsequent Reformation, which ultimately reduced the power of the Church.

The "new vs. news" metaphor helps to explain, in part, how and why certain industries are slow to adapt to innovative change despite awareness of the innovation. More modern "new vs. news" examples include Toyota and other Asian car producers marginalizing US automobile manufactories in 1960s, Personal Computer companies such as Apple surpassing mainframe producers like IBM in the 1980s, and no-frills airlines like Southwest driving traditional aviation firms into bankruptcy in the 1990s. In each case the "new" (i.e., profoundly novel) innovation was seen but interpreted as "news" (i.e., an incremental, and therefore less significant, variant of the status quo) causing a lag to adapt (Miller & Ireland, 2005; Govindarajan & Trimble, 2010; Kuhn & Masick, 2005).

Kay's metaphor is analogous to Thomas Kuhn's notion of "normal science" versus a "paradigm shift." Kuhn posited that most academic inquiries are incremental additions to a given, widely believed construct. He calls this normal science. In contrast, a paradigm shift occurs when scientists make a discovery that radically changes the foundational beliefs of their discipline.

Following the path described by Kuhn and Kay, we argue that systematic, Service-wide cognitive readiness instruction for all echelons represents a paradigm shift for military training. It is fundamentally *new*—more significant than just incremental *news*.

As USMC General Joseph J. Dunford, Assistant Commandant of the Marine Corps, explained at the January 2011 SUDM workshop, the comprehensive implementation of cognitive readiness training, particularly at the lower echelons, will be commensurate with the implementation of maneuver warfare doctrine in the late 1980s. In other words, he suggested that the comprehensive institutionalization of cognitive readiness would represent a substantial, institutional change for Marines—and, we add, the Joint Force. However, widespread cognitive readiness will only be possible if more senior leaders recognize the importance of, and provide sustained support for, these competencies (Fautua & Schatz, under review; see also Rosello, 2009).

Valuing Cognitive Readiness

Unfortunately, senior leaders and policymakers may fail to recognize the full importance of widespread cognitive readiness for the military. Essential cognitive and relational competencies may, instead, be viewed as mere "soft skills" and perceived as secondary to more traditional, kinetic "hard skills." In other words, cognitive readiness may be seen as "nice to have" but not "need to have"—particularly for lower echelon personnel.

Consequently, military policymakers may struggle to sufficiently support cognitive skills efforts, particularly when they compete for resources against other forms of education, training, and assessment. Cognitive skills instruction may lack the immediate appeal of kinetically focused endeavors or the pull of technologically based investments. Or, as stated more plainly by Army Major General Robert H. Scales (Ret.), raising the priority of psychological skills and cultural training in a techno-centric environment may be a "tough sell" (Scales, 2006). However, implementing such training and education programs across the Services could have a substantial effect with relatively little investment in resources, compared to investments in large scale weapons systems.

Finally, even if leaders recognize the importance of cognitive competencies and commit resources to them, curriculum developers may fail to sufficiently adjust. Developers may mistakenly interpret cognitive readiness instruction in a procedural fashion, similar to training for hard skills. That is, implementers and related decision-makers may misperceive cognitive readiness training as merely *news*, i.e., as a slight adjustment to developed doctrine and programs of instruction, instead of a new paradigm that requires novel techniques, metrics, and standards.

Fortunately, these legacy mindsets are slowly changing as various military organizations, school centers, and

operational units work together with researchers developing instructional training model advancements and the accompanying measurements for training (this is evidenced, in particular, by the Marine Corps' SUDM effort, mentioned briefly above). However, even after military leaders and instructional practitioners "buy-in" to the institutionalization of cognitive readiness, they still require tools with which to implement it.

CHALLENGE #2: COGNITIVE TRAINING

One of the major barriers to achieving cognitive readiness is its abstract nature. Outside of the academic community, most people cannot readily describe what *sensemaking* or *metacognition* entail, let alone identify appropriate instructional activities to engender these capacities. Although the research community has developed effective implementations of such training, investigators must now identify reachable, scalable, and measurable ways to translate the results of their research into actionable, practice that is readily implemented by the military.

We have recently created a concept, called the Cognitive Skill–Stance (CSS) Hierarchy, which may provide a starting place for facilitating cognitive readiness training and assessment (see Fautua & Schatz, under review). The CSS Hierarchy helps explicitly articulate the linkages between situated, observable concepts and more abstract cognitive constructs. Within the various levels of the CSS Hierarchy, curriculum developers can embed appropriate training recommendations and standards of performance.

Although its real utility must be determined through empirical testing, we believe that through use of the CSS Hierarchy, researchers and practitioners can begin to converge upon a shared understanding of cognitive readiness. The authors have been collaboratively working with TECOM to do just that: operationalize the CSS Hierarchy model to develop easy-to-implement and effective instructional tools designed to be used by sergeant-, lieutenant- and captain-level instructors to develop higher-order decision-making competencies.

Cognitive Skill–Stance (CSS) Hierarchy

The concept of a CSS Hierarchy was adapted from the field of engineering, specifically from Rasmussen's Abstraction Hierarchy (1986). Abstraction Hierarchies are multilevel-level diagrams that represent complex systems as a series of goal-directed rows and part–whole columns (see Figure 1). In the CSS Hierarchy, the higher-level rows specify goals and abstract concepts, while the lower-levels describe discrete implementations, like specific situations or scenarios. The diagram's leftmost columns represented whole-system components (such as battalions, Services, or Joint capabilities), and the rightmost columns describe smaller-scale units.

Once populated, each level of the CSS hierarchy will include specific concepts and competencies (depicted as boxes) that 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, metrics, and instructional suggestions. In so doing, different performance and instruction standards can be articulated based upon the differing degrees of abstraction. For instance, more conceptual ideas (at the higher levels) can be described as general goals and educational techniques, and more contextualized components (at the lower levels) can be linked to explicit performance metrics and training strategies (Fautua & Schatz, under review; see also Fowlkes, Schatz, Stagl, & Norman, 2010).

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 proposed CSS Hierarchy, adapted from Rasmussen's abstraction hierarchy

Defining Terms: Cognitive, Skill, and Stance

We dubbed the representation a "cognitive skill–stance" hierarchy, after much thought. The term *cognitive* is intended to incorporate both traditionally "intellectual" skills, as well as related psychological proficiencies, such as psychosocial skills. This is the way in which researchers typically define cognitive readiness (see Morrison & Fletcher, 2002).

The word *skill* implies "a capacity, usually acquired through training and experience, to do something well, to perform competently certain tasks" (Smith, 2002, p. 661). Skills are repeatable and teachable, largely subject to conscious control, and must be exercised by choice (Smith, 2002; see also Becker & Schatz, 2010).

The term *stance*, however, may seem peculiar. It is intended to evoke the automaticity of experts and to reflect deep mastery of relevant knowledge, skills, and attitudes, similar to how Grisogono (2007) uses the term, when she refers to an "Adaptive Stance." The logical epitome of cognitive readiness is to engender it so deeply that the cognitive and relational skills transcend the level of a *skill* and develops into a *stance*. More precisely, a stance reflects the pervasive automaticity of a skill or a "cognitive ways-of-being." It is, we hope, a more accessible description of similar psychological constructs, such as unconscious competence or, more accurately, "conscious competence of unconscious competence" (Chapman, 2010).

To better describe the notion of a stance, consider this example: Despite the hectic and dangerous activities on an aircraft carrier deck, the accident rate is kept to a minimum. Researchers attribute this phenomenon not simply to good training, but also to focused mindfulness where even the weakest anomaly (of danger) is detected by deck hands, all of who maintain a culture of safety and precision (Weick, 2003; Stanley, 2010; Baran & Scott, 2010). Those personnel have developed stances by deliberate and focused training, extensive feedback, and the encouragement of corresponding attitudes. Their competencies, in skills such as sensemaking and mindfulness, prepare these personnel for the cognitive demands inherent in that environment, enabling them to perceive and react to even the weakest signals of potential safety issues, such as an errant sheet of paper floating across the deck.

Such "cognitive stances," re-scoped to include a wider set of competencies and for a broader range of personnel, is our vision of cognitive readiness.

CSS Hierarchy Rows, in Detail

As mentioned above, the uppermost rows of the hierarchy describe abstract competencies, while the lower rows express more prescriptive, more explicit skills, metrics, and training events.

- *High-Level Goals:* This row of the hierarchy differs from the others, in that it contains goals instead of skills. These goals may include commanders' intent, rules of engagement, or core Service values. They could also include objectives applicable to interagency and multinational partners as well. By linking skills to their desired effects, personnel will be better able to understand "why," adopt appropriate goal orientations, and develop the attitudes necessary to maintain appropriate stances. To refer back to the carrier example, a possible goal may be "maintain safety at all times."
- *Macrocognitive Skills:* This level of the hierarchy describes multifaceted constructs, such as "decision-making" or "sensemaking." In general, these capacities cannot be directly trained. Instead, they must be broken down into related subskills and practiced in contextualized settings. Similarly, they can only be truly assessed in real (or realistic) performance environments.
- *Microcognitive Skills*: This level reflects the subskills mention above. These include train-able cognitive skills, such as "pattern recognition" or "creative solution generation." Although all levels of the hierarchy are intended to include definitions, instructional guidance, and standards for performance, the skills at this level begin to be associated with more immediately tangible performance criteria and explicit teaching approaches.
- *Operational Tasks:* At this level of the hierarchy, the microcognitive skills are translated into proceduralized forms and explicit descriptions suitable for didactic instructions or drill-and-practice. In other words, the cognitive skills are translated into more traditional tasks, conditions, and standards and more narrowly described based upon the trainees' duty assignments.

  However, personnel who meet the standards of this level have not yet developed cognitive readiness; instead, this level of the hierarchy provides (necessarily) limited descriptions of the cognitive and relational competencies as a scaffold to deeper understanding. As in the microcognitive row, skills listed in this level are packaged with performance metrics, training recommendations, and other guidance.
- *Situated Training Events:* Finally, the lowest level of the hierarchy (like the uppermost) differs from the others. Instead of describing skills, per se, the lowermost row describes contextualizations of the skills, such as training scenarios, case studies, or tactical decision-games. All of these elements are also linked to explicit Measures of Performance (MOPs), Measures of Effectiveness (MOEs),

recommended instructional techniques, and similar training support.

This lowest level provides immediately actionable task-specific information that instructors and curriculum developers can immediately understand, regardless of whether they can personally describe the nuances of the more complex (higher-level) cognitive and relational constructs.

Figure 2 provides a limited, stylized example of how these rows may be used. The example is limited to the rightmost column of the hierarchy, i.e., it only depicts skills at the individual level.

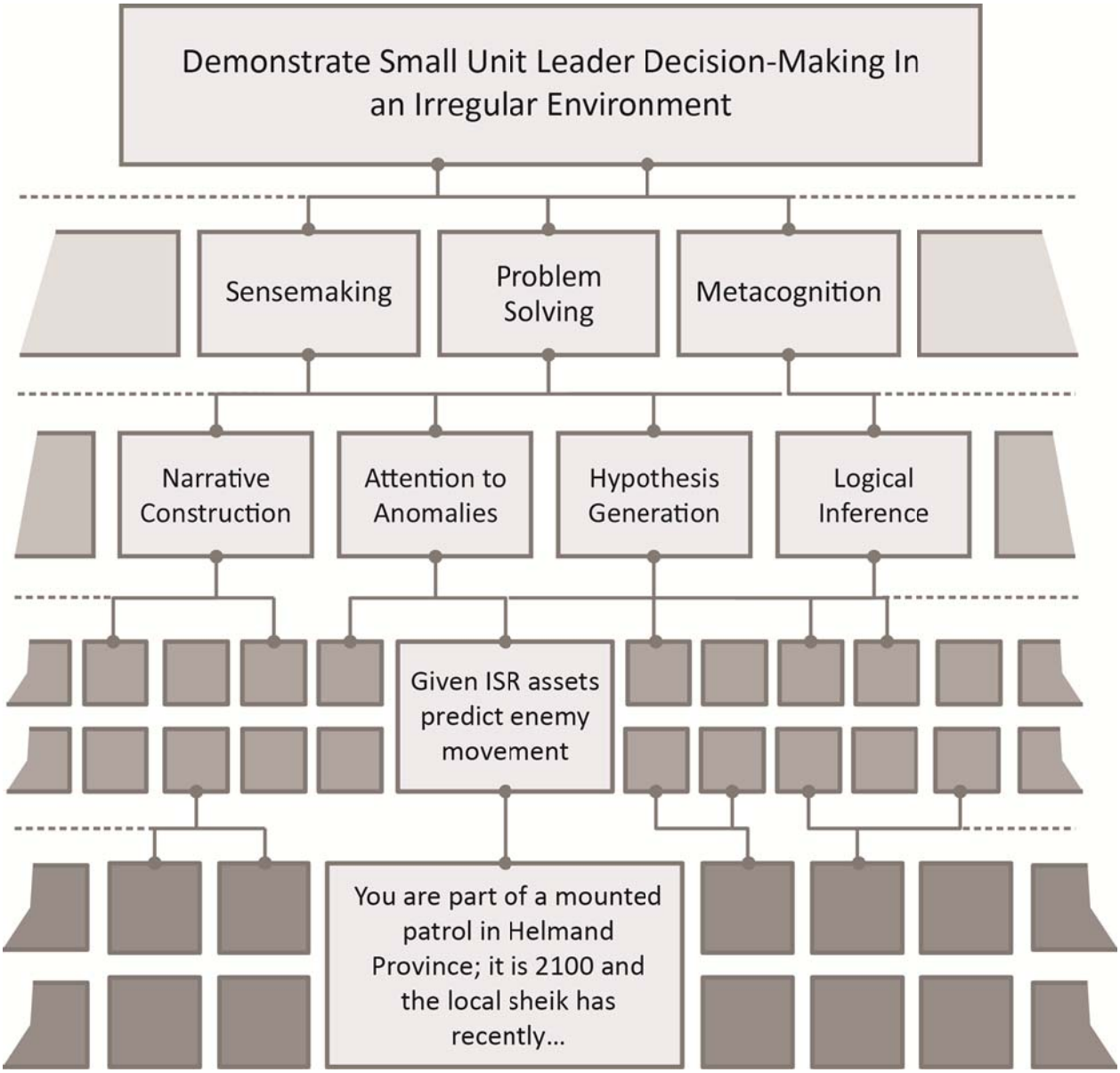

Figure 2. Limited example of the CSS Hierarchy in the context of individual decision-making
Sample content provided for explanatory purposes; not intended to definitively describe decision-making

CSS Hierarchy Columns, in Detail

The hierarchy's horizontal axis conveys a whole–part relationship, from the individual level, through squads and other small units, and up to the Service, Joint Force, or even international force levels. These columns help to emphasize both taskwork and teamwork skills, and they provide explicit links between individual actions and team, Service, or multinational goals.

VALUE OF THE CSS HIERARCHY

The CSS Hierarchy is a shared representation of lower-level and higher-order concepts, both at the individual and team levels. By its design, the hierarchy gives insights into the deeper meanings of the cognitive competencies while also providing actionable training insights, and this should practitioners codify and standardize specific higher-order knowledge, skills, and attitudes in ways consistent with evidence-based training methods. More specifically, it should help instructors and trainees developed shared mental models of cognitive readiness, provide a common language and framework with which to discuss cognitive readiness, facilitate related instructional experiences, and help bolster transfer of training.

Development of Shared Mental Models

Shared mental models describe overlapping understanding of a concept by members of a team or group. Individuals with converging models have deep, rather than merely superficial, shared views (Cannon-Bowers, Salas, & Converse, 1990). This enables team members to anticipate each other's needs, to provide back-up support, and to communicate efficiently (Stout, Cannon-Bowers, Salas, & Milanovich, 1999).

For cognitive readiness to become a pervasive training and education concept, military instructors and trainees must develop shared mental models of this concept. Unfortunately, abstract and complex ideas, like sensemaking or mindfulness, typically cannot be quickly and fully explained with simple examples. Deep understanding of such notions is instead derived through experience and through mentally linking those experiences to other thoughts, ideas, and memories (Piaget, 1967). Or, stated more plainly, researchers cannot merely define cognitive competencies and hope that instructors will similarly interpret their meanings and devise appropriate collectively understood training accordingly.

The hierarchy acts as a schematic, explicitly articulating the concepts of cognitive readiness in a way that facilitates shared understanding. Once populated, it should facilitate the creation of shared mental models regarding cognitive readiness.

Actionable Training and Assessment

Some critics may assert that the recommendations related to cognitive readiness lack actionable operationalizations or that cognitive readiness is too "fuzzy" to train and assess. In other cases, practitioners who otherwise support cognitive readiness instruction may nonetheless struggle to explicitly define cognitive readiness skills, formal metrics, and most appropriate instructional approaches.

The CSS Hierarchy can help address some of these gaps. By situating the abstract skills (at the higher levels) into specific contexts (at the lower levels), the diagram provides a consistent "re-contextualization" from the abstract to the practical. Further, by integrating descriptions, metrics, and instructional advice across each cell, the hierarchy provides appropriately tailored guidance—neither too restrictive for complex constructs nor too esoteric for practical training. In these ways, the hierarchy can enable instructors to develop realistic training of higher-order cognitive skill sets in accessible ways.

Transfer of Training

Finally, the hierarchy representation should help engender better horizontal and vertical transfer. Horizontal transfer refers to generalization of skills across different settings or contexts (Kozlowski & Salas, 1997). An example of horizontal transfer is learning the skill "perspective taking" for a mission in Afghanistan and then being able to generalize some of those capacities to a new mission in, say, the Horn of Africa. By describing higher-order concepts, while still training to mission-centric operational tasks and situated training events, the hierarchy should assist instructors to better facilitate such horizontal transfer.

Vertical transfer describes to transfer upwards, across different levels of the organizational system (Kozlowski, Brown, Weissbein, Cannon-Bowers, and Salas, 2000). In other words, vertical transfer involves the interlinking of individual training outcomes with higher-level systems outcomes. In traditional training contexts, vertical transfer receives less attention than horizontal transfer; however, "vertical transfer is a key leverage point for strengthening the link between training and organizational effectiveness" (Kozlowski et al., 2000). The horizontal linkages, as well as explicit ties between skills and high-level goals, are intended to facilitate improved vertical transfer.

What the CSS Hierarchy is *Not*

The proposed CSS Hierarchy may seem reminiscent of other cognitive skill frameworks, such as well-known taxonomies created by Gagne (1985), Bloom (1956), Anderson (1981), or Merrill (1983). However, the CSS Hierarchy is not intended to supplant these established frameworks. Instead, the Hierarchy should provide a means by which cognitive skills can be more readily operationalized and articulated for real-world military instruction.

In other words, the CSS Hierarchy should support cognitive readiness curriculum development by providing a structure that facilitates the *articulation* and *operationalization* of cognitive skills. However, the Hierarchy will not directly support the *identification* of cognitive skills. To identify appropriate cognitive skills, curriculum developers will need to turn to content-focused research, such as Bloom or Gagne's work, rather than the structure-focused concepts described in this paper.

CSS HIERARCHY LIMITATIONS

Although the CSS Hierarchy has proved to be a useful tool in some of our initial trials with it (e.g., as applied to Marine Corps SUDM training concepts), it is not a "silver bullet" for training. First, as in most things, the quality of knowledge gleaned from the Hierarchy depends upon the quality of data inserted into it (i.e., "garbage in, garbage out"). Thus, researchers, curriculum developers, and instructors must carefully consider the content as they attempt to populate and/or employ a CSS Hierarchy.

Second, through informal testing with military curriculum developers, we have determined that more instructions, completed Hierarchy examples, and corresponding "worksheets" must be developed to facilitate Hierarchy use. For instance, some end-users have requested that we also develop frameworks that help curriculum developers and instructors more readily identify appropriate instructional strategies and assessment techniques. These resources will help curriculum development committees and military instructors more easily define, breakdown, and link instructional methods to the "boxes" within the CSS Hierarchy.

Third, related to item above, curriculum developers have found it difficult to link traditional Training and Readiness (T&R) tasks, which generally emphasize psychomotor behaviors, to the cognitive skills found at the higher levels of the Hierarchy. To help resolve this issue, we are exploring the development of procedural instructions and worksheets to help "unpack" this process into clearer, more manageable steps. However, connecting operational training tasks (e.g., T&R tasks) to the more abstract cognitive readiness educational objectives remains a challenging activity.

Finally, as with all emerging concepts, the ultimate utility and efficacy of the CSS Hierarchy must be determined in the future through empirical testing and impact assessment. Also, the Hierarchy and its associated usage procedures and "worksheets" will surely be further refined as ongoing use and empirical testing help refine its structure and usage instructions.

NEXT STEPS

Continuing efforts are currently underway to identify the core competencies of cognitive readiness and, hopefully, populate the CSS hierarchy with meaningful results. Although we do not have those answers yet, it is our intention that, through discussions of the Hierarchy and its potential employment, we can encourage related researchers to work towards this cause and deliver results in a common form that can be easily applied by military instructors, i.e., the CSS Hierarchy.

CONCLUSION

In this paper, we have offered a metaphor (i.e., "new vs. news") and process (i.e., the CSS Hierarchy) intended to assist the Services as they attempt to accelerate the acquisition of cognitive expertise and expand cognitive readiness instruction at the lower echelons. More specifically, it is our intention to provide a simple tool to mobilize application of these concepts and then help facilitate the development of systematic military cognitive readiness training.

Achieving Service-wide cognitive readiness is a potential game-changer for military operations (Klein & Weick, 2000). Or, as Major General Scales [ret.], remarked: "harnessing the social and human sciences as the essential amplifiers of military performance just as the physical sciences were the amplifiers of past world wars" (Scales, 2006). However, institutionalizing cognitive readiness will require a cultural shift (Scales, 2006). Among the instructional community, in particular, new perspectives must be encouraged. Training, education, and assessment of cognitive and relational competencies require different approaches than are commonly employed for lower-echelon training today.

The theme of this year's I/ITSEC is "Prepare the Force…Secure the Future." The institutionalization of cognitive readiness, across all echelons, reflects that motto. It is through increased emphasis on cognitive readiness that the Joint Force will be best prepared, best able to secure success, both today and in the future.

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