Chapter 2
The Evolving Definition of Cognitive Readiness for Military Operations

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Readiness, including cognitive readiness, means different things to different people. In education, we speak of readiness to learn—readiness for third-grade reading, readiness for Algebra I, readiness for Physics 101, and so forth. In training, we usually mean readiness to do something—perform a task, job, or mission. Certainly the two meanings are related. They are both intended to be measureable indications of preparation to do something. Learning is itself doing something, and, conversely, the act of doing something may bring about learning. Interdependency between these two perspectives deserves more discussion, but that must remain an issue for elsewhere. The focus in this chapter is on preparation to perform task-based military missions.

2.1 Readiness

Operational readiness in the Department of Defense (DoD) keys on items that can be measured. Historically, these items fall into four basic categories that are reported for each organizational unit:

- Materiel—enough "systems" such as aircraft, tanks, trucks, radios, and radars
- Equipment—enough spares, supplies, and consumables
- Personnel—enough people certified by training to have the necessary skills at the necessary skill levels to perform anticipated unit missions

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- Training—completion by the unit of a required number of annual training events such as field exercises, firing range exercises, command and control exercises, and fleet exercises

These categories have been used in one form or another for many years and by various mandated reporting systems to assess each unit's readiness to perform its missions. A unit that satisfies criterion levels for materiel, equipment, personnel, and training is assumed to be "ready." The four categories have been found to be useful and necessary for assessing unit readiness. The issue raised by cognitive readiness is whether more could and possibly should be done to assess readiness.

2.2 Cognitive Readiness

Nothing is so certain in military operations as unpredictability. Unanticipated tactics, new technological capabilities, novel applications of existing technologies, and surprise are all notoriously characteristic of combat engagements. Noncombat military operations such as peacemaking, peacekeeping, humanitarian relief, and crisis management are also known for their potential to bring on unanticipated challenges.

Military units and personnel can be prepared to assume anticipated roles and responsibilities, and much can be done to train them for the missions they are expected to perform. These missions can be decomposed into specific tasks. The tasks may be identified as essential for individuals and units to perform alone or with other individuals and units including those involved in joint (multiservice and/or multinational) missions. The tasks are described in detail for readiness assessment along with the conditions under which they are to be performed and the standards for performance that they must satisfy. If all goes well, the resulting lists of tasks lead to education and training objectives.

The reductionist nature of this approach has been a matter of concern because of the eventual need to deal with the whole of unit performance once these tasks are reaggregated into mission functions (e.g., Hiller, 1987). Reassembling tasks into capable mission performance is addressed by the recent development of mission-essential competencies, which tie the successful performance of mission-essential tasks to the underlying cognitive capabilities needed to perform them successfully (e.g., Alliger, Colegrove, & Bennett, 2003; Chapman, Colegrove, & Greschke, in press). But even with task and competency requirements fully met, the potential for chaos, the unexpected, awaits.

How, then, do we prepare people, teams, and organizational units for the unexpected, which by definition is something we cannot anticipate? Following the lead of Etter, Foster, and Steele (2000), we began to treat this matter as an issue of cognitive readiness, for which Morrison and Fletcher (2002) tentatively suggested the following definition:

> *Cognitive readiness* is the mental preparation (including skills, knowledge, abilities, motivations, and personal dispositions) an individual needs to establish and sustain competent performance in the complex and unpredictable environment of modern military operations. (p. I-3)

Military training, especially training provided to certify and ensure personnel readiness, provides instruction in necessary knowledge and skills, which are embodied in instructional content, such as facts, concepts, and straightforward procedures, and instructional objectives, such as memorizing, understanding, and applying this content.

But "training readiness," which is a central issue for local unit commanders, keys on more context-free, transferable instructional abilities that match content such as adaptive procedures with objectives such as analysis, evaluation, and creative synthesis of new approaches. These abilities allow individuals and units to adapt the knowledge and skills they possess to rapidly evolving operational environments. Training to acquire these abilities is based on realistic experiences that develop what Sternberg (e.g., 2006b; Sternberg & Hedlund, 2002) describes as tacit knowledge—knowledge built up from experience that enables individuals to solve real-world, practical problems. This knowledge is also suggested by Klein's discussion (e.g., 1989) of recognition-primed decision-making focused on the rapid, intuitive decisions so frequently required by military operations.

Both tacit knowledge and recognition-primed decision-making are relevant to current notions of cognitive readiness. This is where the authenticated, situated experiences, so strongly promoted by constructivists (e.g., Tobias & Duffy, 2009) and delivered by simulations and games (e.g., Tobias & Fletcher, 2011), may find a critical role. The primary ingredient added by cognitive readiness is the inclusion of unexpected problems and opportunities in training simulations used to develop individual and unit readiness.

The unexpected is a frequent and widespread characteristic of the free-play, force-on-force engagements found in training exercises—and in military operations themselves. Free-play exercises enable leaders at every level to develop abstract, relatively context-free competencies that can be enhanced through training and measured to assess readiness (Chatham & Braddock, 2001; Gorman, 1990). They provide opportunities for the experiences and pattern recognition development upon which Sternberg's tacit knowledge and Klein's recognition-primed Decision-Making can be established at the general, context-independent level needed to deal with the unexpected.

Cognitive readiness then applies to all military operations, but it is particularly relevant to situations that arise suddenly and require immediate attention—situations that are increasingly characteristic of today's "irregular warfare" operating environment. These characteristics, expanded from those listed by Hurley, Resnick, and Wahlman (2007), include:

- Central role of "human terrain" (local culture, language, customs, norms, and mores)
- Close cooperation of civilian and military organizations in performing their operations
- Emphasis on small-unit operations as they engage allied, opposing, and nonaligned individuals and groups
- Consolidation and coordination of peacemaking, peacekeeping, and social reconstruction operations
- Activity to ensure that host nation's military and civilian organizations are sufficiently secure, stable, and legitimate to assume the responsibilities assigned to them
- Abandonment by adversaries of established norms in treatment of prisoners and nonaligned civilians and the use of chemical, biological, radiological, and nuclear weaponry

Cognitive readiness is as relevant to irregular as to regular warfare. In both cases it raises a number of issues. Can it be better defined? Can it be measured? Can it be trained? Should it be routinely included in routine readiness assessments of individuals, teams, and/or units—military and otherwise?

Post-engagement reviews and analyses such as those provided by Christianson and Zirkle (1992), Orlansky and Thorpe (1992), and Knarr and Richbourg (2008) point to a general description of cognitive readiness in military operations as the ability to:

(a) Remove ambiguity and recognize patterns in uncertain, confusing, and chaotic situations.
(b) Identify and prioritize problems and opportunities presented by these situations.
(c) Devise effective responses to the problems or opportunities presented.
(d) Implement these responses.

Given these characteristics, what components or attributes do they, then, suggest for cognitive readiness? To get the conversation started, Morrison and Fletcher (2002) suggested the attributes shown in column two of Table 2.1. Column three lists subsequent components proposed by O'Neil and discussed by O'Neil, Lang, Perez, Escalante, and Fox (this volume). Column four lists the components proposed and reviewed for this chapter.

O'Neil made a significant advance over the original suggestions by Morrison and Fletcher by further reviewing and analyzing cognitive readiness into specific knowledge, skills, and attributes. He eliminated Transfer, Memory, Automaticity, and Leadership from those proposed by Morrison and Fletcher. He also eliminated Emotion, which he deemed an affective, noncognitive component. He peeled off Adaptive Expertise as a competency from Adaptability as a skill and added Teamwork and Communication. Finally his model includes Knowledge, in the form of Prerequisite and Context Knowledge.

Table 2.1 Components of cognitive readiness proposed by Morrison and Fletcher (column two), O'Neil (column three), and this chapter (column four)

Attribute	Morrison and Fletcher	O'Neil	Fletcher and Wind
Situation Awareness	X	X	X
Problem Solving	X	X	X
Metacognition	X	X	X
Decision-Making	X	X	X
Adaptability	X	X	X
Creativity	X	X	X
Transfer	X		
Pattern Recognition	X		X
Automaticity	X		
Leadership	X		
Emotion	X		
Teamwork		X	X
Communication		X	X
Adaptive Expertise		X	
Interpersonal Skills			X
Resilience			X
Critical Thinking			X

This chapter argues that the components of cognitive readiness should be relatively content- and context-free. If they were not, we would be dealing with anticipated matters and no longer in the land of the unanticipated and unexpected. For this reason, "Knowledge" components are not included in the framework presented here.

This suggestion may occasion some debate by echoing the notion of developing cognitive functions rather than specifically targeted knowledge and skills—of learning Latin to develop cognitive functions that will help us to learn German, solve math problems, or perform other cognitive activities. The contrary idea, which reaches back to E. L. Thorndike's transfer through identical elements (e.g., 1913; Thorndike & Woodworth, 1901) is that if the objective is to learn German or solve math problems, then we should study German or math, not begin with Latin—valuable though that may be in keeping classics scholars employed.

However, in dealing with the unexpected we simply do not know in advance what the objectives of instruction should be or what identical elements they may present. We need to find ways to develop widely usable and context-independent abilities or to select individuals who already have them. This suggestion brings us to the candidate components listed in column four of Table 2.1 and proposed for consideration in this chapter.

The components originally suggested by Morrison and Fletcher and included by O'Neil and this chapter are Situation Awareness, Problem Solving, Metacognition, Decision-Making, Adaptability, and Creative Thinking. We accepted O'Neil's elimination of Transfer, Automaticity, and Leadership. We also accepted his elimination of Emotion from the list, although we view and include emotional control as an aspect of Resilience. We agreed with O'Neil's inclusion of Communication and Teamwork, while adding Interpersonal Skills, Resilience, and Critical Thinking. All these components may eventually need to be bundled or unbundled as thought and research continue. We did not separate out Adaptive Expertise, but left it bundled under Adaptability, even though our focus is quite close to O'Neil's notion of Adaptive Expertise.

We retained Memory and Pattern Recognition as components, but, as our thinking progressed, we have now focused almost exclusively on the pattern recognition functions of memory and list Pattern Recognition by itself in Table 2.1. In accord with Wickens and Flack (1988), Mayer (2005), Bolstad, Endsley, and Cuevas (this volume), and others, we view Pattern Recognition as the basis for integrating the sensory information (visual, aural, etc.) introduced by preceptors (eyes, ears, etc.) in working memory with the contents of and patterns included in long-term memory.

Pattern Recognition applies an abduction process based on intention and long-term store to identify, organize, and separate out what matters in sensory input from what does not. We suggest that Pattern Recognition is a rapid cognitive activity that enables and leads to relatively more deliberate and conscious processes of developing Situation Awareness to support Decision-Making. Pattern Recognition then continues to serve the processes required for Situation Awareness, and the two remain interdependent, but, in this framework, different.

We included Problem Solving from the original Morrison and Fletcher components, as does O'Neil, but eliminated Transfer as too context-dependent to include. We recognize that far transfer, where more abstract, analogous reasoning finds application, may be closer to Problem Solving than near transfer, which depends more on specific, concrete elements common to both settings (e.g., Barnet & Ceci, 2002). We also surmise that Transfer resembles Problem Solving more as we ascend from what Salomon and Perkins (1989) described as low-road transfer (which occurs almost automatically, with little, if any, conscious thought) to high-road transfer (requiring conscious thought and meta-cognitive skill).

Finally, Mayer and Wittrock (1996) address the relationship between Problem Solving and Transfer with their contrast of knowledge transfer and problem-solving transfer. They describe knowledge transfer as focused on learning, when prior learning improves speed or accuracy in learning something new. They describe problem-solving transfer as occurring when solving one problem improves speed or accuracy in the act of solving another one. In cognitive readiness for military operations, the issue is particularly tied to speed and accuracy in Problem Solving. The intersection between Transfer, which we eliminated, and Pattern Recognition and Problem Solving, which we include, seems real. Some forms of Transfer may serve to enable both Pattern Recognition and Problem Solving, but these two appear to be the core issues in cognitive readiness rather than Transfer, especially when it comes to dealing with the unexpected.

If attributes of cognitive readiness are to be viewed as indicators of likely operational effectiveness and included in routine assessments of military readiness, then the next step is to examine evidence that these attributes are measureable and trainable. The position of this chapter—and its current contention in furthering the conversation concerning cognitive readiness—is that these components should be:

1. Relatively content- and context-free. Each component must be applicable to a wide variety of situations that may be neither anticipated nor expected.
2. Measurable. A component of cognitive readiness may be valuable or even essential, but if it cannot be defined or detected through measurement, then it must remain a matter of chance—not a quality that is amenable to systematic assessment, selection, and development.
3. Trainable. An attribute of cognitive readiness should be trainable and not just a matter of selecting personnel for military duties. To some degree it may be born and not made, but, as a practical matter, it should be amenable to enhancement and shaping through instruction (training and/or education) to meet the needs of military operations—or any other human activity.

Of these, the third (trainable) may be the most controversial. Cognitive readiness could include components that are not trainable, but if there is nothing to be done to develop and improve them, then the military can only hope its recruiting and selection processes will provide the cognitive readiness it needs. Enhancing the availability of cognitive competencies through training and/or education seems as essential in this area as it is in others.

2.2.1 Discussion of Candidate Components

The following comments address each of the components proposed in the fourth column of Table 2.1 as candidates for inclusion in the concept of cognitive readiness. The components are addressed in the same semi-chronological order that they are presented in the table. Each is briefly described along with equally brief discussions of measures for them and evidence that they can be improved through instruction.

Situation Awareness. This component of cognitive readiness is the deliberate process based on Pattern Recognition needed to identify in any current situation what elements are relevant for achieving mission goals and to project from that how they will evolve. Endsley (1998, 2006) has provided a three-level definition of Situation Awareness that can be described as (1) the perception of elements in the environment within a volume of time and space, (2) the comprehension of their meaning, and (3) the projection of their status in the near future. Situation Awareness thereby provides the perceptual analysis that precedes decision and action.

Measurement. Evidence presented by a variety of researchers suggests that Situation Awareness can be successfully measured by the "freeze method," which involves stopping ongoing activity and examining participants' perceptions and understanding of it. Salmon et al. (2009) compared the freeze method with a posttrial subjective report and found that the scores on the former were the only measures that significantly correlated with performance on a complex task. Endsley (1995) found that it did not intrude on behavior in performing tasks and that its validity was not affected by the forgetting that can limit post-task reflection. The Situation Awareness Global Assessment Technique (SAGAT) (Endsley, 2000) is a systematic assessment using the freeze method that has been found to be both reliable and valid.

Instruction. A number of sources report that Situation Awareness can be improved through training. For instance, Soliman and Mathna (2010) found that training in modeling as a meta-cognitive strategy significantly improved scores on the SAGAT test and reduced infringements in an automobile driving task. Saus et al. (2006) found that training in reflection using the freeze method improved measures of Situation Awareness in a police shoot-not-shoot simulator. Endsley and Robertson (2000) discussed training to enhance the Situation Awareness of teams, noting that more work needs to be done in this area.

Problem Solving. Mayer and others (e.g., Mayer, 2008; Mayer & Wittrock, 1996) have defined Problem Solving as an effort to achieve a goal by transforming a given situation into an objective situation when it is not immediately obvious how to do that. Early on, Miller, Galanter, and Pribram (1960) demonstrated that Problem Solving can be cast as an analysis of task goals and subgoals. Later, Newell and Simon (1972) showed how means-ends analyses can be used to transform this analysis into a plan of action. Baker and Mayer (1999) characterized Problem Solving as cognitive, process-based, goal directed, and dependent on the capabilities of the problem solver.

Problem Solving has been the object of research from the beginning of experimental psychology. It is a multifaceted, complex area of investigation that has produced an equally multifaceted, complex literature. It is fortunate that for cognitive readiness, we need only to decide if a generalized, relatively context-free capability for Problem Solving can be identified, measured, and taught.

Measurement. Baker and Mayer (1999) distinguish between diagnostic measures of the cognitive processes used to solve problems and outcome measures of success in assessments of Problem Solving. Self-report measures such as the Problem Solving Inventory, which has been in wide use for over 20 years, are generally, if not entirely, focused on processes (D'Zurilla & Nezu, 1990). It and others of the same sort are primarily used for counseling—assessing, ameliorating, and preventing psychological disorders. As D'Zurilla and Maydeu-Olivares (1995) and others emphasize, self-report measures of Problem Solving do not assess this skill directly and may lack empirical support for their construct validity.

Computer-based assessments appear to offer considerable promise for Problem Solving in that they can present problems more realistically, manipulate difficulty in real time, and collect both process and outcome data (Baker & Mayer, 1999; O'Neil, 1999, 2002). Chung, de Vries, Cheak, Stevens, and Bewley (2002) linked participants' verbal protocols with their click-stream data to assess problem-solving ability with IMMEX (Interactive Multimedia Exercises), for which they found substantial evidence of validity. If their results can be found in other contexts, measurement of general, context-free Problem Solving may find reliability and validity though interactive computer-based assessments.

Instruction. Techniques such as focusing on problem definition and analysis, acquiring meta-cognitive skills, and managing mental set have been shown to help individuals improve their skills in solving practical problems (Baker, Niemi, & Chung, 2008), but the large research base on teaching Problem Solving mostly concerns specific contexts. Findings from efforts to teach general-purpose, relatively context-free Problem Solving are mixed and rare (Halpern, 2002; Mayer & Wittrock, 1996).

Reed (1987) found that students typically failed to recognize structural features used to solve problems in one subject area that could be directly applied to solve problems in others. Chen (2010) found students instructed in Problem Solving through a database search exercise showed no transfer on other problem solving metrics. On the other hand, Bloom and Broder (1950) found that college students who were taught problem-solving processes such as analyzing problems into parts and comparing their problem-solving processes to those of experts, scored higher on college examinations than students who did not receive the instruction. Kalyuga and Hanham (2011) used cognitive load theory to study flexible problem-solving skills for applying knowledge structures to new situations and found that these skills can be improved by providing instruction in the generalized forms of knowledge structures. In their review of knowledge transfer and problem-solving transfer, Mayer and Wittrock (1996) concluded that instruction that directly focuses on teaching for problem-solving transfer can improve the general problem-solving skills of students.

Metacognition. Metacognition refers to the executive functions of cognition, particularly those pertaining to knowledge and regulation of one's cognitive processes. Hacker (2001) emphasized the self-regulatory characteristics of Metacognition by noting that it enables individuals to be "agents of their own thinking" (p. 50).

Metacognition contrasts in an interesting way with Klein's (2003) notions of intuitive Decision-Making and Sternberg's practical intelligence (Sternberg & Hedlund, 2002) in that it is often viewed as the capacity to bring an automated (unconscious) skill under conscious control, making individuals aware of their own cognitive processes during task performance. The balance of automatic, intuitive Decision-Making with systematic, deliberate responding remains an important but poorly understood aspect of timely Decision-Making and action in cognitive readiness.

Measurement. Metacognition has been measured by self-report questionnaires such as multiple-choice Self-Regulated Learning scales (Hong, O'Neil, & Feldon, 2005), and the Metacognitive Awareness Questionnaire (Schraw & Denison, 1994). Especially notable is Students' Approaches to Learning (SAL), a self-report measure of self-regulated learning strategies, self-beliefs, motivation, and learning preferences developed with excruciating care and thoroughness for the Organisation for

Economic Co-operation and Development (OECD) (Marsh, Hau, Artelt, Baumert, & Peschar, 2006). The SAL aimed for a balance between brevity and psychometric reliability and validity. It consists of 52 items and takes about 10 min to administer. About 17 of its items cover meta-cognitive strategies of planning, monitoring, and self-regulation. An assessment using confirmatory factor analysis with a sample of 4,000 15-year-old respondents from 25 countries validated its factor structure.

Other measures involve verbal protocols that ask participants to think out loud as they solve problems. These tasks may include embedded incongruities that participants are expected to report. Alternatively, their performance may be monitored by latencies, under the assumption that awareness of incongruities may increase reaction times (Royer, Cisero, & Carlo, 1993). The Metacognitive Knowledge Monitoring Assessment (KMA) procedure has been investigated in 26 studies by Tobias and Everson (2009) who found it to demonstrate substantial construct validity. Meta-cognitive measures are reviewed and discussed more extensively in a volume edited by Hacker, Dunlosky, and Graesser (2009). Overall, it appears that Metacognition and meta-cognitive process can be measured with sufficient reliability and validity for a wide spectrum of purposes.

Instruction. Instruction can improve meta-cognitive performance in a variety of subjects as concluded by Clark and Wittrock (2000) and Hacker et al. (2009). Clark and Wittrock emphasize that although meta-cognitive skills can be trained, "they require more than a few days of a study-skill course" (p. 75). Mayer and Wittrock (1996) list a number of studies that found context-specific improvement of meta-cognitive skills through instruction. Hartman and Sternberg (1993) identified four approaches—general awareness; use of meta-cognitive strategies; providing heuristics for planning, monitoring, and evaluation; and rewarding self-reflection—that have been found to successfully improve Metacognition. Mevarech and Kramarski (1997) used a related approach involving meta-cognitive questioning, practice, review, and verification to improve meta-cognitive mathematics skills that might be applied successfully elsewhere. In a review of research on Metacognition, Walker and Schneider (2009) present strong evidence that meta-cognitive skills can be improved through instruction and describe a variety of instructional approaches that have been found through research to do so reliably.

Decision-Making. After World War II, many military decision-making models were based on operations research (Gass & Assad, 2005). These models in turn were based on economic theories of utility maximization, which assumes that users are (1) completely informed about all major courses of action that apply to a given situation, (2) sensitive to differences that distinguish the courses of action, and (3) rational in their choice of courses of action (Slovic, Lichtenstein, & Fischoff, 1988). These assumptions are not unreasonable if planners are given sufficient time to implement the decision-making process in accord with the prescriptive requirements of operations research. However, these assumptions become increasingly untenable in time-critical situations when they must deal with unexpected situations.

Alternatively, Klein (1989) developed a "naturalistic" model of Decision-Making for the real-world, time-sensitive exigencies of military operations. Sometimes described as macro-cognition (Klein et al., 2003), this view focuses on rapid, real-world, and "satisficing" (satisfactory and sufficient, but not necessarily optimal, per Simon, 1956) decisions made in response to experience-developed patterns in complex, high-stakes, exigent situations with ill-defined and often multiple goals. It is closely related to Sternberg's notion of tacit knowledge, which is acquired through a mixture of formal training and wide practical experience (Hedlund et al., 2003; Sternberg, 1997; Sternberg & Hedlund, 2002). As these authors point out, experts frequently use macro-cognition and tacit knowledge to solve pressing, complex problems even though they cannot articulate precisely what it is, how they acquired it, or how they have applied it.

In Klein's recognition-primed Decision-Making, a decision-maker initially assesses the situation to recognize familiar patterns stored in memory. Once the decision-maker selects or generates a candidate alternative based on this Pattern Recognition, he/she mentally simulates its implementation in the present situation. If the outcome is acceptable, or satisficing, it is selected and implemented. If the outcome is not acceptable, the decision-maker discards the alternative and generates another. Klein's model, then, differs from operations research in at least two ways. First, its decisions are made rapidly, or intuitively (Klein, 2003), rather than through carefully deliberated selection of alternatives along with their estimated payoff and probability of success. Second, its decisions are only expected to satisfy current needs satisfactorily; they are not necessarily optimal.

Decision-Making based on the operations research model can be learned and applied academically. Because this chapter emphasizes Decision-Making in military operations, it is focused on matters like Klein's recognition-primed Decision-Making and Sternberg's tacit knowledge. The central issue here is whether intuitive Decision-Making, which seems essential for dealing with the unexpected at the tactical and operational level of military activity, can be measured and improved by instruction.

Measurement. Miller (1993) used the Miller Intuitiveness Instrument and its self-reporting approach to assess the use of intuition in Decision-Making. On the basis of this assessment, she found the instrument to be both reliable and valid in quantifying the self-perception of intuitiveness among practicing nurses (Miller, 1993). Kahneman and Klein (2009) discussed the boundary conditions between true intuitive skill and overconfident, biased impressions. They determined that the distinction keys on the predictability of the situation and the decision-maker's opportunities and ability to learn its regularities. They conclude that self-reported experience does not provide valid measures of intuitive decision-making capability. Results on this point are therefore mixed.

In general, research on measuring the accuracy and use of intuition in Decision-Making appears scarce. Such a measure might well be developed by applying Simon's (1992) view that situations provide cues to solutions that experts recognize and apply—perhaps automatically and unconsciously, perhaps through patterns they have stored in long-term memory. Such recognition requires at least three conditions: (1) the situation provides necessary cues; (2) the decision-maker recognizes them as relevant and important (solving the abduction problem); and (3) the decision-maker's memory contains information, such as patterns, concerning these cues. An instrument might be constructed around these conditions.

Instruction. Given that tacit knowledge can be measured (e.g., Hedlund et al., 2003; Sternberg & Hedlund, 2002) and attributed to experience, it seems likely that it can be improved and its acquisition accelerated through experience-providing instruction (e.g., Fletcher & Morrison, 2012). In doing so, it may well enable the recognition-primed decision-making advocated by Klein (2003). Context-specific evidence can be derived from the US military combat training centers that developed out of the Vietnam-era "Top Gun" experience. These centers provide free-play, force-on-force exercises that dramatically improve success in military operations (Chatham & Braddock, 2001; Fletcher, 2009). Given the success of these centers in preparing individuals, teams, and units for a wide variety of military operations, which almost inevitably include the unexpected, it seems likely that context-independent intuitive Decision-Making is improved through instruction of this sort.

Sternberg's measures of Tripartite Intelligence demonstrate that measurable, context-independent individual differences exist in the ability to acquire and apply the tacit knowledge (e.g., Sternberg, 2006b) needed for intuitive Decision-Making. It therefore seems likely that context-independent cognitive readiness for intuitive Decision-Making can be developed and improved through instruction. However, demonstrating that context-independent intuitive Decision-Making can be developed or improved through instruction remains hampered by the absence of a direct measure for it.

Adaptability. Sometimes referred to as cognitive agility, the ability to deal adaptively with unanticipated situations is essential in many contexts and has been discussed by a number of commentators (e.g., Burns & Freeman, 2008, 2010; Morrison & Fletcher, 2002; Fletcher, 2004; Zaccaro, Weis, Chen, & Matthews, this volume). In today's environment for military operations, new adversaries continually arise using new tactics. In academia, students and instructors have to adapt knowledge that is developing at an accelerating rate. In the workforce, military and, otherwise, technological innovations continue to create new occupations, new techniques, and new organizational structures. Adaptive adjustment to these challenges, especially those that are unexpected, is an imperative for individuals and organizations in all sectors.

As Zaccaro, Weis, Chen, and Matthews (this volume) point out, a number of commentators distinguish between routine and adaptive expertise. This is a helpful distinction; it is the latter expertise that is the focus of this chapter. Notably, Zaccaro et al. emphasize the importance of noncognitive contributors to adaptive expertise. These contributors are not considered in this chapter, which focuses on cognitive issues, but they are not insignificant and deserve attention as readiness issues expand into noncognitive areas.

Measurement. Le Pine, Colquitt, and Erez (2000) developed a computerized task with 75 problems in which the rules determining correctness change unexpectedly. They found strong and reliable differences among subjects in their ability to adapt to the changes. Potosky and Ramakrishna (2002) developed a self-report measure of adaptive self-efficacy that included the individuals' belief that they could learn new skills quickly. Finally, reliability and construct validity was found for Sternberg's (1997, 2006) tripartite model of intelligence, which includes Adaptability. Given these results, it seems likely that Adaptability or at least Adaptive Expertise can be measured, if it is not being done already.

Instruction. Haynie's (2005) dissertation study found that Adaptability and functioning in dynamic environments are enabled through meta-cognitive awareness, which in turn can be enhanced through instruction. Research reported by Sloutsky and Fisher (2008) with 4- and 5-year-old children found that Adaptability relied on fairly ordinary mechanisms grounded in associative and attention learning. Enhancing Adaptability (or cognitive agility) through instruction appears likely, but it remains an open question. Fortunately, a number of strategies have been suggested to develop and/or enhance the Adaptability of individuals and teams. Five of these are listed by Zaccaro et al. (this volume): self-regulated training, active learning, error management training, experiential variety, and developmental work experiences. One might also extract candidate instructional strategies from the taxonomy proposed by Pulakos, Arad, Donovan, and Plamondon (2000) for teaching. There may well be other sources. Research remains to verify these and other promising strategies for instruction in this area, but it seems likely that such research will provide the verification it seeks.

Creativity. However adaptive and decisive a leader may be, the ability to produce and implement innovative, nonobvious responses to both expected and unexpected situations remains critical. Creativity, i.e., Creative Thinking, is especially important for understanding and responding to the ill-structured problems presented by military operations where surprise is at a premium.

Measurement. Sternberg's Triarchic Abilities Test (2006b) includes a well-established, reliable, and valid measure of Creativity. It requires open-ended verbal responses in the form of captions for cartoons, written stories, and oral stories, and, as Sternberg emphasizes, it is only weakly correlated with, and therefore separate from, measures of verbal intelligence. Cramond, Matthews-Morgan, Torrance, and Zuo (1999), among others, recommend the Torrance Tests of Creative Thinking, which assess fluency, flexibility, originality, and elaboration, as the best standardized and most widely used measures of Creativity, perhaps because of the extensive body of research on their reliability and validity that has been conducted over time and across different cultures. Other standardized tests of Creativity along with reviews of their psychometric qualities are also available. Current examples would include the Abedi-Schumacher Creativity Test (Auzmendi, Villa, & Abedi, 1996), The Test for Creative Thinking—Drawing Production (Urban, 2004), and the Epstein Creativity Competencies Inventory for Individuals (Epstein, Schmidt, &

Warfel, 2008). It seems reasonable to conclude that Creativity can be measured with some appreciable validity.

However, Hong (this volume) discusses the inconsistencies in current measures of Creativity that arise from corresponding inconsistencies in its definition. Hong addresses the complex interactions of cognition, personal traits, and environment in distinguishing between expert talent and creative talent and their development. Hong also discusses distinctions between context-dependent and context-independent Creativity—the latter being claimed by this chapter for cognitive readiness. On the basis of Hong's review, it seems reasonable to conclude that measuring Creativity as a context-independent capacity is attainable.

Instruction. Sternberg (2006a) discusses an experimental study in which students taught in Creativity-inducing conditions outperformed students in noncreativity conditions. Niu and Liu (2009) found that the Creativity of 180 Chinese high school students was improved through instruction to develop their strategies for Creativity. A number of other studies have also found that measures of Creativity can be increased through instruction. It seems reasonable to conclude that Creativity can be enhanced to an appreciable extent through instruction.

Pattern Recognition. The chaotic nature of military operations and today's irregular warfare ensures that the conditions under which individuals learn tasks will differ from the conditions under which they must perform them. Pattern Recognition is required to abstract from experience, identify the familiar, and distinguish it from the unfamiliar and unexpected. As discussed earlier, Pattern Recognition may provide the basis for Situation Awareness. It may also be the basis for transferring knowledge and skill to new situations. Like Transfer, it may key on the presence of identical elements as argued by Thorndike and Woodworth (1901) who pointed to the presence and necessity of identical elements to ensure successful transfer of what is learned in training to what is needed on the job. The same may hold for the features of Pattern Recognition that enable Transfer.

Two similar views are as follows: (a) the Encoding Specificity Hypothesis (Tulving & Thomson, 1973), which suggests that memory is best when the conditions of memory retrieval are congruent with the conditions of original learning, and (b) Transfer-Appropriate Processing (Morris, Bransford, & Franks, 1977), which suggests that memory performance improves as similarities increase between the processes of encoding and the processes of retrieval. These views further suggest the difficulties of dealing with the unexpected, which in many cases is unfamiliar as well as unanticipated.

These mechanisms appear to key on the process of abduction—the ability to perceive what in a chaotic, complex, and confusing situation is important and what is not. Relatively little research has been devoted to this issue, yet it may be critical in explaining the intuitive Decision-Making that characterizes Klein's "macro-cognitive" Decision-Making (e.g., 2003) and Sternberg's tacit knowledge (e.g., Sternberg & Hedlund, 2002), both discussed earlier.

Measurement. Methods for assessing a basic capability for Pattern Recognition are usually based on spatial representations—presenting a series of patterns, leaving the last element blank, and requiring its completion. These techniques are used as culture- and language-free assessments of intelligence. The focus in cognitive readiness is not on intelligence but directly and perhaps separately on the ability to organize incoming stimuli in accord with information stored in long-term memory. The relationship of this organizing ability to some form of intelligence may be real but incidental to cognitive readiness. Nonetheless measurement of the context-independent ability to recognize patterns from confusing, unreliable, and incomplete perceptual stimuli remains clouded by this relationship. Research is needed to determine how well information from current laboratory tests for Pattern Recognition applies to the real-world problems in the abstract, complex, and confusing arena of military operations.

Much research on Pattern Recognition builds on the early work by Chase and Simon (1973), which showed that chess masters were far superior to novices in recognizing and remembering patterns of play that would actually occur in chess, but about the same as novices when chess pieces had been arranged at random. Fiore, Jentsch, Oser, and Cannon-Bowers (2000) found that experienced Navy pilots were superior to novice pilots in recognizing realistic aircraft instrument patterns, but not in recognizing instrument patterns that would not occur in the actual flight. Similarly, Bilalic, Langner, Erb, and Grodd (2010) compared the visual search performance of chess novices and chess experts in chess-related and chess-unrelated tasks. They found both object recognition and Pattern Recognition to be essential in visual cognition and of likely relevance to explain the mechanisms of everyday perception. Their work suggests ways to assess pattern recognition ability for more context-free settings, but no reliable and valid instrument seems available to measure Pattern Recognition in the real world.

Instruction. As the studies mentioned above suggest, the available data suggest that Pattern Recognition can be learned from experience. To an appreciable extent, the necessary experience can be provided by simulation. However, the relationship between specific aspects of simulation fidelity and their contributions to the development of pattern recognition capabilities is frequently unclear and unavailable for selecting cost-effective levels of fidelity to include in the design of simulators and simulations. Also unclear is the degree to which specific elements of simulations used in training contribute to the development of context-independent Pattern Recognition.

On the basis of currently available studies, it appears that pattern recognition ability can be measured and learned for specific contexts, but the degree to which context-independent Pattern Recognition can be measured or taught is uncertain.

Teamwork. Most military operations involve Teamwork, sometimes with established teams such as crews, but often with pick-up teams requiring rapid establishment of Communication, coordination, and procedures (Salas & Cannon-Bowers, 2000). In both cases, teamwork skills are critical and must be applied across many contexts, sometimes under constraining time pressures.

Bowers and Cannon-Bowers (this volume) identify two areas of competency needed for effective team membership: context-specific task-work and relatively context-independent Teamwork. The focus here on context independence leads to an emphasis on the latter—a concern with the relatively context-independent competencies of individuals that enable them to be effective members of teams. As Table 2.1 shows, we chose to include Teamwork, despite its many dimensions, as a component of cognitive readiness. The competencies of Communication and Interpersonal Skills are also included as separate but Teamwork-related cognitive readiness components. It may make sense to unbundle Teamwork into other components as thought and research on the topic continue.

Measurement. Spies, Carlson, and Geisinger (2010) list about a dozen possibly relevant tests of Teamwork that now await evaluation for their psychometric qualities. O'Neil, Wang, Lee, Mulkey, and Baker (2003) and Marshal et al. (2005) discuss the development of a framework for assessing Teamwork and subsequent development assessment of a promising Teamwork Skills Questionnaire, which is intended to assess an individual's potential to participate successfully as a member of a team. This instrument was developed as a cost-effective alternative to requiring an individual to participate and be observed as a member of a team, which, in addition to being costly and time-consuming, would likely be domain-specific and team-specific. O'Neil et al. and Marshal et al. report a number of studies, including confirmatory factor analyses, that provide substantial evidence for the reliability and content validity of this self-report instrument and for teamwork skill as a trait.

An additional subcomponent of Teamwork might be characterized as social Situation Awareness. Another subcomponent might be what Bray (1982) described as the "assembly effect"—the ability to assemble the right mix of people to comprise a team (not simply getting the best people). This latter issue may more directly concern an individual's capabilities in creating and developing teams than in participating as a team member. Other subcomponents of Teamwork may come up as work on cognitive readiness continues.

Instruction. Reviews such as those by Salas, Rozell, Mullen, and Driskell (1999) found mixed results in preparing teams for the unexpected. But a number of studies, such as that by Marks, Zaccaro, and Mathieu (2000), using carefully focused research on teamwork skill training have found it to be effective in achieving its objectives of enhancing Teamwork and improving team performance. Two examples follow.

Pritchard, Bizo, and Stratford (2006) abstracted five common elements from a thorough review of current teamwork definitions. They were common goal(s), member interdependency, dynamic exchange of information, coordination of task activities, and structuring of team member roles. Pritchard et al. compared the team performance of college students in two cohorts, one of which received teamwork skills training prior to a collaborative learning exercise and one of which did not. Students in the cohort who received the pre-instruction training scored higher in posttest self-evaluations of teamwork skills, self-reported assessments of team cohesion, and performance skills to be learned in the collaborative learning exercise.

Of particular relevance to the teamwork required by military operations are the findings of Ellis, Bell, Ployhart, Hollenbeck, and Ilgen (2005) in research on training used to enhance the effectiveness of 65 four-person action teams in a dynamic command and control simulation. About half of the participants were selected at random to receive generic teamwork training after which all participants were assigned to action teams. Team members were required to monitor a geographic area and make decisions needed to defend it against hostile air and ground intrusions during a 1-h session. In accord with methods and measures recommended by Bowers, Salas, Prince, and Brannick (1992), the task required planning and coordination of independently performed tasks, collaborative problem solving, and communication accompanied by strict control over extraneous variables. Ellis et al. found that the teamwork training increased both declarative knowledge of teamwork and necessary team competencies. They also found that it increased proficiency in planning, task coordination, collaborative Problem Solving, and Communication. Finally, they found that their measures of declarative knowledge of Teamwork were correlated with measures of team performance.

In sum, the context-independent training in teamwork provided in both studies improved the teamwork knowledge of individuals and the performance of teams to which they were assigned. It suggests that carefully designed training in teamwork skills can improve the ability of individuals to perform successfully in teams, but more conclusive evidence awaits further research and investigation.

Communication. Although communication skills are related to and often intertwined and bundled with Interpersonal Skills, we treat them separately in this chapter. We agree with O'Neil on the inclusion of Communication, both written and spoken, as a separate component of cognitive readiness. Articulating messages that are reliably received and well understood appears to be a cognitive skill that is essential for Teamwork and success in the conduct of military operations. For instance, Olmstead (1992) found that communication capabilities accounted for about half of the variance in the performance of command and control teams. We focused on verbal communication in this discussion and did not include visual or other nonverbal communication (e.g., gestures, body language, facial expressions, even clothing), but all forms of communication may later prove to be reasonable candidates for cognitive readiness.

Measurement. Communication seems essential in establishing the shared mental models needed for successful Teamwork. Rubin (1985) found the Communication Competency Assessment Instrument (CCAI), which uses structured observations of communication behavior rather than self-reporting, to be reliable and valid. Many communication measures are used to assess physician-patient communications. For example, the SEGUE (Set the stage, Elicit information, Give information, Understand the patient's perspective, and End the encounter) has been found to produce reliable and valid measures through the use of a behavioral checklist (Makoul, 2001).

Instruction in Communication. Similarly, a number of studies have found that communication skills can be improved through instruction. For instance, Rubin, Welsh, and Buerkel (1995) found that high school students improved their scores on the CCAI by taking a communication class. Perrea, Mohamadou, and Kaur (2010) found self-assessment and peer feedback to be successful in improving communication skills.

Interpersonal Skills. These skills are treated separately from communication skills and teamwork skills although all three are interdependent. They concern the ability to relate to and deal with others, regardless of social or cultural background, especially, but not exclusively, for purposes of communication, coordination, and cooperative effort. They key on an individual's ability to put himself/herself in another's place and another's understanding of an environment or situation. Communication is essential in conveying an individual's understanding to another in order to develop a shared mental model and successful Teamwork. However, it is often the product of interpersonal understanding and skill. Interpersonal Skills involve listening to and understanding others as well as communicating. They involve determining what must be done to accomplish goals that require interactions with others who may or may not be members of a cooperating team.

Measurement. Weitzul (1992) developed research-based guidelines for use in interviews to assess the Interpersonal Skills of an interviewee, but very little else appeared in a search for context-independent measures of Interpersonal Skills. No tests with documented and adequate measures of reliability and validity were found. On the other hand, a search for measures of empathy, roughly putting oneself in another's place, was more successful. Research on empathy appears to be divided between awareness of and reactions to another's internal state. Several instruments have shown substantial reliability and construct validity for measuring empathy and awareness of another's state. A standard and relevant instrument, which has been available for over 30 years and has been assessed a number of times, is the Interpersonal Reactivity Index (Davis, 1980). A recent trend is the use of brain imaging to study empathic reactions (e.g., Montgomery, Seeherman, & Haxby, 2009). There appear to be several reliable and valid measures to use in assessing empathy as it might apply to Teamwork and cognitive readiness.

Instruction. Role-playing exercises and simulations are commonly used to provide instruction in Interpersonal Skills. Schroeder, Dyer, Czerny, Youngling, and Gillotti (1986) developed a series of videodiscs that successfully used simulations and role-playing exercises to develop the Interpersonal Skills of military leaders. Holsbrink-Engels (1997) found that computer-based simulations and role-playing enhanced Interpersonal Skills development. However, development of Interpersonal Skills through instruction has not been validated through the use of standardized measurement. Several studies using a variety of approaches have shown that empathic intensity (Hooker, Verosky, Germine, Knight, & D'Esposito, 2008) and empathic accuracy (Barone et al., 2005) can be increased through instruction.

Resilience. In discussions with military and civilian K-12 educators, Resilience comes up as a characteristic that is critical for success (Burns & Freeman, 2008, 2010). Applied to cognitive readiness, it is "grit," a refusal to give up in activities ranging from K-12 classroom instruction to sports to military operations. Bonanno (2004), among others, defines resilient individuals as those who maintain healthy, stable, and productive functioning despite being exposed to highly disruptive, traumatic environments or events. The related concept of hardiness is identified as the basis for Resilience (e.g., Bartone, 1999). It is described as consisting of three interrelated attitudes: commitment to experience, control over situations, and challenge to prevail. Bartone (2007) concludes from research on military leadership that it is best predicted by hardiness.

Fredrickson, Tugade, Waugh, and Larkin (2003) were able to reliably identify resilient individuals and found that they were particularly able to use positive emotions to mobilize the psychological, emotional, and cognitive resources needed to successfully cope with significant catastrophes—in military terms, they were able to perform for themselves the duty of commanders to maintain hope. Further, Fredrickson et al. noted the tendency among resilient individuals to seek and focus on positive aspects and meanings in even the most dire of situations. It could be argued that Resiliency is born, not made, but there is evidence that it is measurable and trainable.

Measurement. Tusaie and Dyer (2004) point out that most research on Resilience keys on mental health and an absence of symptoms, rather than direct measures of Resilience. Two measures for Resilience are the Connor-Davidson Resiliency Scale (2003), which is a 25-item measure of Resilience, and the Resilience Scale for Adolescents (READ) (Hjemdal, Friborg, Stiles, Martinussen, & Rosenvinge, 2006), which both Hjemdal et al. and Soest, Mossige, Stefansen, and Hjemdal (2010) have assessed—the latter with a sample of 6,723 teenage subjects. Both of these instruments appear to produce reliable and valid measures of Resilience. Bartone's Dispositional Resilience Scale (1989) was identified by Funk (1992) as a reliable and valid measure of hardiness and shown by Bartone (2007) to produce a reliable measure of commitment, control, and challenge in a population of military cadets. The capabilities and psychometric properties of these tests indicate that measures of Resilience and hardiness are available.

Instruction. It also appears that Resilience can be improved through instruction. Grant, Curtayne, and Burton (2009) compared 41 executives who received direct coaching conducted by professional executive coaches with a control group that received no coaching demonstrated. Using 360° feedback, the researchers found higher levels of goal attainment, Resilience, and workplace well-being in the coached, experimental group. Liossis, Shochet, Millear, and Biggs (2009) assessed a blended cognitive-behavioral program. Using self-reports, they found increases in such aspects of Resilience as greater self-efficacy, optimism, and work satisfaction immediately after the program and later in a 6-month follow-up. Measures in both these studies were subjective. Improvement of Resilience through instruction seems likely, but more conclusive research and results are needed. Resilience may need to be decomposed into confidence, control, composure, self-regulation, and the like.

Critical Thinking. Critical Thinking is related to Metacognition when applied to one's own thinking, but we have included it as a separate component of cognitive readiness because it may also be applied to the cogitation of others as well as to one's own. When experienced decision-makers deal with complex and unexpected situations they employ Situation Awareness to collect evidence, use abductive processes to select what is relevant, look for patterns consistent with their experience, and apply critical thinking skills to identify and evaluate alternative approaches that may not be optimal, but that satisfice (Simon, 1956, again). In general, critical thinking skills are used by decision-makers to ensure that they have (a) asked the right question, (b) collected, organized, and assessed relevant data, (c) avoided bias and mind sets, (d) identified and evaluated assumptions, and (e) generated and evaluated appropriate hypotheses (e.g., Halpern, 2002; Sternberg, Roediger, & Halpern, 2006).

Measurement. Ennis (1993) identified nine tests that assess more than one aspect of Critical Thinking and four others that assess at least one aspect. More recently, Sobocan and Groarke (2009) provided a useful edited volume on the measurement of Critical Thinking. Our review of critical thinking measurement suggests that the most widely used test is the Watson-Glaser Critical Thinking Appraisal followed next by the Minnesota Test of Critical Thinking. Although Fawkes et al. (2002) identified flaws in 66 of the 80 questions on the Watson-Glaser test, Gadzella et al. (2006) found it to be sufficiently reliable and valid for several different subgroups totaling 586 university students. An extensive assessment by Bernard et al. (2008) concluded that the Watson-Glaser test measured Critical Thinking overall, but that its subscales should not be interpreted individually. Given the number of tests identified by Ennis and the conclusions from Bernard et al., and despite reservations by Fawkes et al., it appears that Critical Thinking can, to some useful extent, be measured.

Instruction. Other studies using one or another critical thinking test found that Critical Thinking can be taught. For example, a meta-analysis by Allen, Berkowitz, Hunt, and Louden (1999) concluded that instruction in forensics, debate, public speaking, argumentation, and the like improved critical thinking ability as measured by critical thinking tests. Dale, Ballotti, Handa, and Zynch (1997) found that a problem-solving course for Purdue freshmen increased scores on the Watson-Glaser test from the 20th to the 35th percentile. Johnson, Flagg, and Dremsa (2007) found simulation to be superior to direct instruction in raising scores on higher level cognition measures including those involving Critical Thinking. On the basis of these and other studies, it seems reasonable to conclude that Critical Thinking can be improved through instruction.

Table 2.2 Summary of findings on proposed cognitive readiness components

Candidate component	Measurement	Instruction
Situation Awareness	Can be reliably measured by the "freeze method"—stopping a task and asking about the situation	Training in reflection and modeling as meta-cognitive strategies found to increase scores on tests of Situation Awareness
Problem Solving	Several self-report tests reliably measure Problem Solving process factors. Content validity remains an issue, but computer-based assessment offers serious promise for validity	Efforts to teach relatively context-free Problem Solving are rare, but instruction that directly focuses on problem solving transfer shows promise
Metacognition	A number of carefully assessed tests and verbal protocols have been found to be reliable and valid	Promoting general awareness, heuristics, and self-reflection have raised scores on various tests of Metacognition
Decision-Making	No standardized, objective measurement with established reliability and validity exists—evidence suggests one could be developed	Experience and simulation promote the background needed, but absence of good measures limits evidence of increased decision making skill through instruction
Adaptability	Reliability and construct validity found for measures that include Adaptability	Evidence exists that Adaptability can be increased along with means to do so, but the issue remains to be more fully determined
Creativity	There appear to be several credible measures of aspects of Creativity	Evidence found that scores on measures of Creativity can be increased through instruction
Pattern Recognition	Laboratory measures exist, but evidence that context-free Pattern Recognition can be measured is still needed	Evidence suggests improvements in Pattern Recognition through instruction but lacks standardized measures
Teamwork	One promising self-report measure of context-independent Teamwork ability was found	Early evidence is mixed, but more recent studies have demonstrated Teamwork improvement through instruction
Communication	Reliability and construct validity found for at least one standard test	Scores on Communication tests have been increased by instruction
Interpersonal Skills	Reliability and construct validity found for empathy, but not for overall Interpersonal Skills	Evidence from simulation and role-playing exercises suggests improvements but lacks standardized measurement. Instruction found to increase empathy
Resilience ("Grit")	Reliability and construct validity found for standardized tests of Resilience	Evidence found of increases through instruction and/or coaching. Resilience may need to be further decomposed
Critical Thinking	Several published tests available. Credible findings exist on their reliability and validity	Studies reported gains in Critical Thinking on standardized tests after instruction

2.3 Summary

A number of candidate components were considered under the criteria that they should be (a) relatively content- and context-free, (b) measurable, and (c) capable of improvement through instruction. These components are briefly reviewed with regard to these criteria in Table 2.2. It is entirely possible that new components that meet these three criteria could be added, others could be combined, and still others, such as Teamwork, Resilience, and Pattern Recognition, may have to be further decomposed. The discussion continues—as it should.

In brief, the six candidate components of cognitive readiness that were found to meet the three criteria we chose for cognitive readiness were Situation Awareness, Metacognition, Creativity, Communication, Resilience, and Critical Thinking. Given the promise of computer-based measurement and instruction focused on context-independent, problem-solving transfer (Mayer & Wittrock, 1996), context-independent Problem Solving seems likely to meet the criteria for measurement and instruction soon. With a large number of measures waiting review for reliability and validity and promising results from performance ratings and surveys, Teamwork also seems likely to meet the criteria soon. The same might be said for Interpersonal Skills based on standardized measures for empathy and research evidence showing improvements from simulation and role-playing exercises. Similar optimism seems justified for Adaptability given Sternberg's (2006b) measures of Adaptability fortified by findings that Adaptability can be enhanced by a focus on meta-cognitive awareness (Haynie, 2005) and by Zaccaro's research for the Army (e.g., 2009). Context-independent Intuitive Decision-Making remains more problematic because it lacks objective measures with demonstrated reliability and validity focused on this capability. It is often seen employed decisively in military operations and in research by Sternberg (e.g., 2006b) and analyses by Klein (e.g., 2003), but empirical work focused on this issue remains needed. Finally, the massive corpus of research and theory on Pattern Recognition may yet yield the standardized measures that we sought for context-independent Pattern Recognition, but none that were appropriate appeared in this survey.

2.3.1 Final Word

The challenge of training individuals and groups of individuals for unexpected situations that cannot by definition be anticipated seems both substantive and of practical significance for behavioral science. Thus far, it appears that our research has at hand relevant and substantial responses to most of the issues raised by cognitive readiness. Opportunities remain along with work to be done, especially if cognitive readiness is to be included in routine assessments of workforce readiness in the military and in industry. It seems to be a promising opportunity and a challenge for behavioral research.

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