

Technical Report 1037

Practical Thinking: Innovation in Battle Command Instruction

Jon J. Fallesen, Rex R. Michel,
James W. Lussier, and Julia Pounds
U.S. Army Research Institute

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Practical Thinking: Innovation in Battle Command Instruction

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FOREWORD

The Fort Leavenworth Research Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) performs research on leadership and battle command. A recent initiative of this research is the exploration of cognitive aspects of senior and tactical levels of command.

In August 1994, the Commander of the Training and Doctrine Command, GEN Frederick M. Franks, Jr., requested that ARI play a pivotal role in developing a course for mid-career Army officers. He asked that new instruction on thinking, reasoning, and deciding be developed for inclusion in a course on the art of battle command. In the subsequent 4 months the concept, content, and integration of the instruction into the Command and General Staff Officers Course were completed by ARI researchers.

The strength of the work was the development of theoretical concepts on cognition and their transition to the instruction of thinking in military command and staff positions. The instruction contrasts with the systematic procedures suggested by classical models of decision making. Instead of prescribing a single sequence of steps, the approach considers how tactical commanders and staff actually make decisions and solve problems and identifies basic cognitive skills that support the natural ways of thinking.

The cognitive-based instruction was incorporated as a subcourse on Practical Thinking for the Battle Command Course. The Battle Command Course is a 180-hour advanced elective during Terms II and III that serves as the test bed of the Mobile Strike Force (MSF). The course and the MSF combine the development of new command and staff organizations, weapons, and information technologies for the 21st century. In its inaugural implementation, Practical Thinking instruction was given to 73 senior captains and majors. This report documents the background and rationale for the Practical Thinking instruction, including the lesson descriptions, experience with them, and recommendations for future instruction.

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ACKNOWLEDGMENT

The achievement of the Practical Thinking instruction resulted from the combined efforts of many individuals. The authors wish to acknowledge first and foremost LTC Harry McIntosh from the Leadership Instruction Department at the Command and General Staff College (CGSC). Harry excelled as an instructor for the subcourse and enthusiastically championed the Practical Thinking cause in the Battle Command Course and elsewhere in CGSC.

Personnel from ARI Fort Leavenworth made notable contributions. Dr. Joan Silver developed materials on expertise. Dr. Delane Keene developed formative evaluation materials. MAJ Lawrence "Clay" Miller served as a sounding board as examples were proposed and exercises tried. Consortium fellows Sophie Breeskin and Terrill Saxon reviewed cognitive instruction programs. Dr. Stanley Halpin, our research unit Chief, got the door opened for this opportunity and saw to it that we were able to focus on getting the curriculum and lessons developed.

At CGSC, LTC John Burdan, the Battle Command Course author, dealt with our numerous questions about course and CGSC policy and guidance. Dr. Julia Brandt, Curricula Development Branch, assisted with the development of tasks, conditions, and standards. BG Geoffrey D. Miller, the Commander of the Mobile Strike Force, was the master of diplomacy at handling numerous objectives. We thank him, LTG John E. Miller, then Commander Combined Arms Center; BG Randall L. Rigby, then Deputy Commandant U.S. Army Command and General Staff College; and COL J. M. Kain, then Director of Center for Army Tactics, for allowing the untried and unproven Practical Thinking approach to be included in their most visible and prominent course.

PRACTICAL THINKING: INNOVATION IN BATTLE COMMAND INSTRUCTION

EXECUTIVE SUMMARY

Research Requirement:

Current doctrine and instruction for tactical decision making are based on classical models, but battle commanders do not think or decide according to what those models prescribe. Emerging findings and new theories of decision making show that the classical models provide limited and sometimes poor guidance. The current instruction for tactical decision making procedures is subject to question and new concepts for instruction need to be explored.

In August 1994 General Franks, then Commander U.S. Army Training and Doctrine Command (TRADOC), concurred with ARI study findings that indicated that Army leaders do not receive instruction in alternate ways of thinking. He requested that ARI develop a course on thinking based on their findings about actual tactical decision making. LTG John E. Miller, then Commander Combined Arms Center, and BG Randall L. Rigby, then Deputy Commandant U.S. Army Command and General Staff College, directed that the instruction be included in a 1995 Battle Command Course.

Procedure:

Instead of reverting to classical decision making models and formal reasoning, the basis for the Practical Thinking instruction was to build on the strengths of how people reason informally in everyday situations. Important in this approach are the following three points:

1. The knowledge a person has is the basis for thinking; procedures for decision making (e.g., steps or algorithms) are no short cut or replacement for experience.
2. Cognition, the way thinking is done, can be developed and improved through self-examination and practice of various cognitive skills.
3. Ways of thinking should be adapted to the situation at hand.

The goal of practical thinking is not to pump more facts into the students. Instead it aims to extend how students use what they already know to reason about what they need to know.

The ARI instruction departs from traditional approaches that have been grounded in analysis, probabilities, and formal logic. Traditional theories of decision making assume that solutions come from repeatable processes and can be clearly graded for goodness. Standard procedures or formulae are not satisfactory under most real-world circumstances. Naturalistic studies show that *ideal* decisions are unrealistic in complex, adversarial situations. Decision makers should recognize and adapt to the characteristics of the situation.

Practical Thinking was developed as a subcourse in the Command and General Staff College's (CGSC) elective on Battle Command. This elective is an experimental course exploring new staff organizations, a force structure using 2015 systems, and information systems

for decision support. The students were organized as the staff and subordinate commanders for a notional, tactical division called the Mobile Strike Force (MSF). The use of simulation exercises (SIMEX) creates a realistic setting for tactical planning and execution.

The students had specific problems that they were responsible for working. The Battle Command Course students were responsible to a real Commander for real problems. These problems included the determination of staff standard operating procedures; tactics, techniques, and procedures for 2015 forces; and tactical plans for a series of missions. In addition to these problems worked during class time and study periods, the students also worked as a surrogate staff during simulation exercises and Prairie Warrior '95. BG Geoffrey D. Miller commanded the student contingent of U.S. Army, Air Force, and Marine officers. The 73 students were divided equally among four ARI and CGSC instructors for the Practical Thinking lessons.

Practical Thinking is a unique component of CGSOC instruction as it focuses on how individuals think, reason, and decide. It avoids giving recipes for the steps or analytical procedures for thinking, instead emphasizing a conscious effort to learn, adapt to situations, manage one's own thinking, be open to other positions, remain flexible in approaches to problems, apply standards to thinking, and think using overarching viewpoints.

Practical Thinking concepts were identified by establishing a number of propositions about how we learn and improve our reasoning. The propositions include issues like

1. One's skill at thinking can be improved.
2. Thinking is not always related to high scores on intelligence tests.
3. Reasoning errors can be decreased.
4. Thinking is goal-directed and done in context.
5. Models based on normative decision theory or formal logic are not very useful for improving practical thinking.
6. Instead of changing everyone to a single style of thinking, make people aware of the particular strengths, weaknesses, and safeguards of their style.

Cognitive skills were identified from a combination of these propositions and a review of cognitive skill instruction programs. Fifteen programs were reviewed to identify how thinking skills were addressed in other instruction and the results of that instruction. The programs were categorized according to an emphasis in cognitive skill, metacognitive skill, tools for thinking, and attitudes. The review identified a rich collection of skills and instructional materials. The results showed improvements on qualitative and objective measures. Most of the materials were targeted at children, and none of the existing programs had the desired combination of skills identified for the battle command application. This was not unexpected, but reinforced the notion of developing materials specifically for cognitive skill enhancement of mid-career Army officers.

Cognitive skills were selected by considering the propositions and the types of questions that might be posed by thinkers. The questions were those that in a reflective moment a person might ask him- or herself to make sure that thinking is on track. Questions like, "*what is this situation?*" or "*what needs to be accomplished?*," help identify important cognitive skills. These example questions relate to the cognitive skills of situation assessment and goal identification, respectively. Also in some cases, cognitive skills were proposed from research and theoretical literature and then an appropriate question identified. For example, metacognition is receiving increased research attention. Corresponding questions include, "*how should I think, what*

thinking strategies should I use?"

The candidate skills were then screened for importance and for fitting the available class time. At the same time skills were considered, lesson topics were chosen. Topics were chosen based on the number of lessons that could be scheduled and named according to what the student population could easily relate to. Seventeen hours of instruction were planned for the following topics: Introduction, Multiple Perspectives, Adapting to Situations, Finding Hidden Assumptions, Expertise, Practical Reasoning, Integrative Thinking, and Skill Practice. These lessons addressed:

1. How attitudes affect our thinking.
2. Ways to broaden perspectives.
3. Concepts for identifying hidden assumptions.
4. Ways to resolve uncertainty through reasoning.
5. How to adapt thinking to important aspects of a situation.
6. How to reason to integrate complex and disparate factors.

The materials and instruction tried to conform to an adult learning philosophy that placed the responsibility for learning on the students, rather than a teacher-presented, student-recall approach. This approach was not used to the full extent possible, because of the constraints that the larger course placed on Practical Thinking.

Various methods of instruction were included in the program. Lectures, readings, exercises, discussions, and case studies were all used to keep the instruction dynamic and interesting. Many different types of cases and examples were used to keep the focus on the skill, rather than on the details of the specific problem. Examples included everyday situations, such as job interviews, buying a car, and choosing a course of college study. Examples included real lessons from Combat Training Centers, historical military cases, borrowed and devised tactical problems, and specific problems that the MSF had to address. Specific MSF problems addressed in the practical thinking lessons included the application of critical reasoning standards to new weapon concepts, enemy campaign plans, and a tactical concept for simultaneous attack.

Findings:

A fundamental accomplishment of this Practical Thinking program was the development of the lesson materials. An explicit cognitive skill approach for instruction of mid-career Army officers has not been undertaken before to our knowledge. This created a challenge for relating abstract psychological concepts to practical concerns of battle command.

The Practical Thinking subcourse shared the goal to prepare students to perform tactical battle command with the rest of the Battle Command Course, though there were different intentions and approaches also. The rest of the course was very much directed toward developing a viable MSF Division and staff that would perform well in Prairie Warrior '95 and provide a test bed for warfighting concepts for the 21st century. The style of the division and the student staff were influenced greatly by the presence of a general officer as their commander. While this led to successful performance as a staff and a Division in the Prairie Warrior '95 exercise, the applied approach was not always consistent with the themes of the Practical Thinking instruction. Practical Thinking encouraged reflection, flexibility, discovery,

learning, critical and creative thinking for the practice of battle command in the 21st century. Since the Practical Thinking concepts were newly organized and developed, the principal Battle Command Course (BCC) instructors and the MSF Commander did not have the full opportunity to consider this skill approach and its application to the MSF. The MSF Commander and principal instructors generally supported the goals and objectives of the Practical Thinking subcourse. However, due to lack of time for familiarization and training on the concepts, they did not explicitly incorporate Practical Thinking for the students' benefit. The principal instructors' full attention was required to respond to challenging demands to ensure that the other 163 hours of instruction would meet other goals. Because of competing priorities in the MSF, the Practical Thinking lessons were shortened from eight to six meetings, and instead of 17 hours there were 12 hours of class time.

Given the limited integration, reinforcement, and attention that was afforded the Practical Thinking instruction, it still had a positive effect. On the average, student self-reports reflected a gain of 12.5 percent in expertise for the six lessons. Of the students who responded to an end of course survey, eighty percent (16/20) felt that the course should definitely be included in future CGSOC classes. Some students felt that the Practical Thinking instruction was the best part of the Battle Command Course. Some wanted more opportunities and latitude to apply the concepts in the MSF, and others hoped to receive future lesson materials and self-development modules. There were also some students who did not appreciate the intent or approach of the Practical Thinking lessons. Some of these felt that thinking is so ingrained that there is not much chance of changing it, and others thought that the instruction should come earlier in their careers.

The instructors felt that there was too much material to cover in the time allotted for some lessons and this resulted in too little time to practice the skills. They found that smaller groups of 8 to 12 students compared to the full classes of 18 allowed the skills to be considered more thoroughly. They also found that Practical Thinking is not so much taught--as it is something that individuals need to actively pursue. Encouraging students to be self-reflective, critical thinkers requires special instructor skills.

While this cognitive skills approach is not prescriptive, and perhaps because it is not, it would help to have assessment instruments for thinking. While an objective paper and pencil test of thinking is the obvious approach, this is not particularly practical. Practical thinking is done by a specific individual in a specific context for a specific purpose. It is important to explore and probably develop cognitive style frameworks and methods that would offer an individual some insight into his or her particular style and not focus on logical reasoning ability.

An additional concern is to identify a fuller set of cognitive skills. Fifteen similar topics were generated by the subcourse author and the students were asked which would be most important for additional lessons. They preferred the more applied topics, specifically, visualizing the battlefield, maintaining focus in crisis situations, and applying practical thinking to leadership. Skills that would be more compatible with the set already identified include: learning and memory, implementing creative ideas, asking questions, discovering problems, and resolving conflicts. These topics fell into a second cluster behind the top three skills.

Combining the students' responses to the course survey and the insights from the developers, five tracks are recommended for future work.

1. The first is a continuation of Practical Thinking lessons in the Battle Command

Course. The Practical Thinking lessons provide a good complement to the very applied nature of what the students are required to do as part of the MSF. The Practical Thinking components encourage the students to further their skills in real contexts. The Practical Thinking teaching points can be better integrated into future Battle Command Courses, since the primary instructors will have a better opportunity to examine and reinforce the materials.

2. Secondly, a separate elective would be a good medium for the Practical Thinking topics, since the students were divided in their reactions to the lessons.
3. The concepts should also be tried out during earlier periods of an officer's career, e.g., during an Advanced Officer Course or cadet training.
4. A fourth implementation alternative is to pursue development of the material as a series of self-development modules. Since the material is focused on individuals it makes sense to format the instruction as self-paced material.
5. While the first four approaches assume that most officers can improve their Practical Thinking, the fifth suggests determining whether certain officers will not or can not benefit from Practical Thinking instruction.

With adequate resources and congruous priorities, there is no reason not to pursue all five extensions simultaneously. Taken together the conceptual thinking for these proposed efforts should go a long way in forming a plan for infusing Practical Thinking principles throughout the Army institutional education and self-development programs.

Utilization of Findings:

The Practical Thinking instruction was incorporated as a part of the premiere course on Battle Command. At the time of this writing, CGSC plans to increase the Practical Thinking curriculum from 12 to 27 hours in the Battle Command Course. This is seen as a positive improvement to allow more skills to be covered and more practice trying the skills. Increased practice can also be accomplished by out-of-class assignments and more specific feedback. The Practical Thinking concepts can be reinforced throughout the BCC by adoption of the concepts by the principal BCC instructors and use in after action reviews of student exercises. The Practical Thinking instruction can be extended to other CGSOC electives, other Army schooling, self-development materials, and for professional development seminars.

Beyond the Army applications, the cognitive skills that were identified and lessons that were developed for them can serve the basis of other adult instruction in complex decision making environments. The Practical Thinking course materials have already gained interest from national, state, and county law enforcement and fire fighting agencies. Up until the recent increased attention in naturalistic approaches, there were few innovations in training decision making. With the development of this instruction (largely based on creativity, critical thinking, and everyday reasoning) there is now an alternative to formal logic, normative-based aids, and sequential procedures that provides great promise for enhancing leader's thinking abilities.

PRACTICAL THINKING: INNOVATION IN BATTLE COMMAND INSTRUCTION

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PRACTICAL THINKING: INNOVATION IN BATTLE COMMAND INSTRUCTION

Scope

Senior Army leaders from the Training and Doctrine Command (TRADOC), Combined Arms Center (CAC), and Command and General Staff Officers College (CGSOC) requested that ARI develop a program of instruction to increase officers' cognitive skills required for thinking, reasoning, and deciding in battle command. This report documents:

1. Background to Practical Thinking instruction.
2. Rationale for the requirements of the instruction.
3. Description of six Practical Thinking lessons.
4. Results of Practical Thinking instruction.
5. Ideas for future instruction.

This report is divided into sections corresponding to these topics.

Background to Practical Thinking Instruction

For over a decade, ARI has tracked how the Army instructs and trains problem solving and decision making. The research has a rich history. The research has taken many forms including evaluating training programs (e.g., Garlinger, Fallesen, Solick, & Lussier, 1987), evaluating problem solving instruction (e.g., Lussier, 1990; 1992), measuring command and control performance (Carter, Lockhart & Patton, 1984; Halpin, in preparation a), assessing staff procedures (e.g., Fallesen, Carter, Perkins, Michel, Flanagan & McKeown, 1992), developing decision aids (e.g., Flanagan, McKeown, McDonald & Fallesen, 1992), and identifying tactical expertise (Michel & Serfaty, 1993). The work has been concerned with how decision making is performed, how well it is performed, and how it could be performed better. One ingredient that led to more productive research was following a paradigm that focused on understanding what people actually do instead of relying on normative models of decision making that suggest what ideal performance is.

In the last few years the Army outlook on problem solving and decision making has undergone change. There have been several catalysts for this change, including the growth of the Battle Command Training Program (BCTP), the Battle Command Battle Laboratory (BCBL), and the National Training Center (NTC). The focus on providing realistic command and staff training situations with the commensurate opportunities for seeing how command and control (C2) is done promoted greater interest. Also senior Army leaders have demonstrated greater interest in the pursuit of "information age technology" (Department of the Army, 1994). They have a better appreciation of the possible uses and the complexities of developing the technology than ever before. Leaders who served in Desert Storm have been influenced to consider how C2 contributed to their combat experiences, and what conflicts there were in C2 procedures, organizations, or systems. These reflections led to the realization that C2 had been treated as a single entity, and that people associated C2 most strongly with communications systems rather than either *command* or *control*.

LTG Wishart (1990) urged a clearer distinction of command and control; this in turn led to greater interest in exploring what makes for good command. GEN Franks (1993) initiated

the use of the term Battle Command to force a change in perception of C2 from a system understanding to a person-centered one. With the increased attention on C2 and more efforts to provide greater detail for battle command concepts, came questions about the appropriateness of the existing normative-based tactical decision making processes. The extent that the classical model is embedded in the tactical decision making procedures is probably not recognized by most doctrine writers or practitioners. There has been some subtle shifting in Army policy guidance, but more importantly there has been increased questioning about what tactical decision making procedures ought to be. The critical questioning of the tactical decision making process has been a continuing research theme of ARI's (e.g., Brezovic, Klein & Thordsen, 1990; Fallesen, 1995; Michel, 1990; Thordsen, Galushka, Klein, Young, & Brezovic, 1989; Thordsen, Klein, Michel, & Sullivan, 1991).

An important question about tactical decision making is whether current Army instruction on problem solving is adequate. There is no dispute over *how* the material is taught, but there are questions about the content and completeness of *what* is taught. An obvious way to consider this question is to consider the outcome of recent Army operations, like Just Cause, Desert Storm, Provide Comfort, and Restore Hope. Based on their successes the general conclusion is that instruction, doctrine, and practice must be pretty good. To accept this conclusion one must assume that doctrine and instruction have a direct effect on performance. There lie two potential flaws. One flaw disregards that decision making is an active process of generating knowledge and solutions. The other flaw under-estimates the adaptive behavior that people demonstrate throughout their lives. One's experiences may be the best instruction on decision making. Knowledge that is developed during prior decision making allows problems to be solved proficiently regardless of what formal procedures are trained.

Another way to address the question of adequacy of problem solving instruction is to check the extent that doctrine and teaching practices are used outside of the classroom. A review of findings on command and control and tactical planning was conducted to examine this issue (Fallesen, 1993). The general conclusion was that there is a disconnect between what procedures are taught for the tactical decision making process and what is actually done in training, combat, or other operational settings. At a Senior Leaders Conference (29 Jun 93), GEN Franks, TRADOC Commander, echoed this finding by pointing out that how command is described to be done and how it is actually done are not the same.

The Army's descriptions and teachings imply neat and orderly sequences of tasks that are well coordinated among commanders, their staff officers, and across echelons. The deliberate decision making process espoused by Army doctrine is based on the classical model. It asserts that multiple options are to be examined individually, not until each is evaluated should the results be compared, and then the best is selected. Students are taught to use decision matrices to scale and score attributes for each option and then compare options. Actual performance is almost as varied as there are different commanders and units. The disconnects are identified in Table 1.

Sometimes the disconnects are so great that it is difficult to assess what does happen. Typically measurement in research is based on what the doctrinal and teaching models specify the procedures to be. The pre-determined measures do not capture what is actually done and the standard measures end up with little or no corresponding data. If commanders and staff do not do what is taught, then instruction is not as good as it could be. The first reaction might be to fault training and try to get commanders and staff to adhere more closely with the training model. Alternatively we must question the appropriateness of the model. The success of our

Table 1.
C2 Performance Problems and Issues

Estimate Procedures - Failure to follow procedures. - Imprecise procedures. - Inflexibility of estimate procedures. - Excessive time demand.	Formulation of Alternatives - Failure to track concepts. - Generation of single alternatives. - Inadequate concepts and contingencies.
Management of the Process - Failure to include required staff (poor coordination). - Inadequate Commander involvement. - Poor management of the process.	Evaluation and Comparison of Alternatives - Failure to evaluate. - Serial evaluation of options. - Reaching early decisions. - Inadequate war gaming.
Information Exchange - Failure to exchange information. - Failure to present plans to commander. - Failure to communicate interpretations.	Planning and Synchronization - Incomplete planning. - Poor planning.
Situation Assessment - Failure to consider factors. - Failure to verify assumptions. - Failure to assess information quality. - Failure to interpret information. - Failure to make predictions.	Enacting Plans and Monitoring - Poor orders dissemination. - Failure to track the battlefield.
	Battle Success - Staff characteristics related to effectiveness. - Understanding related to effectiveness. - Quality of procedures related to effectiveness.

Army's leaders depends on their ability to learn from experience and their resourcefulness in doing what makes the most sense in spite of the formal procedures that are prescribed.

The underlying assumption of ARI's battle command research is that performance could be improved noticeably if instruction more closely corresponded to the actual decisions and the way experts make them.

"Basically, proficient decision makers are able to use their experience to recognize a situation as familiar, which gives them a sense of what goals are feasible, what cues are important, what to expect next and what actions are typical in that situation. The ability to recognize the typical action means that experienced decision makers do not have to do any concurrent deliberation about options. They do not, however, just blindly carry out the actions. They first consider whether there are any potential problems and only if everything seems reasonable, do they go ahead." (Klein , 1989, p. 58)

The disconnect between the doctrine-based teaching points and practical application is not unexpected if considered from the emerging field of naturalistic psychology. Traditional teaching on problem solving and decision making is grounded in classical, normative models that have come from economics theory. They portray the decision making process as one that is objectively rational and seeks the selection of an optimal option. This thinking considers that all options (or at least all good options) can be identified and compared to pick the best one. It mostly ignores how options are developed or identified and diminishes the fact that uncertainty exists about current situations or future outcomes. The naturalistic approach has something quite different to say about decision making. Its concern is not with what might be some ideal of performance that is not humanly likely, but to identify how people decide naturally. The

notion is to direct improvements based on understanding of actual performance. The emphasis of normative models is rational and optimal selection, while the accent of naturalistic models is adaptation of what one knows to the situation. The latter perspective acknowledges the existence of uncertainty and the importance of existing knowledge.

The naturalistic position questions the wisdom of a rigorous, analytical approach.

"The culprit is an ideal of analytical decision making which asserts that we must always generate options systematically, identify criteria for evaluating these options, assign weights to the evaluation criteria, rate each option on each criterion and tabulate the scores to find the best option. We call this a model of concurrent option comparison, the idea being that the decision maker deliberates about several options concurrently. . . These strategies sound good, but in practice they are often disappointing. They do not work under time pressure because they take too long. Even when there is enough time, they require much work and lack flexibility for handling rapidly changing field conditions." (Klein, 1989, p. 56)

So there are several issues that point to the inappropriateness of the classical models. The classical processes conforming to the classical model are imprecise and do not completely cover the tasks that need to be done (Fallesen, 1993). The classical model and resulting doctrine and instruction do not make allowances other than to start over for changes that might occur during the situation.

An alternate model was proposed by Fallesen, Lussier, and Michel (1992) that does not require multiple options or other systematic aspects of the classical model. The principles upon which a more natural C2 process description was based include the following:

- There is no single sequence of steps which is universally appropriate for C2; C2 activities are highly interactive and a sequence is best determined immediately preceding and refined while working a specific problem.
- A simple model should be used as the core of the process description. A model of plan-direct-monitor was chosen, which eliminated the standard step of "coordination" because it occurs throughout the other three processes.
- Situation assessment is a fundamental activity which is based on understanding and predicting.
- Selecting a course of action is only one of many C2 activities. As such, more emphasis needs to be placed on situation assessment and predicting, wargaming, synchronization, deception planning, contingency planning, and rehearsals.
- Amount of effort must be allocated appropriately to leave enough time for planning; decisions on basic concepts must be made early.
- The commander is more involved in focusing the staff than in the past.
- The staff must act as a team and synchronize its own activities.
- Multiple courses of action are developed only if there are sufficient reasons to do so.
- Brief-backs and rehearsals are required for appropriate communication and directing.

- Monitoring involves comparison of actual outcomes against prior expectations.
- Synchronization, contingency planning, and deception planning are explicitly covered as parts of the C2 process.
- The staff must be aware of their own preferences and biases and be open to other perspectives.
- The avoidance of errors is a key to success; active error checking practices need to be done.
- Wargaming requires its own description as it is the means to visualization, forecasting, and feasibility assessment.
- Time must be actively managed.

These principles attempted to remedy the imprecision, incompleteness, and flaws of the classical model by making procedures more adaptive. Some of these themes were echoed in a pamphlet defining Battle Command (Madigan & Dodge, 1994). Also doctrinal writers attempted to make the tactical decision making process more adaptive by laying out three different processes (U.S. Army, 1994). The adaptations take advantage of differences in time available and the experience of the staff. The resulting processes are called the deliberate, combat, and quick decision making processes. The deliberate process generally represents the traditional full process; the combat process is a streamlined deliberate process with greater involvement by the commander; and the quick process is one where the commander makes quick decisions as required. The deliberate process is still based on the classical model and its systematic and rational basis.

The proposed principles were not completely satisfactory as a substitute for the classical-based procedures, because like the doctrinal-based procedures they too lack detail. But here the lack of detail was because of the very complex, situation-specific, and broad set of tasks that this approach recognizes. An alternative to doctrinal-based procedures and general principles was sought. Instead of specifying *one size fits all* procedures, the alternative focused on improving *thinking skills*. The Practical Thinking instruction described in this report is the alternative to specific or general prescriptions of procedures. The Practical Thinking approach provides detail on the underlying cognitive skills and ways of improving them. This cognitive strategy allows a more detailed examination of how decisions are made and problems solved than the traditional tactical decision making procedures.

The traditional processes alone are not representative of what is done. The intention of following systematic, unbiased decisions does not fit the type of tasks required for battle command. The traditional model can make contributions, but does not need to be the starting framework for the entire process or used as an unwavering set of rules to follow. Some of the beneficial uses of the traditional procedures include coordinating the group problem solving process, communicating decisions to others, and persuading others that one has followed an objective process supporting unbiased decisions. The basic reason for continuing support of the deliberate decision making process is probably because of traditionalism and that nothing better has been developed to displace it.

With growing dissatisfaction with the classical principles, exploration along naturalistic lines provides an opportunity to see what potential a cognitive skills approach has for improving thinking. The goal for the development and trial application of the Practical Thinking instruction has been to test a cognitive skills approach. Such approaches are not foreign to

education.

Military education, just like the civilian sector, has been concerned with how students reason, but reasoning is generally relegated to a back seat to instruction in other subjects. In civilian education, primary and secondary instruction provides few opportunities for students to acquire such proficiency. Nickerson (1984) points out, "Unfortunately, in spite of the efforts and successes of many teachers, many students graduate from high school without acquiring the ability to deal effectively with intellectually demanding problems. A sizable fraction of high school graduates who are about to enter college are not adequately prepared to do the kind of thinking their college experience will require of them. (p 28)" A National Academy of Sciences Panel (1984) examined the performance of high school graduates and found that many cannot draw correct inferences from written, pictorial, or mathematical information; cannot develop alternatives and reach conclusions; and have difficulty expressing their ideas intelligibly and effectively. Even with the very best students, there is room for improvement (Voss, Perkins, & Segal, 1991).

A cognitive skills approach is similar to that of conceptual competence recommended by Kluever, Lynch, Matthies, Owens, and Spears (1992). They argue that although leader development doctrine is sound, the execution is incomplete. While leader development programs address technical and interpersonal competence, conceptual competence is largely ignored. To correct this mismatch between leadership doctrine and practice they present eight issues (pp vii-viii).

1. Army officer training and educational institutions do not explicitly identify the conceptual skills that graduates must possess.
2. Learning objectives at officer training and educational institutions, especially prior to Senior Staff College, do not focus on cognitive levels appropriate for developing conceptual competence.
3. The Army formal education system is truncated at the lieutenant colonel level and does not address the conceptual development of colonels or general officers.
4. The Army's program for advanced civil schooling focuses on developing technical competence to fill operational requirements rather than general enhancement of conceptual competence.
5. Army systems are aimed at assessing technical and interpersonal competence of officers but the Army does not have methodology for assessing conceptual competence.
6. The current officer evaluation system does not account for the different levels of cognitive complexity required for direct-level versus senior-level leaders.
7. DA Pamphlet 600-3, in prescribing an assignment pattern leading to battalion command, focuses on direct-level leader competencies. Consequently, those selected for command may not have fully developed conceptual skills.
8. Although Military Qualification Standards III (Coordinating Draft) appropriately calls the self-development pillar the most dominant and further states that the reading and self-assessment components are mandatory, there is no mechanism for generating motivation on the part of individual officers.

The conceptual competencies and cognitive skills of the Army's leaders are appropriate targets for improving battle command proficiency. If skills, like thinking, reasoning, and

deciding, are not developed, battle command may become an overly analytic or a simply intuitive practice.

Human Dimensions of Battle Command

A switch in approach from a strictly procedural basis for battle command tasks to one aiming at the cognitive skills will not be accomplished quickly. To make a change, the cooperation of key Army activities is needed. One person who was asking similar questions to those that ARI was raising was the TRADOC Commander. At a Senior Leaders Conference, GEN Franks reportedly asked the assembled body "what kind of research is being done in information processing and decision making" (from MG Malcor's notes of the 29-30 Jun 93 meeting). As a result ARI generated an information paper highlighting our programs on tactical decision making (see Figure 1).

In response to this information GEN Franks in a message (26 Oct 93) to Director ARI (Dr. Johnson) requested that ARI develop a battle command initiative, recognizing the area is unique and an undefined capability. The "goal is to identify and explain 'the art of battle command' and determine how it can be formally transmitted and taught at our institutions." Further, he requested that ARI

"develop the following areas key to the art of battle command:

- A. Define skill requirements.
- B. Develop strategies on how these skills may be developed.
- C. Determine how these skills can be trained and maintained (institutionalized). This includes developing measurements and training materials for use in formal schooling."

He also wanted the study to

"Include an analysis of thought processes necessary to be a successful battlefield commander. Includes visualizing the current and future state of the battlefield, then formulating concepts of operations to get from one to the other. How to teach and practice synthesis, that is inductive reasoning from bits and pieces of information. How to reinforce the intuitive sense of battle commanders that allows conclusions in an instant informed by an intuition learned from practice."

He requested that the project be conducted as a special study on the human dimensions of battle command and that it be reported back directly to him. ARI agreed to do this. The study was organized as a compilation of associated ARI research with emphasis on future directions that research would take.

Dr. Johnson's reply (15 Dec 93) stated that the effort would be organized around three objectives:

1. Understand what battle commanders do: define skill requirements necessary for battle command, distinguishing more effective from less effective commanders.
2. Determine how to train and educate battle commanders: define strategies for developing the complex thinking skills required for battle command.
3. Identify and analyze the thought processes necessary to meet battle command performance requirements: identify what the technology base has or can do to assist in developing cognitive skills such as decision making, intuition and visualization."

Meanwhile GEN Franks also expressed interest in the cognitive decision making

**Research on Cognitive Information Processing,
Art of Command, and Decision Making at the
Army Research Institute**

The Army Research Institute (ARI) maintains an active program of research in the cognitive functions underlying the command process. The research is funded in the 6.1, 6.2, 6.3 and SBIR programs.

A key element in producing experienced commanders is to understand what specific skills distinguish them from less experienced commanders. ARI is engaged in research that will identify the critical elements of combat expertise through a comparative examination of junior and senior officers' cognitive approach to identification and solution of tactical problems. The final product of this research will be a validated list of characteristics that define tactical "expertise" and recommendations for training to encourage the growth of such expertise.

Not only must commanders have the ability to use certain skills, but they must also choose the right moment to use that skill. ARI research is determining the frequency of skill use in certain tactical situations. ARI will develop techniques for expanding and regulating commanders' strategies for the use of their skills.

Another research project examines the specific mental skills used in situation assessment in maneuver planning. Interviews are conducted with senior tactical staff and are integrated with up-to-date cognitive theories. The framework will lead to soldier-centered concepts for improved situation assessment training, procedures, and decision aids.

In a battle situation, commanders can be overwhelmed by the tremendous amount of information that reaches them. The role of decision aids is to address specific aspects of that information stream to aid the commander to make a decision. Decision aids, however, are difficult to develop so that they are effectively integrated into the commander's job. ARI is engaged in a NATO-sponsored study to put together cognitive analysis techniques to identify and verify decision making requirements of command and control tasks. The techniques will be tested in actual decision aiding projects.

Figure 1. Information paper on cognitive research.

processes of commanders during Prairie Warrior '94. He wanted to know how commanders think, reason, and decide. He requested that battle commanders be studied as part of TRADOC Analysis Command's (TRAC) data collection. ARI agreed to take the lead for this issue. ARI researchers observed a student playing the division commander of the Mobile Strike Force (MSF) '94 and a second student playing the commander for a non-automated division. The effort aimed to determine the effects of "digitization enhancement" on the shared understandings of the battlefield and on the battle tempo. It was hypothesized that digitization would increase situation awareness of the MSF commander and that in turn the better situational awareness would produce shorter decision cycles and decisions of greater breadth.

Style of reasoning was assessed for each commander. The MSF commander was found to be reflective, tending to view many perspectives, and organizing information into a coherent picture. The other commander tended to focus on isolated problems using hypothetical-deductive reasoning. It was found that these different styles did influence the two commanders to perform differently. The divergent style of the MSF commander led to more self-reliance on his own interpretations and less perceived need for others' interpretations. Thinking about situations with very complex mental models led to a preference for similarly rich, integrated information. The digitization was not particularly sophisticated to provide comparably processed and integrated information. The complex understandings of the MSF commander, that were derived through considerable mental effort, led to some reluctance to consider contradictory evidence. The style differences between the two commanders overshadowed any observable difference due to the digitization enhancements. The idea that an information technology's usefulness needs to accommodate decision makers' styles was reinforced by seeing the style

differences of the two student commanders. (TRADOC Analysis Center, 1994).

This Prairie Warrior '94 analysis illustrates the value of examining battle command from a psychological perspective. If it had not been done, the differences in performance could have been attributed to digitization effects, instead of the relatively stronger effects of individual cognitive style and skill.

These observations along with findings from previous field exercises were used in reporting on The Human Dimensions of Battle Command (Halpin, in preparation b). There were 10 observations or insights on cognition reported to the TRADOC Commander. The top insight concerned the lack of explicit instruction on ways to improve thinking.

Insight: 1. Army officers are not formally instructed in alternate ways of thinking, reasoning, and deciding.

So what: Perhaps the most critical assets that battle commanders possess are their abilities to think, reason, and decide. Battle commanders display -- and situations demand -- variety. Instruction should not advocate methods based on a single model.

What next: Identify the variability in leaders and determine how to enhance and supplement skills used in everyday thinking, reasoning, and deciding.

A desired by-product of the study was to gain TRADOC's endorsement and participation in a cognitive research program, allowing necessary research into understanding leader/battle commander decision making. At the same time it was hoped that existing and emerging findings could be transitioned into doctrine, training, leadership, organization, materiel, and soldier developments and begin to displace the limitations of the traditional principles of decision making. It was thought that new developments in the understanding of "natural" cognitive skills (e.g., problem solving strategies, decision making behavior, planning) would be possible to incorporate into a self-development program. Since cognition is a uniquely individual and personal concern the most direct way to reach the officers may be to make self-development materials available that could be pursued according to each individual's needs and interests. The self-study materials could be tested, updated, and eventually could serve as a model of the skills to reinforce in classroom instruction and doctrine, if the materials proved valuable.

TRADOC's interest was more immediate. TRADOC had an urgent desire to implement the notions of the battle command study into classroom instruction. MG Herrling, TRADOC Chief of Staff, reported the CG's tasking "to move from study and analysis to implementation and get an elective started at CGSOC, centered around decision making/problem solving aspects of Battle Command" (ATCS memorandum, 19 Aug 94). GEN Franks instructed MG Ernst, DCST, to "take the lead and, in coordination with CGSOC, Battle Command Battle Lab-Leavenworth and ARI, develop prototype elective course. Focus should be on developing/teaching alternative ways of problem identification, formulation, and solution. Objective is to offer the course to all students by January 1995" (memorandum, 15 Sep 94). ARI was instructed to "continue to research the art of Battle Command, assist in development of the course, and provide feedback and methodology for instruction. Conduct an assessment of the prototype elective and recommend appropriate adjustments, if required, for subsequent classes at CGSOC."

LTG Miller, Commander Combined Arms Center, directed the tasking to the Command and General Staff Officer College (CGSOC) (memorandum from ATZL-CG, 21 Aug 94).

"[D]evelop a Battle Command Course to be available for CGSOC students by January 1995. Purpose of the BCC is to provide our future commanders with the theoretical underpinnings of their craft and to develop key thinking, reasoning, and decision making competencies required of effective battle commanders at battalion and brigade level."

CGSOC took the lead for the elective and requested that ARI participate. The cognitive-based instruction was included as part of the Battle Command elective, A308. This elective was a departure from normal CGSOC courses. Seventy-three students were selected for participation. The 180 hour elective organized the students into the staff for the Mobile Strike Force (MSF), a notional Division with weapon and tactics capabilities projected to the year 2015. The students were led by BG Geoffrey Miller as their Commander. The students were responsible for learning and defining the advanced system capabilities, including a command information management system. They organized staff functions for more versatile operations and developed their own staff procedures and force tactics, techniques, and procedures. They had contact sessions on advanced tactics and logistics and prepared as staff groups with command post exercises.

ARI approached the instruction by addressing specific cognitive insights:

1. Need instruction on alternate ways to think, reason and decide.
2. Domain knowledge is paramount in Practical Thinking.
3. Emphasize situation assessment skills over rigorous analytical approaches.
4. Need better problem identification.
5. Determine how commander's intent is understood and misunderstood.
6. More than one problem solving approach is viable.
7. Provide explicit instruction on thinking and planning.
8. Include instruction on managing one's own thinking.

Seventeen hours were allowed for the cognitive-based instruction out of the 180 scheduled hours. There were many objectives for this course, centered around the test bed activities for future doctrine, weapons, staff organization, etc. The Practical Thinking portion did not intend to teach battle command concepts per se, nor teach battle command lessons learned from Combined Training Centers, (CTCs), nor teach tactical decision making procedures, nor teach MSF system capabilities, procedures, or staff organization. These were subject matter areas that would be better developed and taught by others. Although these areas were reinforced when relevant, the ARI instruction focused on cognitive-skill based instruction.

Background summary.

Classical models of decision making and reasoning have provided the basis for Army and military instruction on tactical problem solving and decision making. The emerging field of naturalistic psychology brings into question many of the explicit rules from the classical models that have become embedded in Army doctrine and instruction. Naturalistic approaches concentrate on the practical ways in which decision makers, especially expert decision makers in complex settings, adapt and decide. Actual field performance shows marked departure from the

explicit rules of the classical models.

An alternate approach for preparing Army leaders to decide has been taken. The focus has been switched from procedural steps and rigid decision rules to the cognitive skills basic to problem situations. The groundwork for this cognitive skills approach to instruction was laid in a study identifying the Human Dimensions of Battle Command (Halpin, in preparation b) for the TRADOC Commander. That study recommended that Army officers be given explicit instruction on how to enhance and supplement their skills for everyday thinking, reasoning, and deciding.

GEN Franks responded to that recommendation by asking ARI to help in the development and trial application of a battle command course. TRADOC, Combined Arms Center (CAC), BCBL, and CGSOC worked together to stand up an innovative course on Battle Command, employing students in a division of the future. Cognitive skills instruction developed by ARI was incorporated as part of that elective.

ARI's goals with the course were to verify that an approach to cognitive skills instruction could be defined commensurate with the concerns of battle command and that the instruction be developed and transitioned for suitable implementation to the students. This report describes the rationale and the approach to the cognitive instruction.

Requirements for Practical Thinking

Instruction on Practical Thinking was requested by senior Army leadership to help develop battle command skills in future commanders and principal staff officers. The concept for Practical Thinking instruction encompassed new alternative topics on ways of thinking that were recommended in the ARI Battle Command study (Halpin, in preparation b).

The concept for instruction was based on the assumption that people do not naturally reason using formal operations from standard logic in dynamic, uncertain situations (Cheng, Holyoak, Nisbett, & Oliver, 1986). Rather, research has shown that problem solvers in these types of situations tend to rely on their prior knowledge and experience to generate and develop a workable solution (Fallesen, 1993; Klein, 1989). Therefore, the challenge for lesson development was to include instruction to enhance natural predispositions with evaluative techniques.

Practical Thinking is an important and valid notion to contrast with formal thinking (see Table 2). Galotti (1989) identifies the characteristics of formal and everyday reasoning. Formal reasoning can occur when all premises are supplied, problems are well-bounded, and there is usually one correct answer. Everyday reasoning occurs when premises are implicit and some premises are not supplied at all, problems are not well-bounded, several possible answers might exist, established procedures rarely exist, there is uncertainty about the outcome of a solution--sometimes even after the solution is applied, and problems are solved as a means to further ends, not as ends in themselves. Scribner (1986) describes Practical Thinking in contrast to

Table 2.
Contrast of Formal and Practical Thinking

Aspect	Formal Thinking	Practical Thinking
Application	Well-bounded problems	Complex, everyday problems
Variation	General purpose	Tailored to circumstances, values, experience
Source of control	Theory dictates	Person determines how thinking best proceeds in each situation
Process	Convergent	Creative and discriminating
Orientation	Form, process oriented	Goal oriented
Foundation	All premises exist	Some premises are implied or missing
Knowledge	Knowledge exists or can be determined	Some level of uncertainty always exists
Goals	Goals are taken as given	Goals are determined. If they already exist, they are checked.
Outcome	Single answer exists and is found through application of the process	An answer might not occur or many acceptable answers might exist
Theoretical basis	Classical models, enforce rational decision making	Naturalistic, understand what makes people adaptive and effective

theoretical thinking. Practical Thinking involves integrated mental processes directed toward some goal and performed in specific circumstances. Practical Thinking ability involves adaptation to changing conditions of the circumstances and to the changing states of knowledge, purpose, and values of the person.

Practical Thinking was conceptualized to include aspects of both critical and creative thinking. Critical thinking is judgmental (analytical), cautious, and convergent. It checks on the sensibility, relevance, and relationship of meaning and possibility. Creative thinking is generative, daring, and divergent. Together they make up Practical Thinking that relates to the naturalistic model based on how people actually think and act. The use of the term *Practical Thinking* resulted from the realization that innovation and evaluation complement each other. In this sense, this is the practical way to approach thinking, rather than by classical or formal ways.

Available courses based on critical thinking skills were not sufficient because they were often based only on the assumptions of formal methods from classical logic that, while having evaluative components, required one to ignore plausible solutions generated from one's experience (e.g., Peng & Reggia, 1990). Similarly, courses on creative thinking emphasized prior knowledge and experience, but did not emphasize evaluation of the information or recursive processes (Bransford & Stein, 1984; Cinnamon & Matulef, 1979; Friedman, 1984).

Practical Thinking is related to the naturalistic models that are based on how people actually think and act, rather than on how someone or some organization believes they should think and act. Practical Thinking does not assume a normative model of behavior. Rather, this approach advocates that one use one's experience, knowledge, and evaluative skills to explore, define, and refine the problem, find a solution, and weigh the consequences. Also important is learning to manage thinking during the short term and how to learn and prepare oneself for future problems. In this sense, this instruction presents students with a "practical" way to approach problems.

The proposed objectives for Practical Thinking were

1. To make students aware of alternate ways of thinking (that contrast with formal, logical, procedural models of decision making).
2. To introduce Practical Thinking skills to students and to increase their competency with those or similar skills they themselves determine.

It was recognized that the instruction would have a strong attitudinal component; that students' attitudes would influence whether they would change their ways of thinking.

Focus on Practical Thinking

The focus of the ARI concept was to increase the student's awareness of the importance of thought and to improve useful skills. The concept addressed a perceived deficiency in an officer's traditional, formal instruction. That instruction does not explicitly improve ways of thinking, except from a technical competency standpoint (Kluever et al., 1992). Doing so would at least increase their appreciation of the criticality of Practical Thinking for complex problems. Thus the approach was to center on individual instead of staff or team development. A

considerable part of the effort was to influence attitudes. Much of tactical decision making instruction already focuses on the external structure of the process (namely, the order of steps, the use of decision matrices, and coordination among staff). Thus it was deemed important to focus on the individual reasoning level of skill that allows the adaptation necessary to solve actual problems that the procedures do not provide guidance for.

In the normal course of Army instruction, thinking skills are left to lay fallow under the surface of the more apparent activities and facts that can be explicitly taught, observed, and tested. Curriculum development efforts try to compensate for this indirect approach to thinking by requiring the classification of lessons according to Bloom's taxonomy of educational objectives (1956). Bloom's widely-used taxonomy offers little beyond description, suffers from a weak conceptual framework, and uses indistinct labels. (See Paul, 1993 for further discussion of Bloom's taxonomy and its relationship to critical thinking.) This instruction, in contrast to the "cognitive afterthought" of the behavioral approach, is intended to force thinking issues to the surface.

Attention to critical thinking and reasoning is already of interest in Army education. Several examples exist at the Combined Arms Center. The Battle Command Battle Laboratory (BCBL) is interested in how to develop future leaders and the skills required. The Curriculum Development Department is also tracking the developments of the critical thinking movement. They realize the complexities involved in implementing it in an institution aimed at preparing officers for duty as field grade commanders and principal staff officers. One reason cited for not more vigorously pursuing critical thinking is the absence of good ways to measure its effects. At the 1994 ARI-BCBL Battle Command Workshop, the education subgroup reported the need for a shift away from the institution being responsible for learning to officers themselves taking on the responsibility.

The CGSOC Professional Reading Program is consistent with a skills approach and intends to improve thinking, but does not explicitly identify the skills to be developed. The Leadership Instruction Department is exploring new ways of teaching related subject matter (e.g., A716, New perspectives for leading the Army through change and C710, Senior-level leadership and the art of command). In these programs, improving thinking is more or less an incidental process.

One alternative is to focus more on experience. Klein (1989) proposes that, instead of relying on classical analytical models, we need to look to the recognitional side of making decisions to find ways to improve.

"There are different ways to make decisions, analytical ways and recognitional ways, and that we must understand the strengths and limits of both in order to improve military decision making. Too many people say that the ideal is for soldiers to think more systematically, to lay out all their options and to become, in effect, miniature operations researchers. This attitude is even built into military doctrine." (Klein, 1989, p 57).

Analytic, systematic methods are not necessarily effective. Systematic procedures alone do not offer much support to identify or overcome what we do not know. Nor does a systematic approach support the time-compressed conditions of most battle command decisions.

We probably think in a natural way rather than systematically because of a principle

called cognitive economy (Rosch, 1978). Cognitive economy is natural and adaptive. It tries to employ the smallest amount of cognitive effort to provide a mental reserve when higher thinking loads are demanded. Analytical decision procedures conflict with cognitive economy because of the heavy load they impose on attention, memory, and processing.

"The goal of analytical decision training is to teach procedures that are so abstract and powerful that they will apply to a wide variety of cases. If this had been successful, it would have been quite efficient. However, we have learned that such rules do not exist. Instead, we need to enhance expertise by presenting trainees with a wide variety of situations and outcomes, and letting them improve their recognitional abilities." (Klein, 1989, p 64).

The practical importance of recognition and experience are given in the following story.

"A recognitional approach can save time and effort for more important concerns. An experienced brigade commander looked at a map and selected a site for an engagement area. . . . Other sites were then proposed that he had not even bothered to consider, although they seemed plausible to his less-experienced subordinate. He was able to explain why each alternative was defective and seemed surprised that anyone would even think about them. In other words, his skill enabled him to generate only plausible options so that he did not have to bother with computing advantages and disadvantages. He could use all of his experience to judge what was needed for the situation. He could generate a workable first option, so there was no reason for him to generate many more options and then have to perform a painstaking evaluation of them." (Klein, 1989, p 58).

To take advantage of this recognitional perspective, Klein suggests that training be revised. He believes that some special positions need training in analytical decision strategies, but general training might be more productive by focusing on situation assessment. He indicates that actual cases need to be considered to develop sharper discriminations of which circumstances call for analytical procedures.

The Practical Thinking approach is compatible with Klein's arguments but imply a different conclusion and a different approach to instruction. Although consistent with Klein's recommendations that decision making can be improved by increased exposure to domain situations, we must also equip students with techniques for learning to learn and increase their desire to attend to everyday situations. Everyday situations are excellent opportunities to learn if we were only to reflect on them. Instead of concentrating on abstract, universal procedures (the direction implied by classical models) or on specific cases to build and refine tactical judgments (the direction implied by Klein's theory), the Practical Thinking approach focuses on the thinking skills themselves. Thus it recognizes that a single, generalized model will not be optimal across situations. This approach borrows the attention to situational and contextual factors of Klein's recognitional approach, but tries to make the recognitional and other reasoning processes better understood by more explicit definition.

The Practical Thinking approach also addresses the role of the student in the instruction. By focusing the students on their thinking, they should reflect on how they are thinking, assess how they do it, how they might do it differently, and how intrinsic feedback, motivation, and attitudes can improve it. "[A]ttitudes as well are critical to creative thinking. They cannot be taught directly, any more than one can teach students to like Shakespeare. Teaching creativity

must involve exposing students to the flavor and texture of creative inquiry and hoping they get hooked." (Perkins, 1984, p 21)

"A lack of confidence in our ability to solve problems can manifest itself in a variety of ways, including lack of interest, fear of exploring new domains, and fear of criticism. These feelings can interfere with problem solving and can prevent us from engaging in activities that might improve our problem-solving skills. . . . By identifying the attitudes that inhibit success and defining appropriate goals, we can begin to explore strategies that may stop us from repeating earlier failures." (Bransford & Stein, 1993, p 221)

The goal of this cognitive based instruction was to make a pragmatic model of thinking, reasoning, and deciding more explicit. Several propositions can be identified that impact on the requirements of cognitive skill identification and instruction. These propositions are discussed in the following paragraphs.

Thinking as a skill

Thinking is considered to be a skill that can be improved (e.g., Friedman, 1984). Naturalistic methods of studying battle command performance and educational theory make it possible to identify a set of critical thinking skills appropriate for remediating errors and suitable for instruction (e.g., Carlson, Khoo, Yaure & Schneider, 1990). Recent advocates of a field called situated learning claim that learning only occurs by performing actual processes in the applied situations. Reder (1994) says though that basic skills *do* generalize from one context to the next. "There is ample evidence that transfer is much better when instruction includes both concrete and abstract instruction" ("Academy Releases Report," p 16).

Errors in thinking

A person's performance may result in undesired outcomes. Although not necessarily defined as errors, the performance in question is subject to improvement. Reasoning errors may fall into identifiable, regular categories, like cognitive limitations and biases, but not all of the biases identified in the research literature are bona fide problems (Gigerenzer, 1991). The area of decision making bias research typically follows the premises of rational probability theory. The apparent biases can disappear when the decision maker's previous knowledge is taken into account and by distinguishing between single cases and judgments over time. The errors or biases that are identified in the literature probably represent reasonable adaptations of people's abilities to situational constraints. The definitions of biases are useful anyhow as a starting point for considering possible ways to improve performance. Table 3 shows some general statements of biases and Table 4 shows cognitive limitations. A survey of tactical planning errors is also reported by Fallesen (1993). Instruction can be geared toward actual limitations to keep errors from recurring.

Adaptive thinking

Decreasing reasoning errors or improving reasoning is tied to flexible, adaptive thinking (Payne, Bettman & Johnson, 1988; 1993). Being sensitive to the factors that are important to

adapt to, is an important part of critical thinking. The factors or characteristics can be classified according to one of three sets: task (what is required to do), situation (or environment), and decision maker (or person).

"Skilled practical thinking incorporates features of the task environment (people, things, information) into the problem-solving system. It is as valid to describe the environment as part of the problem-solving system as it is to observe that problem solving occurs 'in' the environment. . . . experience makes for greater rather than less reliance on environmental sources of information If experts in a domain use the environment more (or more effectively) than novices, two implications follow: becoming skilled in a practical domain may move in a direction opposite to that posed by classical psychological learning theory, namely, from the abstract to the concrete. A second implication is that models of thinking that can only deal with the world as represented in the head may find analysis of many practical thinking problems quite intractable." (Scribner, 1986, p 23-25).

Various educational research supports the notion that thinking can be adapted to these features by teaching people how to control, regulate, or guide their thinking (e.g., Perkins, Faraday & Bushey, 1991). This skill is called metacognition.

Flexibility.

Scribner (1986) indicates the importance of flexibility. Flexibility is "solving the 'same problem' now one way, now another, each way finely fitted to the occasion. Formal models of problem solving lead us to expect that repetitive problems or problems of the same logical class will be solved by the same sequence of operations (algorithms) on all occasions of their presentation. Variability sometimes enters the system in the guise of shifts in executive control from one higher-order strategy to another. These strategies, presumably, differ from each other in the modes of solution they regulate, but each generates consistent solutions to all instances of a given problem type." (p 22)

Creativity.

Schön (1983) refers to a concept called 'informal improvisation' and calls it the hallmark of professional expertise. Studies by Kusterer (1978) show that much of a worker's knowledge is about handling situations that the 'standard operating plan' did not cover.

"Practical problem solving is an open system that includes components lying outside the formal problem -- objects and information in the environment and goals and interests of the problem solver. Expertise in practical thinking involves the accomplishment of a fitting relationship among these elements, an accomplishment aptly characterized as functionally adaptive. Beneath the surface of adaptation, however, lie continuing acts of creativity - the invention of new ways of handling old and new problems. Since creativity is a term ordinarily reserved for exceptional individuals and extraordinary accomplishments, recognizing it in the practical problem-solving activities of ordinary people introduces a new perspective from which to grasp the challenge of the ordinary." (Scribner, 1986, p 28)

Table 3.
Biases (adapted from Hogarth, 1987).

Bias	Source	Description
Acquisition	Availability Selective perception Frequency Illusory correlation Data presentation Framing	The likelihood of something happening may be judged by how easily examples of it come to mind. What is not or cannot be perceived is not used. Prior knowledge imposes structure on a task. Observed frequency is used instead of observed relative frequency to assess events. The frequency with which two events occur and their degree of association are misjudged. Information characteristics affect judgment: order, sequence, qualitative, quantitative, missing information, and context. Whether information is presented as gains or losses, positives or negatives will affect goals and assessments of outcomes.
Processing	Inconsistency Conservatism Non-linear extrapolation Habit Anchoring and adjustment Conjunction Representativeness Law of small numbers Justifiability Sunk costs Misconception of regression 'Best guess' Consistency	Strategies are not applied consistently. When new information is received assessments are not updated. Exponential processes and joint probabilities are under- or over-estimated. Choices are based on prior satisfaction. A cue value is used as an anchor and adjustments made for a new cue. Insufficient adjustment leads to underestimation. Descriptions that are more elaborate are associated with a higher likelihood. Some object or event is judged more likely to generate some other object or event if the two are similar. A small sample is expected to be representative of random chance. An inappropriate decision is believed to be justified if it is based on a rational rule. Staying with a previous course with a heavy investment instead of ignoring that and focusing on future costs and benefits. Regression toward the mean is often ignored. Unreliable and uncertain information is often ignored. What is known is more important than what isn't known. Consistency of information, without an associated increase in accuracy, leads to greater confidence.
Output	Wishful thinking Illusion of control Question format	The probability of an outcome is higher when it is based on desire rather than knowledge. People tend to feel that due to their skill they have more control over events than they actually do. How judgments are made affects the outcome, e.g., greater willingness to give more to remove a risk than to acquire an equal reduction of risk.
Feedback	Misperception of chance ("gambler's fallacy") Attribution Hindsight Outcome irrelevant learning Logical fallacies in recall	Observation of unexpected chance outcomes leads to an expectation that the likelihood of events not recently observed will increase. People attribute undesirable outcomes to bad luck and desirable ones to skill. Knowledge of events alters the memory of prior predictions, so people think they are more accurate than they really are. Observable outcomes provide information that indicates something about events that did not occur or were not observed. Inability to recall details leads to 'logical' reconstruction that can be inaccurate.

Table 4.
Cognitive Limitations (from Essens et al., 1995)

Limitations	Subcategories	Examples
Schema	Instantiation	Poor fit of data to schema or slots with guesses instead of data (poor modeling). Poor use of lower (over-specialization) or higher (over-generalization) schema. Error in accretion: an experience is incorrectly assessed as another. Error in tuning: incorrect elaboration and refinement of concepts. Improper use of most common schema; forced to fit the situation (a "habit" bias). Several schemata are triggered, but wrong one is picked. Schemata are confused. Familiar elements incorrectly called into script. Too much reliance on existing schemata, reluctance to generate specialized schema.
	Formulation	Inappropriate conditions embedded in the declarative part of the schema. Inappropriate rules or responses embedded in the procedural part of the schema. Key parts of rule conditions are omitted or new rules are incorrectly formed. Non-standard elements haven't been stored as cues & are unavailable to form new schemata or to distinguish existing ones. Schemata are not formulated when appropriate.
	Execution	Correct schema is activated, but procedural error (e.g., computational error).
Learning	Classification	Links among concepts are not made or made incorrectly. Important attributes are left out of classifications when they are formed. Memories are excessively reorganized when new experiences and repetitions occur.
	Feedback	Insensitive to feedback (related to feedback biases).
	Rules	Rules or regularities are not generalized to induce new rules.
Knowledge	Representation	Insufficient knowledge and relationships, e.g., poor goals, values, or knowledge. Poor organization of knowledge. Inability to use or retrieve appropriate representations. Inappropriate crossed memories. Poor integration of knowledge or poor representation for a particular state.
Basic Processing	Understanding	Poor encoding or representation of the situation and its meaning. Ignoring important classification attributes. Failure to recognize salient features and critical relationships in a problem. Failure to consider implications of models identified in the search.
	Generalization	Missing or inappropriate abstractions or chunking. Incorrect normalization - transformation to an event that was not most likely. Thinking occurs at wrong level of abstraction. Too few abstractions or relations.
	Reasoning	Inappropriate strategy selection (incorrect schema) and reasoning. Inconsistent application of a strategy. Inability to hold in mind various possibilities. Poor trade-offs about importance. Ignoring uncertainty rather than trying to resolve it. Failure to project ahead. Inadequate search for counterexamples. Inappropriate use of analogical reasoning. Failure to critique, check for consistency, validity of assumptions. Failure to de-conflict ambiguous information.
Metacognition	External monitoring	Failure to recognize that a situation requires something to be done. Failure to gauge difficulty of a problem.
	Internal monitoring	Failure to assess likelihood of knowing. Failure to monitor actions, evaluate one's strategy. Failure to organize thoughts.
	Regulation	Inability to allocate attention and cognitive resources. Poor use of time. Failure to set goals. Inability to synchronize processes. Inability to control actions, revise one's strategy. Planning is overly opportunistic; lacks adequate control.

Efficiency.

"Skilled Practical Thinking often seeks those modes of solution that are the most economical or that require the least effort." (Scribner, 1986, p 23). "By partitioning the world into classes, we decrease the amount of information we must perceive, learn, remember, communicate, and reason about." (Smith, 1988, p 19).

Knowledge.

Our capabilities to adapt our own knowledge, understand and generate new knowledge, and to learn are important. Goal-directed thinking can be considered to be either using the knowledge we have already learned so we can solve a problem, generating new knowledge to solve a problem, or to learn the process so the knowledge can be produced when it is needed.

"Practical thinking involves the acquisition and use of specific knowledge that is functionally important to the larger activities in which problem solving is embedded. In recent years the centrality of knowledge to intelligent performance has been widely recognized in cognitive theory. . . . In every job examined, these procedures were constructed around, and relied on knowledge specific to the setting and relevant to the task at hand -- case equivalencies, storage dimensions, numerical representation systems. . . . Less routinized activities pose more 'problems' and thus require the acquisition of more information for overcoming problems." (Scribner, 1986, p 26-27).

"[P]art of the problem is that conventional instruction usually presents knowledge as given, when it should encourage a view of knowledge as the product of creative effort." (Perkins, 1984, p 22). Domain knowledge is essential to rapid tactical problem solving. Already knowing is more useful under time pressure than skills to construct knowledge. Instruction for "knowing how to" should not in any way replace "knowing that." Already knowing is difficult, however, especially as the roles of the Army and its officer corps grow in diversity.

Problem identification.

The Human Dimensions of Battle Command report indicated problem identification as an often overlooked aspect of problem solving.

"Practical thinking involves problem formation as well as problem solution. Models of formal problem solving suggest that problems are 'given' and intellectual work consists of selecting and executing a series of steps that will lead to a solution; the initial problem may be decomposed into subproblems as part of the solution procedure, but its terms are fixed. . . . But even preset problems may be subjectively reconstituted. On many occasions, problems arise that have a general shape but not a definite formulation. One artful aspect of practical thinking is to construct or redefine a problem that experience or hunch suggests will facilitate a solution or enable that application of a preferred mode of problem solving. This form of creativity is noticeable and has been well-remarked in professional activities, . . . in which the capacity to devise problems that fit good solutions is highly prized." (Scribner, 1986, p 21)

Variability in thinking styles.

Trying to change the ways people think is more difficult than teaching declarative knowledge (e.g., arithmetic facts, weapon capabilities, tactical maneuvers). Students probably feel that learning new ways to think would be unnecessary, since they already use everyday reasoning relatively effectively. Styles have been acquired as ways that an individual has learned to adapt to his or her circumstances. There are considerable differences in the style of thinking that people display. Various styles have different strengths or weaknesses and differ across situations. Self-awareness is an important part of appreciating one's own thinking style, preparing to modify ways of thinking, and "posturing" oneself to solve a specific problem. Based on an unpublished search of methods, existing types of "cognitive style" are of questionable use for tactical decision making. New ones need to be developed so we can better understand the dynamics of behavior.

Inadequacy of previous models.

Classical models of decision making assume all-knowing decision makers, one choice situations, and predictable futures. These models are based in economics theory and are of limited use in complex, dynamic, uncertain problems in tactics and battle command. Formal, logical models of reasoning are of little use in the complex, dynamic, uncertain world in which we must adapt (Beach & Lipshitz, 1993). This is because formal logic is obscure and rigid. It is primarily an organizational form to relate aspects of known, assumed, or implied information. The reasons that formal logic are not complete or appropriate include:

1. Logic is just one aspect of reasoning. Logic alone is not sufficient for improving reasoning (Colberg, Nester & Trattner, 1985; Johnson-Laird, 1983).
2. Formal logic does not address content or context. People typically look for content and context cues to adapt to the situation. Deductions may be based on content instead of the laws of logical form. People also construct explanatory models of human behavior (Pennington & Hastie, 1993).
3. Seldom does one have complete, certain information. An important part of practical reasoning is plausible reasoning, when there is uncertainty. To say that a person needs more information before he can start thinking is often pointless. Thinking is concerned precisely with extracting that information from experience and projecting it to situations where there are unknowns. (See Rogers, 1994 for discussion of Battle Command and this point.)
4. Logic is a formal system of thought. It is complex, time-consuming to learn and apply. It comes from a game where one person tries to persuade a listener to agree with premises so that the listener will have to accept the conclusion.
5. The technique concentrates on form not on content. But reasoning involves both; content is overwhelmingly important for assessing the reliability or truth in an argument or belief.
6. Premises are taken as true or false. But our perception of truth is seldom absolute, without any doubt. There is uncertainty associated with our informal premises. When

the truth of one or more premises is in question, the conclusion is in doubt. Even in formal logic, "we must reach a premise which we must either assume to be true without sufficient proof or which we must evaluate by methods other than deductive reasoning" (Moore, 1967, p 18).

7. Logic relies on specific meanings, more restrictive than everyday language usages (e.g., words like "all," "is," and "not"; figurative uses are precluded, like 'My uncle is a lion.')
- People have difficulty with negative statements in logic, e.g. drawing inferences from negative premises (Matlin, 1983).
8. The rules of logic do not conform with the rules of conversation, when one considers a speaker's intentions (Puckett, Pollina, Laipple, Tunick & Jurden, 1993). Imagine someone tells you that if it rains, then the enemy cannot reach their terrain objective. You know that the enemy has not reached their objective, so you conclude that the speaker also is indicating that it must have rained. A person's understanding of another's verbal intentions follows Grice's (1975) maxims of communication (specifically: quantity, quality, relation, and manner). If there were relevant reasons other than the relationship stated, then we assume the person would have mentioned them (Chapman, 1993).

Abstract training in logic has been shown to be ineffective for aiding reasoning (Cheng, Holyoak, Nisbett, & Oliver, 1986).

Organizing instruction.

There are several considerations for the combination of instructional materials. One view suggests that cognitive skills are trained in an incidental matter with focus on specific subject matter, e.g., mathematics, physics, or in this case, tactics. Another view, and the one integrated into this instruction, was that cognitive skills can be explicitly identified and organized in a coherent manner (Hayes-Roth, 1980; Hayes-Roth & Hayes-Roth, 1979).

"Centering curriculum on subject matter also causes the thinking skills to be taught piecemeal. Thinking skills are taught haphazard as the content dictates. This makes it impossible to comprehensively cover in any systematic manner the thinking skills the students need to learn. When teachers are forced systematically to cover prescribed content, they are distracted from systematically covering thinking skills. The content may be covered, but thinking skills probably will be neglected." (Friedman, 1984, p 24)

This relates also to the selection of exercises used to illustrate teaching points and practice skills. Using many short exercises with different situations and keeping the problems brief, helps put the focus on the skills, rather than the specific problem context (de Bono, 1976).

Methods of instruction.

Education and training of soldiers in this abstract area of ways of thinking, needs to use variability in methods and materials. The material must be interesting, attention getting, and as practical as possible. Various approaches of presenting the instruction were considered (e.g.,

Table 5.
Methods of Instruction

Implementation	Example targets
Lectures	Significance, alternate perspectives, basic explanations
Readings	Everyday reasoning, naturalistic reasoning, groupthink
Exercise discussion	'What does this mean to you? How would you apply this?'
Self-awareness reflection	Solve a problem and report on how you did it.
Attention exercises	Discuss obstacles, biases, shortcomings of decision matrices
Skill-building exercise	Metacognitive "quick test," questions, memory techniques, assumption testing, creating problems for others, creativity, multiple perspectives, etc.
Scenarios for discussion problems	'How would you solve this?' Marine tactical decision games (Schmitt, 1994), ARI experimental scenarios
Case studies	Problem identification

see Eitington, 1989), but the overriding concern was the content or substance of the instruction. All of these implementation techniques (shown in Table 5) were used in some form. Self-awareness instruments and testing were desired but not used because of the lack of suitable materials consistent with the philosophies of this instruction.

In a pedagogical model of instruction, the teacher prescribes what is to be learned and the students demonstrate what was taught. This ensures some minimal level of quality in measurable objectives, but puts the students in a passive, receptive role. While these intentions are suitable for teaching facts, algorithmic procedures, and well-understood areas, they are questionable for very complex, dynamic, and uncertain areas (such as battlefield planning, command, and control) and for adults who have some advanced level of competency. Using behavioral objectives assumes that the collective wisdom of the institution knows best what a student should know and the measurable standard by which the instructional process and the student can be held accountable. The wide variability in experience and procedures conflicts with the notion of "one size fits all" procedures. In contrast the andragogical model (Knowles, 1990) proposes that the teacher's role is as a facilitator and that the student is primarily responsible for learning. Cognitive instruction for mid-career officers would certainly fit the andragogical model much better than the pedagogical model. To excel the conventional model relies on regulation, while the adult learning model relies on students' interest for autonomous inquiry and application.

Knowles (1990) lists six identifying features of this adult learning approach which are relevant to consider for the practical thinking application.

1. Adults need to know why they need to learn something before undertaking to learn it.
2. Adults have a self-concept of being responsible for their own decisions and lives.
3. Adults come into an educational activity with both a greater volume and a different quality of experience from youth.
4. Adults become ready to learn those things they need to know and be able to do in

- order to cope effectively with their real-life situations.
5. Adults are life-centered (or task-centered or problem-centered).
 6. While adults are responsive to some external motivators (better jobs, promotions, higher salaries, and the like) the most potent motivators are internal pressures (like the desire for increased job satisfaction, self-esteem, and quality of life).

Because adults have been conditioned through years of schooling to expect that the teacher and the institution is responsible to teach them, when they return to that setting they often come with an attitude of "teach me." But giving them what they expect causes conflict with their increased sense of self. The internal conflict can lead to disregard for the educational experience. The methods of instruction should be varied and engaging since success depends on the students' interest.

Shaping critical thinking.

Brookfield (1987) discusses a general philosophy to model and reinforce critical thinking. Guidelines to consider in the development of instruction include what a teacher can do: be critical teachers, model critical thinking, be willing to take risks, affirm the critical thinkers' self-worth, listen attentively, demonstrate support to critical thinkers' efforts, reflect or mirror critical thinkers' ideas and actions.

Tempering expectations for course results.

Altering the ways people think will initially cause delays and more effort to solve problems. New ways of thinking will cause interference with in-grained, 'tried and true' -but limited- ways (Carlson, Khoo, Yaure, & Schneider, 1990). The assumption is that over time, a person will adopt the heuristics that are useful, if they are perceived initially as having merit; are memorable or periodically refreshed; and if the desire exists to improve.

Demonstration of "learned behaviors" will be difficult to observe, because only over time will new "philosophies" of thinking be applied in observable ways (the result of classroom instruction and practice may result in second or third order effects with only subtle differences in observable behavior or outcome). Cognitive instruction is similar to studying history. There may not be direct parallels between the lessons learned from the Civil War and planning mechanized armor operations in the 21st century, but projecting the past principles into a current or future situation is still useful.

Research on ways of thinking is not well integrated; there are few straightforward implications or simple directions for implementation. Voss, Perkins, and Segal (1991) point out that one of the emerging understandings is that the knowledge base about reasoning (from which instructors can draw their lessons) has been lacking. They continue, "[U]ntil recently, the phenomenon of contextualized reasoning, as opposed to abstract mathematical or logical reasoning, has received very little theoretical attention from psychologists. . . . The shift to additional concepts of reasoning is only recently receiving attention in research and so far has had relatively little application to classrooms." This proved true in the search of appropriate concepts and materials for the Practical Thinking curriculum. The absence of materials implied that the materials had to be constructed from scratch. Therefore, these first attempts should be considered exploratory and provisional and assessed accordingly.

Review of Cognitive Instruction Programs

Cognitive instruction programs were reviewed for applicable approaches, description of skills, and lessons learned in doing this type of instruction (Fallesen, Pounds, Breeskin & Saxon, in preparation). Fifteen cognitive instruction programs were reviewed. The results from the various programs were generally positive, but were not as substantial as would be hoped. Positive results were indicated on some measures for some programs but not for other measures. For example, positive results were indicated for the Odyssey program (Harvard University, 1986) on the number of solution features and the amount of detail. For the Productive Thinking Program (Covington, Crutchfield, Davies & Olton, 1974) positive results were found on fluency, better ideas, and detection of anomalies but not on better overall solutions. Nickerson (1984) puts the typical efficacy outcome in perspective.

[E]ducational evaluation is inherently difficult, and its results are seldom unequivocal; program developers have sometimes been sufficiently convinced of the merits of their approach that they have not been motivated to attempt an evaluation themselves. . . . Quantitative data on a few programs indicate that they produce modest improvements in performance on a variety of tests of mental ability. They make it clear that no one can yet assure the development of effective thinking skills in the classroom, but they reinforce the conviction that the goal is a reasonable one and that progress is being made in its pursuit. (Nickerson, 1984, p 36)

Bolstering skills and attitudes as general and as pervasive as those dealing with thinking is not easy to do, and the absence of overwhelming efficacy should not be discouraging. Most of the reviewed materials were targeted at younger students, and none of the existing programs had the desired combination of skills identified from the propositions and recent cognitive theories. The absence of existing cognitive programs was not unexpected, and reinforced the need for developing materials specifically to try to enhance the skills of mid-career Army officers.

Identification of Cognitive Skills

There are several sources available for identifying cognitive skills including cognitive instruction programs (Fallesen, Pounds, Breeskin & Saxon, in preparation), curriculum lists (e.g., Ennis, 1987; Paul, 1993), and cognitive model taxonomies (e.g., Guilford, 1967). These lists are typically geared toward a very basic level. Some of these sources rely on formal logic contrary to the naturalistic approach valued here, and some of the skill sets seem incongruous. So to develop a more cohesive set for the purposes in mind here, skills were proposed as "thinking questions."

The skills were formulated as questions about how a person understands, remembers, reasons, and so forth. The above propositions led to the identification of an initial list of candidate lesson topics (see Table 6). The questions helped to identify the skill or the process that might be used to think about what operational situations are, what they mean, what goals are important, and what solutions are possible. The second column in the Table indicates the psychological field that provides subject matter from which to draw to build the instruction.

Table 6.
Problem Solving Skills Suggested by Reflective Questions

"Thinking" question	Related construct
What is this situation?	situation assessment, understanding
What is this situation like?	analogical reasoning
What isn't this situation like?	dialectical reasoning
What else could this situation/solution be?	creativity
Any assumptions unneeded, new ones needed?	hidden assumptions
What is the real problem?	identification, definition, framing
What needs to be accomplished?	goals, planning
What do I know about situations like this?	assessment of own knowledge
How should I prepare for future situations?	learning to learn
What don't I know that I should?	using uncertainty
What do I still need to know?	missing information
How can I remember?	memory techniques
How could this situation happen?	explanation-based reasoning
What constraints are there?	constraint-based reasoning
What is likely?	plausible reasoning
What should I know?	learning to learn, attention, novelty
How to reason?	consistency, clarity, counter-arguments
What is the solution?	everyday reasoning
How should I think about this problem?	metacognition

Summary of requirements.

The Practical Thinking subcourse is part of a process to determine (1) whether a cognitive skills approach has any merit for Army officer development, and (2) how to implement such a program. It appears that improving how people control their thinking does have an influence on the quality of performance. (Cohen et al., in preparation; Fallesen et al., in preparation; Freeman & Cohen, 1994). There are clearly cognitive skills which can be improved (e.g., dialectic argumentation, mnemonic techniques, planning of time, and analytic methods) (Covington, 1987).

Practical Thinking concentrates on conveying the importance of thinking skill, the significance of correctable problems, and new concepts as examples to show that alternate ways can be identified. Some of these different concepts may be found to be worthwhile by the students. Although it may look as if more procedures are being offered, they are not meant to be general, absolute rules to follow, but skills that are mental resources that can be applied in the right situation. Problem solvers need to determine when deliberate thinking is appropriate,

plan to do it, and manage it as uncertainties are explored. The training materials should provide guidance when the concepts should be useful.

A cognitive skills approach requires careful examination of how people actually think and explicit identification of the skills to train. The basis used here were various propositions about how people think and learn. These implied requirements were combined with questions that guide our thinking to identify candidate cognitive skills.

Practical Thinking Lessons

Several aims were identified for developing the Practical Thinking material. Ultimately we wanted to increase cognitive skills that would improve battle command performance. This was something that the students would have to take primary responsibility for. Accepting responsibility is largely a matter of understanding the need to change and improve. Attitudes were addressed to encourage understanding of the Practical Thinking rationale, concepts, and tools. The concepts were offered to impress upon students the importance to learn more than simple procedures or subject matter knowledge that are presented elsewhere in their education. Instruction stressed the students' desire to learn, to consider how they think, and to find and try out tools for thinking. Lessons were centered around obstacles to thinking and concepts for improving thinking. The instruction intentionally avoided the prescription of procedures for thinking. The materials introduced concepts and techniques for performing certain skills, like finding hidden assumptions. These concepts were used to illustrate different ways to think and were not meant to be prescriptive.

For example, one problem with parochial and traditional views is that they keep new ideas from being thought about, tried, and implemented. The instruction included historical instances of parochial views and some of the reasons why they are held. Techniques were given for taking multiple perspectives, such as taking on other person's views and attitudes to see where they would lead, if they were true. Some components were included that were drawn from the cognitive instruction programs that were reviewed. The efforts were geared toward improving cognitive skill, especially metacognitive skill, informing about attitudes, and offering tools, heuristics, or guidelines for thinking. The six lessons are briefly described in the following text and in Table 7.

The lessons started with a general overview, covered creative thinking, thinking about thinking, dialectical argumentation (possibility thinking), everyday and informal reasoning, and integrative thinking about putting an encompassing picture together. The order of lessons was selected to go from broad, familiar topics to more advanced and specific ones. The seven Practical Thinking meetings were spread out throughout the Battle Command Course to accommodate other course elements.

The topics selected for the first Practical Thinking lesson provided an *Overview* of the purpose of Practical Thinking instruction, gave examples of the skills to be covered, and allowed the students to start to reflect on how they think and how others might think.

The second lesson was on *Multiple Perspectives*. It was intended to support the MSF course requirement to shift from the usual way of looking at things and to apply more creative processes and solutions. Attitudes, general guidelines, and specific techniques for shifting perspectives were presented and practiced through class exercises.

The third lesson was called *Adapting to Situations* and covered how the Practical Thinking skills related to the tactical decision making procedures taught elsewhere in CGSOC and how organizing one's thinking can be beneficial. A tool was offered for deciding how to adapt one's thinking to the situation. This lesson was focused on metacognition, but several of the instructors chose to provide more concrete discussions about making decisions under stress conditions.

The next lesson was on *Finding Hidden Assumptions*. Finding hidden assumptions was

based on situation assessment research done by Cohen et al. (in preparation). Finding hidden assumptions covered the problems associated with assumptions that are not apparent in a person's thinking. Finding hidden assumptions opens up the range of possibilities for what a situation is, what it means, why it might happen, and what to do about it. The nature of beliefs and their relationship to assumptions and "facts" were discussed as were unstated assumptions. A specific technique for finding hidden assumptions was discussed and practiced.

The fourth lesson was on *Practical Reasoning*. Practical reasoning covered the essence of Practical Thinking, problems or flaws in practical argument (i.e., the debate that goes on inside one's thought processes), standards of thinking one might use to avoid the flaws, how reasoning is affected by attitudes, and six general tools as prompts for deeper thinking.

Integrative Thinking followed practical reasoning. It included discussion of the characteristics of military expertise and stages characterizing different levels of reasoning sophistication. The lowest stage is characterized by the deference of the thinker to a person or other source (like published doctrine) in authority. This stage characterized the lack of critical and integrative thinking. The highest level is characterized by the ability to put complex understandings together in overarching views. The differences and similarities in levels were demonstrated with a car buying example that everyone could relate to. Students were also challenged to predict how someone at each integrative thinking level would respond to a tactical scenario with high situation and goal uncertainty.

The original allocation of instructional time and number of lessons was reduced because of other course demands. As a result, a planned lesson on expertise was dropped, and the topic of expertise was included in the integrative thinking lesson. Also a final lesson on *Skill Practice* was shortened and taught immediately following the integrative thinking lesson. These changes and others caused the classroom contact to be reduced from a planned 17 to 12 hours.

Table 7.
Summary of Practical Thinking Lessons

Lesson Topic	Basic Concepts	Purpose	Content Summary	Provisional Standards
Introduction	What are different ways of thinking? What are some of the key components of thinking?	Provide a course overview. Describe rationale and philosophy for instruction on Practical Thinking. Stimulate students to consider how they think. Establish expectations by providing an outline of course topics and initial introductory exercises.	Practical Thinking intends to capture the strengths of how we think for everyday problems, calling on experience more than formal models. Practical Thinking includes creative and critical elements. Thinking is a rich interchange among problems, possibilities, evidence, goals, and values. By being more mindful we can develop better thinking habits.	Change in thinking will be indicated by such things as a willingness to try out alternate approaches to thinking, being open to others' positions, being prepared to think about issues instead of ignoring or dismissing them, and asking insightful questions.
Multiple perspectives	Think outside the box. Thinking is often constrained with unnecessary boundaries.	Demonstrate ways to (a) broaden perspectives, (b) take different perspectives, or (c) find a better perspective when assessing situations, and solving problems.	Whenever we reason we do so within some frame of reference or perspective. Any defect or restriction in that perspective is a possible source of problems in reasoning. Taking multiple perspectives helps to understand situations, find new or creative solutions, and reason about solutions. The lesson describes 12 techniques for altering perspective, 9 guidelines, and 6 attitudinal elements.	Skilled performance will be characterized by (a) an openness to take different perspectives; (b) flexibility in finding potentially useful perspectives; (c) focus on most important elements of a situation, even if they go against common ways of looking at the situation; and (d) if solutions are not easily generated or if solution attempts fail, consideration of a variety of perspectives.
Strategies for adapting to the situation	There isn't a single right procedure for thinking. Need to learn to be aware of how thinking progresses and how to guide your thinking deliberately.	Demonstrate the reasons why procedures need to be adapted, what factors provide the basis for adaptation, and ways to think about adaptation. Provide a bridge between formally taught tactical decision making procedures and the thinking skills to be emphasized in the subcourse.	Effective performance depends on adapting one's knowledge, experience, and styles to specific tasks and situations. To guide thinking we must think deliberately about how to solve problems and decide. This process is similar to decision triage. Use the GO-FTTE-WIN questions to remind how to plan your thinking: What are goals and obstacles of thinking? How familiar is the situation, how important, how much time is available, how much effort required for an acceptable level of effort? What's important now?	Thinking strategies will be matched to the situational demands and constraints of the problems. Behaviors indicating that the strategies have been developed include (a) willingness to maximize efficiency of thinking; (b) deliberate planning of how to think about and solve problems; (c) determining the most important things to think about; (d) making the best use of available time; (e) using what is already known in the best way possible; (f) monitoring and keeping track of progress made in thinking.

Table 7. (continued)

Lesson Topic	Basic Concepts	Purpose	Content Summary	Provisional Standards
Finding hidden assumptions	Some assumptions are hidden as "beliefs" when there is no factual basis for them. Practice asking "what else could this be?"	Increase awareness to assumptions that we make unknowingly. Provide techniques for identifying hidden assumptions and handling unexpected events.	Cases like Pearl Harbor, Bay of Pigs, Battle of the Bulge, Shuttle disaster indicate assumptions that were ignored or treated as facts. Check assumptions by applying the perfect intelligence source ("crystal ball") technique: what else could this be, what else could explain this? Once identified judge plausibility. Keep track of unexpected events, don't disregard them, explain them in accordance with other understandings.	Limits of understanding of problems will be improved in terms of completeness and thoroughness. Outcome indicators will be less surprise by own and threat capabilities and actions, increased consideration of possible events and corresponding contingency planning ("what if" thinking), and quicker and more accurate realization when events do not go as initially determined.
Practical reasoning	Limit the extent that attitudes influence reasoning unjustly and recognize when there is a failure to reason critically.	Make explicit what reasoning techniques are commonly used. This serves to demonstrate fallacies of arguments and different ways to reason. Describe and assess standards of reasoning, attitudinal pitfalls, and reasoning fallacies. Apply questions for quick starting reasoning.	Knowledge is key in reasoning. There are different ways to prepare for uncertainty, but uncertainty is inevitable. We can fill in our gaps of knowledge by creative and critical exploration. Standards: fairness, relevance, evidence, clarity, consistency. Pitfalls: rationalization, mind sets, attitudes, identification. Fallacies: magnitude, lack of knowledge, false dilemma, hasty generalization, hindsight bias, confirmation bias. Quick start: What if? What else? So what? What specifics? Is there a weak link? What is unexpected?	Practical reasoning ability will be marked by increased attention to the soundness, accuracy, and consistency of others' conclusions and in conclusions generated by one's self. Improve the use of practical reasoning by making it more explicit: increase (a) awareness of reasoning qualities and types of argumentation, (b) critical judgment of others' arguments, and (c) application of everyday logic to specific problems and beliefs.
Integrative thinking	Learn from experience. Understand cause and effect relationships. Put the big picture together.	Demonstrate differences in integrative thinking. Address how it is acquired, how it relates to expertise and intuition. Provide guidance for developing integrative thinking.	Integration - understanding the relationships among events and concepts. Differentiation - knowing when what we know doesn't apply. Levels: reliance on authority, awareness of complexity, reflection, emerging synthesis, and mastery. Improve integrative thinking by resolving uncertainties, spending more time understanding problems, applying Practical Thinking techniques, and practicing patience.	An increase in integrative thinking ability will be indicated by increased consideration of the level of knowledge, rules, and principles used in problems. Integrative characteristics will be important in one's thinking and in judging the viewpoints of others: exceptions to rules; increased tolerance of ambiguity; using situation uncertainty; identification of tension and interaction among alternatives; consideration of the dynamics in a situation; and synthesis of overarching viewpoints.

Overview

Practical Thinking is less concerned with the form and process of arguments and decision making than it is with the practical application of individual knowledge to fulfill goals. So instead of teaching forms of arguments or violations of those forms, or enhancements to decision making steps, everyday thinking issues were addressed. These issues included the use of relevant evidence, identification of goals, consideration of different or multiple possibilities, and applying personal thinking standards, and so forth.

It is typical practice to use traditional models of decision making or reasoning when developing instruction to improve thinking. The classical model for decision making refers to the steps involved in generating multiple options, evaluating each independently, comparing the results after all options have been evaluated and picking the option with the best overall score. One major difference is that the classical model uses an analogy of a gamble where the decision maker does not have control over the outcome. In tactical situations that is the purpose of the decision maker to influence the situation for a favorable outcome. This difference by itself should be sufficient to direct attention away from classical models, but there is also no empirical evidence that use of classical decision theory improves performance (Beach & Lipshitz, 1993).

The standard model for reasoning is formal logic. In logic the emphasis is on the form of an argument. Logical forms are simpler than the actual situations that we face and serve only as an artificial form into which to translate our arguments and conclusions.

"Formal logic has as its primary unit of analysis the argument, a formal argument typically consisting of two premises and a conclusion. A conclusion is valid if it follows from the premises in a manner that is consistent with the rules of logic. In addition, evaluation usually takes place by converting the premises and conclusion to symbolic form, as 'All *A* are *B*.' The examination of validity is thus content-free." (Voss et al., 1991, p xiii)

The model assumes that knowledge is a fixed commodity, that perfect knowledge exists or can be determined. But ambiguity does exist. Formal logic intends to help the process through systematic organization. Too much systematic structure can be stifling. Formal logic can only verify knowledge by causal or inferential chains. Putting the necessarily long formal, logical chains together does not have much to do with how we actually think. Translating what we know and what we want to think about into logical form becomes an unnecessary burden that many are not willing to invest, considering the marginal return on the effort.

Informal reasoning provides a better model for Practical Thinking. It "involves inferences, justifications of beliefs, and explanations for observations" (Voss et al., 1991, p xiii). Informal or everyday reasoning occurs in real situations. In informal reasoning,

"the quality of the argument is not determined in terms of a set of rules that indicates whether the conclusion is or is not valid; instead the quality is judged in terms of *soundness*, referring to (a) whether the reason providing support is acceptable or true, (b) the extent to which the reason supports the conclusion, and (c) the extent to which an individual takes into account reasons that support the contradiction of the conclusion (i.e., the counterarguments). . . . When an argument is evaluated in terms of soundness, the contents of the assertions are important, and the conclusion and reasons are not evaluated solely in symbolic form, as they are in formal logic." (Voss et al., 1991, p xiv)

It is this very concern that the instruction on practical instruction addresses. The focus is not on formal, logical reasoning, but on practical reasoning as it occurs more naturally and more broadly in everyday and work-related settings. In a "logical" argument, the premises support a test of the conclusion by providing reasons for accepting the conclusion. Logical forms of argument are typically not concerned with the reasons supporting the premises. The premises are assumed to be true. Rather, it is concerned only with the logical relationships between the premises (e.g., given the premises are true does it follow that the conclusion is true?) (Moore & Parker, 1992). Critical thinkers, instead, test the assumptions on which the conclusion is based as well as the conclusion.

So this instruction is based on the consideration of thinking that focuses on content and the plausibility of thought, rather than the more remote *structure* of the argument.

The second distinction of this instruction with other attempts is that it rejects the notion of a single, universal procedure for decision making or problem solving. George Marshall provides good advice regarding this point. In *Infantry in Battle* (1939) he writes, [thinking] "ability is not god-given, nor can it be acquired overnight; it is a process of years." He believed that the process requires experience solving many different types of problems, making clear decisions, concentrating on the most important question at hand, and an elasticity of mind.

Experience and the direct knowledge we gain are instrumental for thinking, this lesson also deals with attitudes that affect our thinking. The aim is to encourage consideration to how we think and offer potential ways for self-improvement. The goal is not to control what we think or how we think, but to help uncover how we think, how we could think differently, and what ways to do it better.

Students are told not to expect miraculous changes overnight. It would not make sense to diet only during a diet seminar or to expect that weight will be lost only during the seminar. So it is with efforts to improve thinking. The effort and results will not be just during class time, nor will thinking be improved just because of listening and practice in class. Improving thinking starts and ends with deliberate effort to attend to one's thinking throughout everyday situations.

To become more in tune to how one thinks is primarily a process of becoming more mindful (Langer, 1989). Mindfulness is contrasted with automatic behavior, where there is not much of a thoughtful process. Mindlessness gets us into trouble. The experienced flight crew of a 1982 Air Florida flight went through the manual pre-flight checklist and noted that the anti-icer control was *off* (like it always was before). But in this case, Washington DC was experiencing one of its worst blizzards ever and the plane crashed into the George Washington bridge and the Potomac river, killing 74 of the passenger and crew. The goal of these lessons is to become more mindful. By being mindful, better thinking habits can be developed that through practice will be adopted as more natural, adaptive ways of thinking practically.

To become more mindful requires a process of being more explicit about what decisions are made, which ones just occur, and which ones require deliberation. Being more explicit is a process of isolating components of thinking (through introspection), considering them individually, analyzing how they might be improved (with concepts, tools and techniques offered in the lessons), and putting the skills together.

Practical Thinking was defined for this lesson to consist of the application of creative and critical thinking skills to reason and reach conclusions about 'everyday' situations and problems.

Being creative has to do with considering unusual possibilities in understanding a situation and generating solutions to problems. The critical part has to do with evaluating tentative understandings, conclusions, and solutions from multiple perspectives.

The lesson exercises prompted students to think introspectively, to think about how they think. One example was an attention-getting problem dealing with a clever NFL play. Students were asked to explain why the play worked and whether it would work again. Another exercise involved asking questions about a specific decision or problem that students recalled vividly and had them describe the solution process in their own words. Different ways to assess the different problems could be highlighted. For example, the different problems could be compared across contextual features, types of information, clever solutions or insights, etc. A third example was discussed that described the dilemma of a business executive. The problem description included elements of the problem, the goals, possibilities for resolving the problem, type of evidence or support for resolution, and various processes used to address the dilemma. All of these exercises can illustrate nontraditional ways of describing problems, give students some terminology to think about their own thinking. The everyday descriptions contrast with the classical decision making and formal logic model. The point is not to suggest that procedures prescribed by the classical models are not useful, but that they are not unique, not necessarily complete and sufficient, and that there is not just one right way to describe and improve thinking.

The final exercise was fashioned after an incident described by Woodward in his book the *Commanders* (1991). In the real incident, the Filipino President requested bombing of their own airbase when rebels had captured it and were using it to bomb the presidential palace. An uncritical solution would be to decide whether or not to comply with their request. A better, alternate solution (that was attributed to GEN Powell, Chairman of the Joint Chiefs of Staff) was to redefine the problem based on the goal to keep the rebel planes grounded. Contributing to this insight were Powell's knowledge that bombing might not keep the planes grounded and that the use of force could backfire on the U.S. From the students' personal experiences with this problem or from their familiarity with the actual event, a list of obstacles was generated that prevent clear, Practical Thinking. One class's list of obstacles to thinking are those shown in Table 8.

Table 8. List of Thinking Obstacles from Class

Victim of experience
Haste, jumping to conclusions
Stereotypes (regional biases)
Hidden agenda
Emotions
Personalities
Background
No end state
Wait for information to resolve uncertainty
Pursue only one train of thought

Another list was presented that more directly corresponded to the lessons of Practical Thinking (see Figure 2). The similarities between the two lists were discussed and overviews of the future lessons were presented. Summaries of the five subsequent lessons to the Practical Thinking course are covered in the introduction lesson and presented in the following Tables 9 through 13.

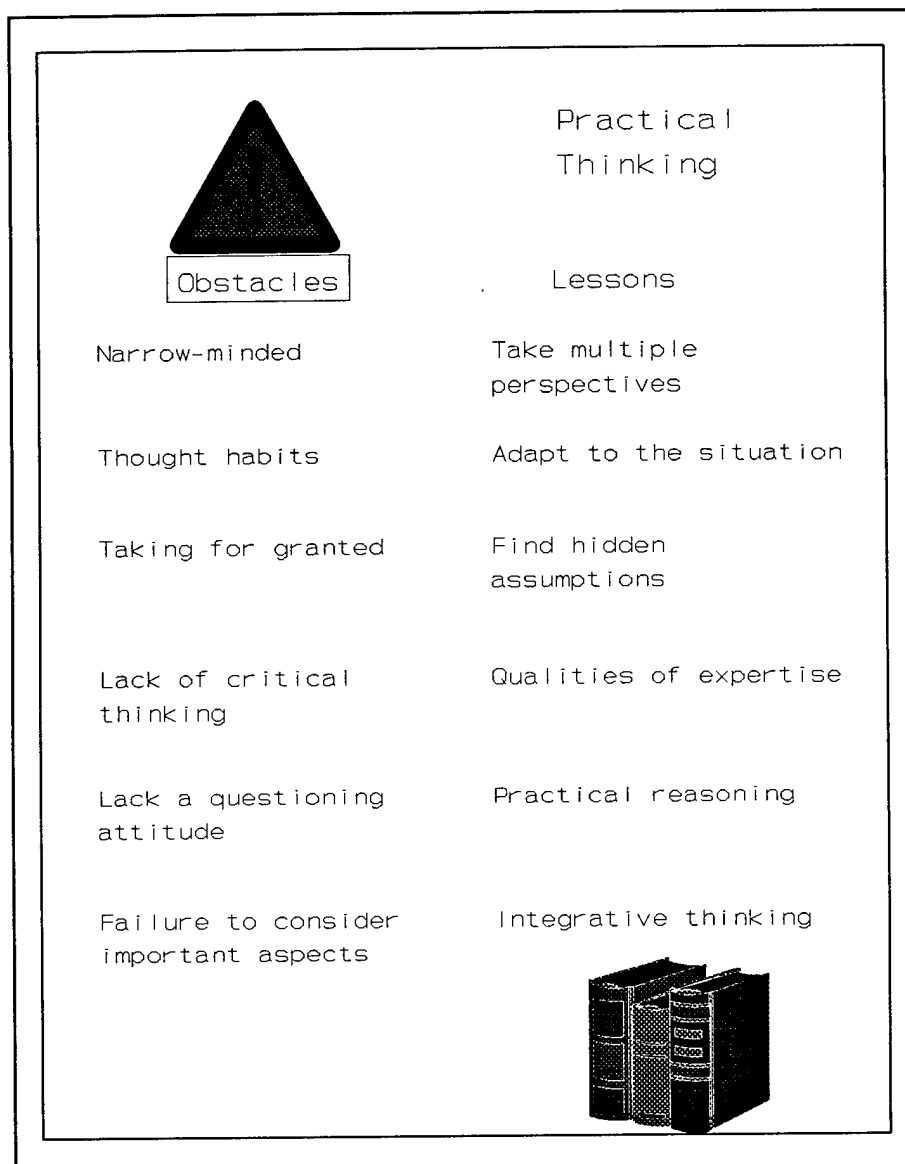


Figure 2. Lessons addressing thinking obstacles.

Overview summary.

The students are challenged in the introductory lesson to consider how they think. Several exercises allow them to recognize obstacles in their thinking and in others. Practical Thinking instruction can prompt a change in attitude to change thinking. But the actual change and continuing effort to change is up to the individual. The "alternate" skills will have to be tried to determine what habits of thought work best for them.

Table 9. Preview of Multiple Perspectives Lesson

Obstacle - Narrow perspective

Example of the problem - Using what you know best to respond to a problem, instead of constructing a better perspective or considering several perspectives. (From the class exercise think how to execute the bombing from a tactical standpoint instead of thinking about it from a US national policy perspective or Panglossian rebel perspective or Panglossian civilians.)

Multiple perspectives -- What were examples of narrow minded thinking given in the problem or in your discussions?

Goal - This lesson shows the importance for taking multiple perspectives and gives techniques and tools for taking or forcing different perspectives. No one set of characteristics of thinking is definitely right. (We initially assume that our way is right, but it might not be right for someone else.) This lesson shows various ways to consider multiple possibilities.

Table 10. Preview of Adapting to Situation Lesson

Obstacle - Habits of thought or procedures

Example of the problem - Using the same approach to all problems, not adapting the approach to the conditions of the situation.

Adapting to the situation -- Adaptation is appropriate when you face a novel situation and are required to solve a problem. Everyday jobs require this. Adapting has to do with considering how what we know about a situation can be applied. Plan what you need to think about and how to think about it? Were these deliberate choices?

Goal - This lesson addresses how we can **manage** our thinking. (When we think about our thinking, this is technically called metacognition.) Some of the important ways to adapt our thinking are presented.

Table 11. Preview of Hidden Assumptions Lesson

Obstacle - Unrecognized assumptions, taking something for granted

Example of the problem - The U.S. "advisors" in the Panglossian (Filipino) problem may not have considered what would happen if the Panglossian President would have denounced the US involvement for especially aggressive acts such as bombing civilians.

Finding hidden assumptions -- Were unstated assumptions made explicit (e.g., how actions here would affect national policy or international perception -- failing to help, appearing as the aggressor had things gone bad)? Were alternatives to assumptions sought about what was happening or what was likely to happen?

Goal - This lesson relates to ways to identify/uncover hidden assumptions and what we can do when a previously hidden assumption raises its ugly head.

Table 12. Preview of Practical Reasoning Lesson

Obstacle - Lack a questioning attitude, solution-minded not problem-minded

Example of the problem - Deciding whether or not to adopt the requested solution, instead of developing a better understanding of the problem and possibilities.

Practical reasoning -- Did you look for flaws in your reasoning (premises, conclusions) or others? Apply 6 "quick start" questions: so what, what if, what specifics, anything unexpected, what else, is there a weak link?

Goal - Instead of getting everyone to follow logical reasoning form, this lesson addresses various ways that we *actually* reason. Based on what we know about how we actually reason we can improve the soundness of conclusions, instead of the validity of them.

Table 13. Preview of Integrative Thinking Lesson

Obstacle - Incomplete view, failure to consider important aspects

Example of the problem - Not considering fully what bombing the air bases would mean for long term U.S. interests; not considering what the cause of the rebellious acts might be, such as human rights violations by the government against rebel sympathizers.

Integrative thinking -- Did you try to put all the pieces together to develop a big picture? Did you identify overarching principles to use? How were you able to deal with the ambiguity and uncertainty?

Goal - This lesson addresses different degrees of integrative thinking and techniques for integration. Relates to thinking directed at the right level (e.g., problem definition).

Multiple Perspectives

We often do not see what others see happening, or we fail to think of new solutions, or do not judge solutions objectively--all because we are set in a way of thinking. One third of a sample of newly promoted brigadier generals were evaluated as being extremely bright and self-confident but also extremely inflexible (Campbell, 1984). Increasing our skill of viewing situations and possible solutions from different perspectives should increase the accuracy and thoroughness of thinking (Bransford & Stein, 1984; de Bono, 1970; Friedman, 1984). The dangers of narrow perspectives are demonstrated in this lesson by discussing historical instances of decision making (see Orgill, 1970; Reagan, 1987). Guidelines for taking multiple perspectives offer the opportunity to increase the ability and inclination to take different viewpoints and develop better understandings, and more directed solutions.

This lesson was expected to be especially fitting for the MSF students because of their requirements to consider the implications and practices for weapon systems, staff organizations, computer decision support systems, and doctrine for the year 2015.

Whenever we reason we do so from some point of view or frame of reference. Any defect or restriction in one's perspective is a possible source of problems in reasoning. A point of view may be too narrow, too parochial or may be based on misleading analogies. Taking a different perspective can serve to test the appropriateness (the extent of fit) of the spontaneous perspective. Taking several perspectives can test the boundaries of understanding and proposed solutions, they can help generate new solutions for especially perplexing problems. This would inject the element of surprise in tactical situations. Having broader perspectives allows one a better chance of happening upon a better, fuller situation understanding, more practical reasoning, understand other's views, and to be better equipped to meet varying situations (Adams, 1986; Flesch, 1951).

This lesson explores the concept of thinking from different perspectives, offers ways to help take new perspectives, and gives examples and opportunities to exercise multiple perspectives.

Switching to a different perspective is largely a matter of attitude (Adams, 1986; Langer, 1989). By doing so one will counter the tendency to come to closure too quickly (Brightman, 1980). The quicker one comes to closure while forming a concept and the narrower that concept is encoded, the less likely that the concept will be related to other concepts (see the encoding specificity principle, Tulving & Thomson, 1973).

Once you see things in a certain way and when you finally have closure and definition, it is hard to break that closure. This narrowed understanding is referred to as mind sets and functional fixedness. Breaking the set or fixedness will allow seeing that a telephone can be used as a music box, a screwdriver as a weapon, or a dime as a screwdriver.

The background reading for this lesson addresses the pace of changing techniques of warfare. Too little adaptation and too much conservatism lead to rigidity of tactics which are easily defeated. Too rapid experimentation may actually provide opponents with an edge, because they can adopt and refine the advances by avoiding the early errors and high development costs. Reagan (1987) gives many examples of traditionalism in the British Admiralty, Army, and Cavalry, and relates some widely recognized failures (e.g., France's Armistice line, the U.S. Navy at Pearl Harbor) into the terms of his theories.

One historically important example of narrow perspectives was the lack of anticipation of the attack on Pearl Harbor in December 1941. Admiral Kimmel (Commander in Chief, Pacific Fleet) and his staff suffered from what Janis and Mann (1977) refer to as groupthink. Groupthink occurs when the leader and the group mutually bolster each others' misjudgments, thereby protecting each other from discomforts of painful or unpopular decisions.

Janis and Mann note that Kimmel had

"considerable worry about his old policy and also about any new one that seems capable of handling the threat that is challenging the old policy; he has no hope of finding a better solution than the old policy, even though he now knows that it entails some serious risks; finally he ends up reducing his conflict by bolstering the old policy in a way that denies the importance of the challenging warnings. . . . the decision maker fails to engage in the full set of vigilant activities that normally are expected when a person is confronted with serious, consequential choice. The search for relevant information is extremely limited and is generally characterized by highly selective attention. . . . New information to which the decision maker is exposed is processed in a biased way, strongly influenced by wishful thinking." (pp 123-124)

There were a number of signals that they received, but each was dismissed (see Table 14).

Admiral Kimmel probably saw the potential dangers in loss of life, threat to security, etc. with either alternative.

"What [he] failed to consider was a compromise alternative of a partial increase in surveillance, with some dispersal of warships, cancellation of weekend leaves, full alert of antiaircraft units, and other precautionary measures that could have increased the safety of the fleet at Pearl Harbor without being exorbitantly costly." (p 124)

Admiral Kimmel's and his staff's interpretations of the signals seem inappropriate given what happened, but at the time they were repeatedly warned about the danger and recognized the danger, but decided to do nothing about it. Regardless of how unlikely they thought an attack would be, their flaw was not exploring multiple possible future situations and associated safeguards.

The Pearl Harbor example illustrates an extreme example of a narrow and distorted perspective. Additionally, there is the feeling that criticism of some aspect is an attack on the institution itself. The antecedent conditions of groupthink are shown in Table 15. The symptoms of defective decision making in group think are also indicated in Table 15. The first three correspond directly to the issue of narrow perspectives. Wishful thinking in terms of considering only the best outcomes may have been operating. The intentions of the enemy were assessed in terms of what US Forces were doing and other possibilities were downplayed. Additionally there is the feeling that criticism of some aspect is an attack on the institution itself. This has a possible strong effect in the military.

Although there has been considerable analysis of groupthink and flaws in group settings and policy setting, there has been less attention devoted to the psychological flaws of individuals (outside laboratory situations). The cognitive dispositions of individuals that can lead to problems in perspective include those discomforts identified in Figure 3. Thinking is driven by a natural desire for consistency, economy, understanding, resolution, and closure.

Table 14.

Cues and Reactions by US Pacific Fleet Prior to Japan's Attack on Pearl Harbor

Pearl Harbor: Failure in Perspective	
Cues	Response
6/1941 - 8/1941 Relations deteriorating	Train personnel and supply outposts. Start limited alert.
11/1941 More ominous warnings	Discount warnings, conclude precautions are satisfactory. Subsequent warnings were discussed, but discounted.
11/24/1941 "War is imminent. Surprise aggressive movement any direction including Philippines and Guam" from Chief of Naval Operations	No change in response.
11/27/1941 "An aggressive move by Japan is expected within the next few days. Execute appropriate defensive deployment" from Chief of Naval Operations.	Prolonged discussion with staff about plans. Literally interpreted message and since there was no specific mention of Hawaii there was no follow-up. Assumed Army units went on full alert, but they too were still on limited alert.
12/3/1941 Headquarters gives warning about Japanese order to destroy secret codes.	Interpreted the message to possibly mean last minute war preparations. Since the message referred to most and not all codes, they concluded that it must be routine practice.
12/3/1941 Adm Stark indicates that the President and Secretary of State believe that Japan is preparing to launch a surprise attack.	No change in response.
12/6/1941 Adm Stark gives emergency war orders to destroy classified documents. The FBI reports that Japanese consulate has burned documents for the last 2 days.	Adm Kimmel admits concern about the safety of the fleet at Pearl Harbor. Staff convinces him that the limited alert condition will be sufficient.
12/6/1941 Adm Kimmel's Chief of Naval Intelligence reports that all 6 of the Japanese carriers cannot be located.	Adm Kimmel's Operations Officer states that the Japanese do not have sufficient force to attack Hawaii.

The instruction also used examples from training exercises at the National Training Center (NTC) and the Joint Readiness Training Center (JRTC) to illustrate the problems that follow from the lack of considering different perspectives.

An NTC example showed that a FASCAM minefield was not considered from an enemy perspective (i.e., why the enemy would put a minefield there). Most people, even when they try to take an enemy perspective, do not do it very well. The portrayal of the enemy is too cooperative, the enemy does what we hope they will do, they do not think and react to us, and often, the enemy's goals are not viewed as distinct from our goals. We think of the enemy's possible actions from the viewpoint that we are trying to defeat him. It takes practice and discipline to really put yourself in the enemy's place and try to devise ways to beat the friendly forces.

Table 15.

Antecedent Conditions of Groupthink and Symptoms of Poor Decision Making

Antecedent conditions	Symptoms of defective deciding
1. High cohesiveness. 2. Insulation of the group. 3. Directive leadership. 4. High stress with a low degree of hope for finding a better solution than the one favored by the leader or other influential persons.	1. Incomplete survey of alternatives. 2. Incomplete survey of objectives. 3. Failure to examine risks of preferred choice. 4. Poor information search. 5. Selective bias in processing of information. 6. Failure to re-appraise alternatives. 7. Failure to work out contingency plans.

Another practice exercise used a JRTC problem to put the student in the opposing force's (OPFOR) situation. Students were told that they were now to consider themselves to be the Cortinian Liberation Front (CLF), and the enemy is the invading US forces. One advantage of CLF is their troops are probably much more proficient than the enemy on familiar terrain. Fighting in the woods, across JRTC rotations, the CLF has been able to achieve loss-exchange ratios averaging 17 to 1. To help direct their thinking as the CLF the students are asked a series of questions:

1. What are your goals?
2. What are your weaknesses and strengths?
3. What do you think the enemy will do?
4. What is the most dangerous thing the enemy can do?
5. What is your basic plan?

Instructors kept alert to see if students would slip back to the US perspective when they were to be taking the perspective of the enemy. For example, did they use "enemy" to mean the CLF or "us" to mean US forces?

Considering the perspective of others extends beyond the enemy. In the JRTC exercise there are other people involved. The perspective of civilian villagers can be explored. Considering their perspective could help plan the friendly force operation. Are the civilians enemy? Are they like terrain, obstacles, or assets? What are their goals and fears? Also how will U.S. civilians back home react to the operation? Or suppose the President has ordered this operation. What are his goals? What does he want or not want to happen? For example, his view may focus on maintaining support in the U.S. and avoid an embarrassing defeat.

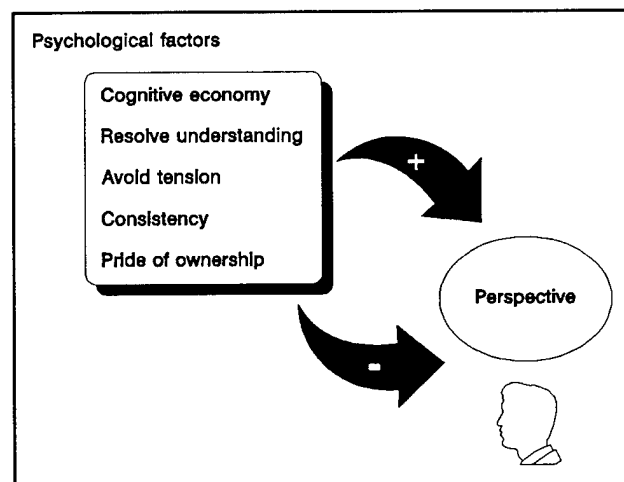


Figure 3. Factors affecting perspective.

Techniques for taking multiple perspectives.

Books on creativity and broadening perspectives suggest a variety of techniques to improve your ability to take a different perspective. For example, there are methods designed to break conceptual blocks (e.g., Adams, 1986; Barker, 1992; von Oech, 1983). These techniques may be helpful to consider different perspectives. These techniques can help to teach a person how to develop the habit of taking multiple perspectives. Thinking and reasoning skills are not simply improved by pulling out a set of techniques and systematically trying all of them. Instead, the techniques can help to take broader and more diverse perspectives appropriate to the situation. Develop better thinking as a habit not as part of a checklist.

Putting yourself in another's place is only one way to broaden perspective. A variety of other techniques have been devised. All the following techniques are designed to view some aspect of the problem differently, to break a mindset.

1. Taking other's perspective.

We can try to take on other peoples' perspectives. Besides taking the enemy perspective, another possibility is taking the perspective of a historical person, a senior commander, or someone else that you know.

2. Devil's advocate

A form of critical thinking whereby you test the validity of a concept by trying to attack it; then, see how it withstands criticism. It is similar to taking the enemy perspective and trying to think about really defeating your own plan.

3. Shift attention or importance (Ackoff, 1978)

A good strategy of problem solving is to focus on controllable rather than uncontrollable factors, but if solutions are not forthcoming, then shift from controllable to uncontrollable factors; or, change the problem definition. Look at a different aspect (e.g., force protection instead of swift destruction of the enemy). Change the most important goal, e.g., near term or long term.

4. Change the entry point (Brightman, 1980)

Many times when you're trying to solve a problem you go down the same path, have the same chain of thoughts, reach the same conclusions or solutions. If you begin somewhere else you may come to a different solution. Backward planning is an obvious method. If you keep trying to find a way from the current situation to a goal and are not successful, try starting somewhere else (e.g., in the middle), and work forward and backward. When wargaming you may go through the same sequence of steps. Varying the wargaming method can give a fuller understanding of possibilities.

5. Change the scope of the problem (Brightman, 1980)

Magnify or reduce values in the problem; for example, suppose the size of an effect was much, much greater than what would happen. Make a much simpler but related problem to solve. Or remove constraints then solve the problem. Solve in detail versus a more conceptual solution. Look at the problem from higher and lower echelons. For example, view the JRTC situation from the platoon level.

6. Change the representation (Brightman, 1980)
If using a visual representation, try a mathematical representation. Or if the problem is stated in words, try a diagram.
7. Reversal (Brightman, 1980)
Make a dramatic change in some aspect of the problem, for example, the goal.
Reversal example: You have built a housing development near an interstate and are thinking of ways to reduce traffic noise. You could change the problem statement to, "How can I increase traffic noise to the houses?" This would possibly produce some new ideas on how to reduce noise. Another example, "How could fratricide be increased?"
8. Fractionation/subgoalting (de Bono, 1970)
Break the problem into pieces, subgoals, or attributes. For example in the standard problem "Unusual uses of a brick," you can generate more ideas by listing the attributes of a brick, e.g., red, rectangular, heavy, porous, holds heat, etc., and then listing uses for red things, rectangular things, etc. Break up the organization of a whole thing among its components to try to look at something in a new way. Fractionation could apply to exploring different staff organizations, principles of war, or tenets of airland battle.
9. Hierarchical solution graphing (Butler, 1994)
First, the problem solver generates an initial list of solutions. Then the list is organized with the goal of finding solutions that have something in common, a superordinate category of solutions. Next, generate other solutions that belong in the same superordinate category. Continue generating superordinates and subordinates. This is a method of generating solutions that may be superior to brainstorming.
10. Analogy (Brightman, 1980; Gordon, 1961; Holyoak & Thagard, 1989; Keane, 1988)
The use of analogy means trying to draw parallels between systems. An analogy typically uses a familiar system to help understand an unfamiliar one. Example: You want to build a roof that reflects heat in the summer and absorbs heat in the winter. You might ask, what do you know that changes color? How does it change color? Sacks that puff up in a flounder gave the idea of white sacks on the roof that expand and present a white surface when hot but contract and allow a black roof when it is cold outside. Analogical thinking will be important to respond to novel situations that Army units will face, e.g., applying tactical command and control procedures to help fight a forest fire or logistical planning for hurricane relief or applying civilian practices to new Army roles, e.g., chemical spill reactions for NBC incidents.
11. Incubation (Adams, 1986)
When possible, think about a problem hard. Stop, and let your thoughts about the problem incubate. Wait a period of time without thinking about the problem, and then try again. It is possible for a problem to get worked out unconsciously. Also, conditions will change so that you do not necessarily follow the same (non-productive) line of thought. Sometimes, for example, you may mentally block the recall of a well known item. If you simply wait this block may go away.
12. Brainstorming (Glover, Ronning & Reynolds, 1989; Hayes, 1981)
This is a well known approach. Brainstorming is based on suspending criticism and

withholding judgment to help form creative ideas and letting weak ideas live long enough to get stronger or to suggest better ideas. Ideas can be chained or mixed together to come up with hybrid solutions.

Guidelines for perspective.

Beyond the twelve specific techniques there are other ways that perspective can be broadened. The following common sayings also may provide help for broader perspectives.

1. Break out of your box. Don't become a prisoner to habit. (Anyone can look for history in a museum, try the hardware store.) (The G2 relies on usual electronic intelligence sources, but a commander might get different insight by talking to a local truck driver.) Explore forced relationships: e.g., What if there was immediate resupply? What does ammunition consumption rate have in common with the number of enemy prisoners of war?.
2. Look somewhere else. Rearrange parts of the problem: situation, goals, solution.
3. Change what you call things and what label you think of them with. The switch could lead to new uses and designs. (Instead of calling a door a door, think of it as a passageway. If you call a class a seminar, it changes the focuses from passive listening to active involvement. Call a computer network an information highway to conjure up meaningful images of uses and techniques.)
4. Solve the right problem. Do not be satisfied with the first good answer. Bypass the first good answer and find the second.
5. Break the rules. Slay the sacred cow. Rules can outlive the purpose for which they were developed. (Example of old rules: need a force ratio of at least 3-to-1 to attack, must have 3 courses of action.) (Recall the saying about Frederick the Great: The loss of the Battle of Jena in 1806 was attributed to him though he had died twenty years earlier.)
6. Recognize opportunities, expect the unexpected. (Fleming's discovery of Penicillin followed a series of opportunities. When the cultures of bacteria he was studying died, instead of discarding them he took time to try to understand what had happened.)
7. Learn from mistakes. (Edison found 1,800 ways not to build a light bulb. One of Madame Curie's "failures" was radium. Columbus was looking for India.) What were the biggest errors for you in the last year?
8. You don't always have to force it. Ease off. (For example, let sidewalk locations get determined by foot traffic patterns.)
9. Trust yourself. (We are taught to guess what the teacher is thinking, implying that the best ideas are in someone else's head. What ideas are in your head?)

The important thing to remember is that you usually should not pull out a list of

techniques and begin going through them when you have a problem. Perhaps if you are stumped you might go to the list and deliberately try the techniques. Further, you might use them when you are deliberately trying to develop different habits and are unable to generate different perspectives successfully. However, if you are in a familiar situation, you probably will not need to go through the list.

Attitudes.

The attitudes we have about problems are very important. Positive attitudes for broadening perspectives include:

1. Consider opposing viewpoints. Be open to different perspectives.
2. Listen to your hunches.
3. Think like a kid, loosen up, be silly.
4. Avoid arrogance.
5. Maintain flexibility to shift perspectives.

Having the capability to shift perspective and doing it are perhaps the most important things you can do. The techniques focus attention on exploring different perspectives and give some mechanics for shifting. Individuals should try to find out how they can best broaden their perspective habitually. The techniques can be used, or whatever else that can be devised. A deliberate effort will be required until taking a broader perspective becomes a thinking habit.

Identifying narrow perspectives.

How does someone know if they are guilty of short-sightedness? Is it possible to go to the other extreme? For example, maybe some people are so enamored with change that the latest new concept is always adopted. This could lead to mounting investments in always newer technologies and weapon systems. The cost and the constant change may cause too much turbulence with minimal gain. (For example, should paper maps really be discarded in favor of the latest incremental generation of computer-generated maps?)

What are the basic assumptions that you hold that you never challenge? Entertain the thought that you might have a very narrow perspective in some area? What is it? (For example, Armor systems are the primary killing systems on the battlefield.) Imagine what could make armored force on force battles obsolete? What would make tanks obsolete? What would make an officer's branch obsolete?

An exercise for perspectives.

The idea of infantrymen wearing power suits is as old as at least the 1950s science fiction in *Starship Troopers* (Heinlein, 1959). Heinlein had infantrymen shot from spaceships in pods. They would land on the planet leaping around as high as buildings and throwing nuclear bombs like grenades. Students formed smaller discussion groups and were asked to design a 21st century powered infantry suit. They were asked to identify what perspectives went into the various designs and what techniques were used. As they worked they were told to keep three things in mind:

1. Be aware of parochialism.
2. Be creative. Use the techniques that were presented.
3. Think critically. Discover the problems and unrealities of the developed concepts.

After working on the design, each group briefed considerations that they used and unique features that were generated. They were asked to reflect on the sources of their ideas and how any of the techniques worked that they used to create a different perspective.

Summary.

A perspective is required to think about a subject. We naturally think from some perspective. Narrow perspectives lead to assessments and solutions that do not fit, are not robust, and crowd out the potentially good solutions.

Changing perspective is useful to find a better understanding, what is possible, what is not, what solutions are feasible, what safeguards should be taken, etc.

Techniques for taking a different perspective can be too sterile. The techniques need to be practiced, personalized, and integrated into one's own thinking repertoire. The techniques may be modified to fit the individual and combined to form hybrid techniques. Techniques for changing perspectives will not overcome lack of experience, knowledge, and sound thinking.

The best way to start making perspective thinking a habit is to focus on a subset of those discussed. One subset might be something like the following:

1. Take another's perspective.
2. Shift attention.
3. Fractionate.
4. Break the rules (what if).
5. Change labels of what we call things.
6. Identify similarities to something that is better known.

The way we think and our attitudes affect our perspective. They have both positive and negative influences. Our thinking is characterized by a natural desire for consistency, economy, understanding, resolution, and closure. These natural tendencies can cause narrow perspectives, but recognizing the symptoms and knowing how to counteract them will reduce the negative effects.

Adapting to Situations

This lesson was designed to provide insight on metacognition, i.e., thinking about thinking. The lesson is titled adapting to the situation because it is a practical application of adapting one's mental capabilities to the characteristics of a situation. This view indicates that a problem solver must actively attend to his or her own cognitive strengths and limitations to conform to the situation (Covington, 1987; Payne et al., 1993). Knowing one's mental capabilities allows appropriate adaptation and application to the problem at hand (Metcalf, Schwartz & Joaquim, 1993). Adapting to the situation includes monitoring the processes, strategies, and information one uses; identifying the most critical aspects of problems to be solved; and deciding when to decide (Flavell, 1979). In relation to the definition of the art of battle command, metacognition involves "knowing if to decide, then when ... to decide" and is involved in the judgments about what to decide (Battle Command, 1993). As in the introductory lesson on Practical Thinking, adapting to the situation assumes that improved performance (primarily efficiency) can be reached by first making one's monitoring and directing skills more deliberate, and through practice the skills will become more in-grained and available for routine use.

This lesson should provide a general way of how to think when one is unsure of what to think or what to do. The teaching points to be emphasized are twofold. The first is that *adapting to situations* involves applying cognitive skills to the tactical decision making and command estimate procedures for a command staff group. Thinking skills are ways to perform the more general procedures. Since thinking processes make up the procedures, they are a basic place to start to improve. Students should strive to improve their thinking skills so they can better adapt to the pressures of combat situations.

Adapting to situations also means to think deliberately about how to think about solving problems and making decisions. One concept to do this is *decision triage*. Decision triage is deliberate attention given to what to decide and how to think. Three sets of questions make up the decision triage technique.

The skills approach taken in this Practical Thinking subcourse is not advocated to replace a "procedural" viewpoint. The skills approach is based on the beliefs that thinking, reasoning, and deciding are situational activities that depend on the person, the environment, and the task. Thinking can be improved beyond the formal, predetermined procedures by matching one's thinking to the situation at hand. This lesson assumes that adapting one's personal thinking-reasoning-deciding to characteristics of the situation is an essential thinking skill.

"Only novices used algorithmic procedures to solve problems. Comparisons of their performance with that of experts suggests that learning how to satisfy the intellectual requirements of a job is not so much a matter of becoming efficient in running off all-purpose algorithms as it is in building up a repertoire of solution modes fitted to properties of specific problems and particular circumstances. The variability experts displayed was exactly that type excluded from formal models: use of different component operations to solve recurring problems of the same kind. . . . Changing solution modes reflected experts' concern with the how of performance and were regulated by higher-order worker-evolved strategies for accomplishing the task in the least effortful ways." (Scribner, 1986, p 22)

The introductory lesson on Practical Thinking addressed obstacles to thinking. One of

those was thought habits. Thought habits use the same approach to all problems, not adapting the approach to the conditions of the situation. A thought habit (Adams, 1986) is a persistent way of attacking a problem (that we are probably unaware of) that can be maladaptive (but in some cases can be an effective way of responding). An example of a maladaptive thought habit is taking the same strategy to prepare for a briefing, even though the approach never provides enough time or practice. Adapting to the situation is a skill to counter weak thought habits. It should make one more attentive to how a problem is thought through: 'Am I thinking about the right things? Am I using a good approach?'

Considering doctrinal procedures.

Established procedures are described in various command and staff instructional materials, e.g., the 6 step problem solving model of CAS3, the 4 step estimate of the situation (Joint Pub 1-02), the 8 step troop leading procedure, the deliberate decision making procedure (DDMP) (Figs. 4-4 and 4-5, US Army, 1994), and the combat decision making process (CDMP).

There are many reasons that an organized procedure for problem solving seems to be a good idea. One is that the problem solver has only one set of steps to learn and apply. The notion is that the steps are universal and will result in a good solution to all problems of a certain type. The procedure offers the inexperienced problem solver something to do that seems useful. Another reason is that everyone in a group has the same procedure to help coordinate what is done. It is useful for high certainty situations.

There are disadvantages as well. Either the method is so general that it does not provide much specific guidance, or it is too restrictive and inappropriate for many problems. The limited steps place the focus on the common elements instead of the unique key aspect in a specific situation. Experts tend to spend the most time with the novel aspects (Bazerman, 1985). The single method may be inefficient, requiring tasks to be done that are not important or useful for a given situation. A procedure focuses on the form of problem solving while saying nothing about context, substance, or knowledge. If the problem solver already has knowledge to make an assessment, knows rules of thumb that apply, or knows a result that will work, then a procedure does not provide any additional help. For example, some soldiers become so familiar with certain terrain, that terrain analysis does not need to be done each time an operation occurs there. Sometimes rules of thumb make good shortcuts, such as knowing that mobility corridors can be estimated by looking at the pattern of vegetation coloring on western European maps. Simply stated, there is no common procedure that is right for every problem or every point in one's experience.

A systematic application of the deliberate decision making procedure is represented by the multi-attribute utility analysis (MAUA) technique (Anderson, Deane, Hammond & McClelland, 1981). MAUA is difficult to do well conceptually. It can fail to discriminate among options (Fallesen, 1995). MAUA and similar "procedures" lead one to believe that a better decision will result if he or she follows the explicit or implicit rules embedded in the procedure. For example, the decision matrix runs the risk of becoming an end in itself, to complete all the cells of the matrix and to make computations, leading to a sound, deductive answer. The processing becomes more important than reasoning and at its worse replaces reasoning. The decision matrix is no better than the individual judgments that go into it or the validity of the identification and relationship of specific attributes and criteria that form the structure of the comparisons (Payne, Bettman & Johnson, 1993). Analysis is relegated to linear, simple

relationships; the combination of relationships is not taken into account in any direct or explicit way. Decision matrices can be useful as a communication and reporting device, but are misleading when they are expected to *generate* an optimal answer. Experts seldom, if ever, rely on decision matrix approaches (Beach & Lipshitz, 1993; Cohen, 1993; Klein, 1993).

Decision matrices may not fit the characteristics of the problem, especially ill-structured problems that not only are characterized by uncertainty, but complex interactions and dynamics. Decision matrices try to make decisions more systematic, but what is more important are decision makers that can apply sound reasoning flexibly to meet unique and unexpected requirements.

An alternate model of task

If concerned about how tactical decisions are made and how to improve the process of making them, one can ask to what extent traditional decision making models are useful for providing guidance? The procedures suggested by traditional models are not appropriate for many tasks, including many combat decisions, and are not used. Traditional decision making models limit the adaptiveness of one's thinking because they do not fit well with the dynamics of combat decisions.

An alternate model is to consider the determination of tactical options as a planning process. Planning is determining the way to accomplish some purpose or goal. A switch in perspective shows that a rigid adherence to tactical decision making procedures may not be adaptive to real battlefield conditions. There is a fundamental issue whether any gain is realized in tactical planning by following the procedural rules associated with traditional decision making models.

The current way of viewing the tasks is that decision making comes before planning. Alternatively, it makes sense to consider the overall goal is to have a plan and that decision making occurs while the plan is constructed and executed.

If a planning model is adopted, it does not mean that tactical decisions are not made. Rather, it casts decision in a different light. During a five hour session of battalion planning (Thordsen, Galushka, Klein, Young & Brezovic, 1989), the staff worked on 27 different problems. In only one of those cases, were multiple options concurrently generated and compared. In the other 26 problems, there were over 200 total decisions that were made for choices that occurred in sequence during planning.

One of the reasons that the classical decision making models are not a good fit with staff jobs is that they treat what is done as choice tasks. There must be multiple courses of action generated, each assessed independently, and results compared to find the most favorable action. This model is appropriate for some problems. But those problems are when options are given, they are fixed, or they cannot be modified. In some everyday situations we are faced with these kinds of options e.g., buying a refrigerator, voting for a political candidate, betting on a horse, selecting a new employee. A model that focuses on *selection* of options should not be the only decision making model that is used for guiding what commanders and staffs do.

Tactical decision making is different than the usual decision situations studied by decision analysts. Technically, decision making involves the selection among existing options. In

many of the experiments on decision making there is little opportunity (or cause) to change the options that are available. The systematic decision making models have little guidance to offer on creating options or planning implementation, which are especially important for tactical problems. In tactical situations the options and plans are under control of the decision maker, and the goals may be constantly changing. Planning situations include things like planning a trip, planning an investment strategy, planning indirect fires, planning the emplacement of minefields, or planning a maneuver concept. In planning, the emphasis is not on which option is best, but configuring a satisfactory solution. In a tactical situation there are too many options to consider all in a systematic way. A planning perspective instead emphasizes finding a way that will optimize resources and gains for subproblems that are identified during the process. The thinking process is adapted to the mental effort that one is willing to put forth. Identification, suitability, and feasibility of the options are thinking challenges for ill-defined problems. There is important uncertainty about the current state and the goal state in tactical situations. Understanding these states and their relationships to what is possible are important. Planning proceeds from ill-defined understanding of the situation, and thinking determines what is suitable.

Rather than a one choice process, there are many decisions to make along the way. Some decisions are modifiable, some less so. There are not any rules that the classical models suggest for what components (e.g., desired end state, deception, tactical maneuver, sector of attack, use of reserves, etc.) to change to distinguish among options. Changes in formulation of a tactical course of action (COA) can proceed almost infinitely. An optimizing decision approach may not be the most efficient means of making global and localized decisions about what a tactical option or plan should consist of.

Adapting skills.

This lesson assumes that people intelligently adapt and apply thinking skills to situations that they face. Once they are skilled at it, they will be able to respond to a problem in a more direct way than by following doctrinally set procedures that are generally targeted at beginners.

It is important to adapt thinking to situations. One way to adapt one's thinking resources is to fill in the missing detail for group coordination steps. This adaptation deals with applying one's thinking resources to the task and procedures at hand. From this approach, thinking skills can be looked at detailing the way steps could be performed. A second way to adapt is to adapt one's thinking based on particular style and knowledge to the constraints and demands of the situation. This second way is sometimes referred to as metacognition. The first way prepares one in advance by emphasizing versatility at skilled thinking. The second way prepares for time compressed situations by increasing attention to how a problem is solved and to make deliberate decisions about how to think.

Metacognition.

There are two generally different views of metacognition. One is more encompassing, making cognition a subset of an executive process (Sternberg, 1986). The other bounds metacognition more clearly so that it is not a superset but a different mode of thinking about how to think (Brown, 1978). Metacognition is important because it is a mental operation that occurs that can moderate the natural recognitional process. Calling attention to metacognition

makes it more explicit so students can become more aware of it and it can be practiced. Table 16 shows some activities of metacognition, organized into those components that have primary influences from external sources, characteristics of memory, and how operations are regulated (Essens, Fallesen, McCann, Cannon-Bowers, & Doerfel, 1995).

Table 16.
Metacognitive Skills

Metacognitive Issues	Focus of Metacognition	Activities
What are the external influences?	Constraints.	Assess time available, stakes involved, and confidence. Apportion time and attention. Know when to make decisions.
What are resource limitations?	Knowledge.	Know what they know and what they do not know. Gauge difficulty of problems.
How are processes regulated?	Operations.	Goal-driven, thinking at the appropriate level of the goal. Plan ahead. Screen options. Check solutions against hypothetical situations. Refine solutions. Evaluate consequences of decisions, use feedback appropriately.

Adapting to the situation is like time management or meeting management, where a number of principles are applied to make a meeting go smoothly and stay focused. That is what adapting to the situation is about, assessing one's own personal abilities and situational demands, so thinking effort can be allocated to external demands. Everyday examples of metacognitive questions and strategies include the following.

1. Asking, 'Do I know enough about this material to pass a test? To remember it for later use?'
2. Adding a column of figures a second time to see if you get the same answer.
3. Skimming a set of instructions (assembling a bicycle, setting a VCR, learning new computer software) to get an idea how much mental effort will be required to understand and perform the operations.
4. Knowing that you are late for appointments so you set your watch ahead.
5. Knowing that you have difficulty remembering names, so upon being introduced to someone new ask for how their name is spelled.
6. Knowing you are good at applying 'so what' or 'what if' questions to new concepts so you consciously take on this role in meetings.
7. Paraphrasing what people say to check that your understanding is correct.

For Battle Command, guiding thinking is deciding about decisions (see Figure 4). Battle Command material describes types of decisions made at different levels of command. All commanders and staff must decide what to think about.

The idea behind deliberate metacognition is to look at external factors that make a difference, how you think about a situation, and to manage your (mental) resources to think about the problem. To do this you can monitor how you are thinking, and you can plan how you think.

An adaptive technique.

For adapting our own thinking, we can apply standard questions in a triage for decisions. This decision triage is based on a set of reflective questions called the quick test (Freeman & Cohen, 1994). This test proposed similar questions to the set here called FITE. "FITE" directs attention to several important questions about a situation:

1. How Familiar am I with this situation? (What do I already know?)
2. How Important is the outcome? (What is at stake, what is at risk?)
3. How much Time is available to make a decision or solve the problem.
4. How much Effort is required to address the problem?

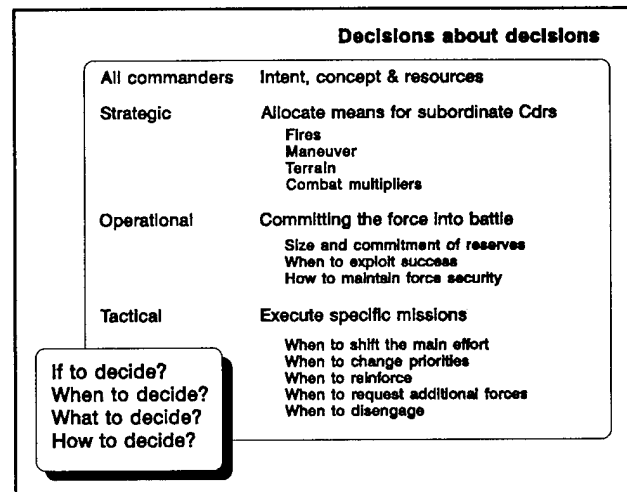


Figure 4. Commander's decisions.

Two additional questions are added to expand the mnemonic to GO-FITE-WIN: GO stands for considering the Goals and Obstacles in one's thinking, and WIN stands for the question, 'What's Important Now?'

Examples of the FITE questions for decision triage are explained:

FITE

How *familiar* am I with this situation?

If you are very familiar, you will likely be capable of responding quickly. You might not even recognize the situation as a problem or that a decision is being made. For example, encountering a detour on your normal route to work, you decide the quickest alternate route is to turn one block early to avoid the problem, instead of following the official detour route.

If you are not very familiar, then you will need more time to gather more information or to generate and think through a solution. You will be required to use different processes/strategies depending on your experience and knowledge. You might need to take some action, try something so you can find out what you need to know. Is someone more familiar and capable of responding to the problem; if so, then is it appropriate to have them do the thinking?

How *important* is the outcome?

If the situation is very important, then you need to give that situation your utmost attention. Do the stakes of various problems differ? What are the risks involved in developing a bad solution, in doing nothing at all? Give your attention to the problem/situations with the highest importance or that are most critical. Assessing importance to determine what to think about is metacognition.

How much *time* is available before a decision or an action is required?

Among all decisions or situations with which you are faced, which is most pressing? Is time sufficient or has the latest window for decision or action already passed? Often we think about what is most immediate instead of what is most important.

How much *effort* is required?

If a very precise response is required, a more careful thinking process is needed and more effort is required. Likewise if the problem is very complex, more effort will be needed to create a good understanding of the problem and possible solutions. If the window of acceptable responses is wide (and magnitude or chance of error low), then any of a number of responses may be appropriate. Requirements for accuracy have direct trade-offs with the amount of effort required. High accuracy typically demands higher effort.

These FITE questions are like a triage for what to pay attention to--a decision triage. They provide the basis for adapting your thinking to important situational discriminations. The answers to the questions are based on your judgment of these considerations taken in absolute or relative (one decision situation compared to another) terms.

Two other sets of questions are useful for planning and guiding your thinking. What are the *goals* and *obstacles* for thinking about this problem (GO)? *What's important now* (WIN)? A decision triage worksheet is provided in Figure 5.

This technique does not come without some possible disadvantages. Planning how to do thinking takes time away from thinking. Also there are not always clearcut answers to these questions. Decision triage raises questions to think about, but absolute rules do not exist for making the trade-offs. Many factors can impact what and how to think. FITE are some that have been found to be more important.

The advantages of the technique include its aim of identifying and organizing the required thinking, the increase in thinking efficiency, improved likelihood of sound reasoning, an audit trail tracing what you are doing, identification of shortfalls in what you do not know but need to know.

Other adaptive questions can be used in goal-based thinking. For example,

1. What is this (situation, problem, solution)?
2. Is a decision even needed? When is a decision needed?
3. Does this problem remind me of something else?
4. What is the problem not like (or what doesn't the problem include--boundaries)?
5. What is the "real" problem?
6. What needs to be accomplished?
7. What do I know? What don't I know? What do I still need to know? How could this happen? What are the constraints?
8. What is likely? What is the solution? What should I learn for the future?
9. How can I remember?
10. What else could this be?
11. How to reason? How do I represent what I think about?

Goals	
Obstacles	
	Low High
Familiarity	
Importance	
Time available	
Effort	
What's important now?	

Goals and obstacles: What are the goals of your thinking (what does your thinking need to accomplish)? What are the obstacles that prevent you from immediately thinking of a solution?

Familiarity: Is the situation unfamiliar, should you apply critical thinking to find if there are problems? Are there parts of the situation that are familiar; how can known solutions be used or improved upon?

Importance: Is this situation or problem important? If there are multiple problems, which problems are most important? Who has the most at stake to gain or most at risk to lose?

Time available: How much time is available before having to commit to a decision? Is there any strategy or decision that would maximize your freedom of action?

Effort: How much mental effort would it take to identify or resolve the problem? How much accuracy or precision is required (or alternatively, how much room for error is there)?

WIN: Remember to focus on what's important. How should thinking be directed to the most important things? (Don't ignore difficult problems, don't just solve the routine, easy problems; don't rush to a solution without considering what the real problem is.)

Figure 5. *Decision Triage*: A concept for adapting thought to the situation.

Guidelines for when to use FITE.

FITE or alternative questions are potentially useful throughout our thinking (see Figure 6). They are useful when training and studying. During this preparation phase they might help determine what the strengths and limitations of your thinking are. You might determine guidelines to apply during performance (such as a SIMEX) to counter recently identified limitations. Metacognition is the thought process by which such guidelines (or heuristics) are addressed.

FITE questions are applicable during performance when starting a problem or when

noticing a new set of conditions. Also when progress is not proceeding at a rapid enough pace you can apply them, e.g., *What progress have I made? Is it as bad as I thought? Should I consider some other way of thinking?* FITE questions are also useful during review of performance to assess what was learned, what problems in thinking, remembering, and learning have been experienced.

Summary.

Adaptive thinking has been considered from two points of view. One was how to adapt (or apply) the Practical Thinking skills to current arrangements of tasks and procedures. Thinking skills are not alternatives for doctrinal tactical decision making procedures. They offer more detail to address important things to be done. Considering other models than the classical decision making ones, shows the importance of planning and other cognitive skills. The second point of view on adaptation is to adapt (select, control, and regulate) our thinking to the problem at hand. The first point of view is about arranging tasks, and the second point of view is about arranging thoughts. Both of these views indicate the importance of improving one's skill to adapt to situational demands.

There are many useful questions to direct our attention and monitor our progress or capability to think (managing our time for thinking, thinking ahead, decision triage, etc.). These questions are addressed by being sensitive to situational factors and one's own knowledge and thinking capabilities. Also three sets of questions, called the GO-FITE-WIN test, were proposed that can be used for decision triage in any situation.

The critical point to remember is to be willing to spend relatively large amounts of time on high-level planning on what problems to address (Covington, 1987; Pressley, 1986). Often people impulsively jump into tasks before they are ready to solve them, either they solve the obvious problems, the easy problem, the wrong problem, or re-apply familiar solutions. Many of the most important decisions are made at the beginning of the process (what problem is identified, what strategy to use to solve the problem, what is attended to). One's prior knowledge should be fully used to plan and allocate one's thinking.

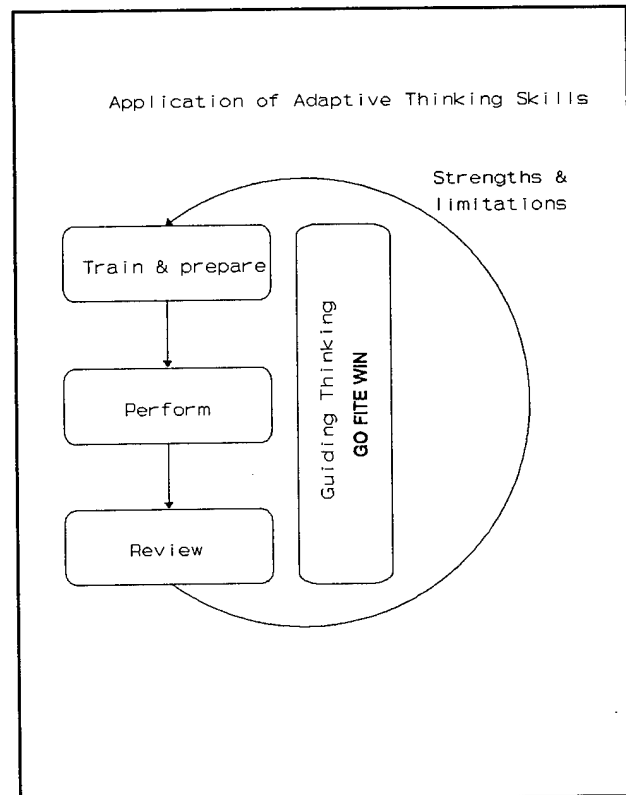


Figure 6. Application of metacognition to learning and performance.

Finding Hidden Assumptions

The lesson addresses when a person thinks about a problem taking certain beliefs for granted. These can be referred to as hidden assumptions or as presumptions. An assumption is considered to be something taken to be true without proof or demonstration, while a presumption is the acceptance or belief based on reasonable evidence. We often do not realize that we are assuming something to be true. Assumptions which are used implicitly in one's thinking processes often go unrecognized and can hamper reasoning. Improving thinking depends to a large extent on finding ways that judgments may be incorrect. The lesson explores the dangers of unrecognized assumptions using a case study on the Bay of Pigs (Neustadt & May, 1986), and practical exercises demonstrate techniques for discovering hidden assumptions.

This lesson provides a technique for revealing assumptions and how to consider them (Freeman & Cohen, in preparation).

Some key points to remember are that

1. One of the most dangerous biases in reasoning is to treat assumptions as beliefs.
2. Finding hidden assumptions can be stimulated by using dialectical reasoning, identification of counter-arguments (or alternate explanations), or the "crystal ball" as the perfect intelligence source.
3. There are various ways that we can react, once hidden assumptions are identified. These ways include reasoning about the plausibility of alternate explanations and knowing how to react to plausible assumptions.
4. When we receive information that does not conform to our expectations, we often ignore it or pay little attention to it. This lesson provides a way to handle unexpected events. The most important aspect is to keep track of unexpected events. Individually they may be easy to disregard but several unexpected events may be cues to significant misunderstandings or miscalculated courses of action. We should try to generate explanations consistent with current assessments, consider the plausibility of the explanations, and consider changing the overall assessment when explanations are no longer plausible or simultaneously true.

Military decision makers constantly face uncertainty. Practical Thinking involves using a creative and critical eye to explore possibilities and protect against unknowns. One way to deal with uncertainty is to take *multiple perspectives*. Another way to deal with uncertainty is to make assumptions that "replace necessary but missing or unknown facts" (U.S. Army, 1994).

Some assumptions are explicit. A battle staff knows what these are and may try to confirm them, if they have time. Other assumptions are disguised as beliefs. A belief is having confidence that a particular thing is true, as indicated by a willingness to act as though it were true. "Assumed beliefs" are not explicitly stated. Hidden assumptions are not necessarily even identified as explicit beliefs, but lay hidden somewhere in one's memory to cause something else to be true. There are things that there is no reason to think otherwise about. We have them because of our propensity to prefer closure and our ability to reason beyond what we know.

There is a 9 dot problem where the task is to draw four or fewer straight lines to

connect all nine dots without lifting one's pencil. The assumption is usually made by the novice solver that he/she cannot go outside the outer most dots. To solve with 4 straight lines, one has to go beyond the boundary that is "assumed" to be created by the outer most dots. To solve with fewer lines, the solver needs to think even more creatively (like using fat dots and three zig zagging lines, folding the paper to move the dots into a single line, rolling the paper into a cylinder, placing dots infinitely close together and using a broad writing instrument). This 9 dot problem can be used as an analogy to other problems where too many constraints are assumed.

Implicit assumptions often go unrecognized. We do not know that we are making assumptions, and we do not realize how they might affect our thinking. Improving thinking depends on recognizing assumptions and determining ways that our judgments may be incorrect.

One problem of hidden assumption deals with not adequately questioning what we believe and why. A second problem is not wanting to change away from a belief that one has already invested (consistency, confirmation bias). It causes less discomfort to disregard information if it does not fit a model, than to thoroughly sort out what it means. An approach is described for exploring either of these problems with hidden assumptions and beliefs.

The reading associated with this lesson discusses the lack of questioning assumptions during the Bay of Pigs planning. Neustadt and May (1986) say that assumptions shape and influence the understandings of a situation, the goals, and the plans.

There are types of assumptions: value-laden truths, maybes, and if-thens. "Truths" are strongly held beliefs that may be impossible to assess truthfulness. "Maybes" replace necessary but missing or unknown facts. "If-thens" are those conditional beliefs that are most open to understanding.

Some of the hidden assumptions by the President and his advisors leading up to the Bay of Pigs were that Castro would become more dangerous in Cuba, that Castro would become Moscow's tool, and that Castro was taking Cuba away from the US. It was assumed that Cubans on the island would be happily rid of Castro and that they would rise up in revolt. Other problems included a misassessment that a "fair chance" to succeed was not a particularly strong endorsement. Also many of the planners felt that the President would commit US Forces once the operation began.

When to look for hidden assumptions.

When is it appropriate to look for hidden assumptions? Cohen et al. (in preparation) propose the "quick test" that helps determine if there is enough time to consider other possible relations and explanations. Looking for hidden assumptions can be done during situation assessment, either the construction of a situation model when recognition is uncertain (unfamiliar, time available, manageable effort) or when you wish to verify the results of recognition (familiar but high importance, time available).

Alternatively, decision triage (GO-FITE-WIN) can be applied. If there is reason to doubt the assessment then answer these questions: is importance high, is time available, how much precision and corresponding effort are required? If the outcome is not important, there is not time available, or there is not effort available to improve the assessment then one would not look for hidden assumptions. But even being open to the fact that other possible meanings exist

can help. One may want to adjust or add to a course of action as time is available. Recognizing that facts are possible assumptions may lead one to a different strategy, such as hedging, delaying, or intensified search for confirming information.

Another indication that it is a good idea to look for hidden assumptions is when the group blindly goes along without challenging ideas or considering a different perspective and when they focus on confirming evidence. This is like Admiral Kimmel and his staff at Pearl Harbor (Janis & Mann, 1977). They ignored warning signals so they would not contradict the actions they were already taking.

Technique for finding hidden assumptions.

Neustadt and May (1986) offer two questions to think more clearly about a situation. The first was, *"How much of your own money would you wager that the presumed thing actually happens?"* The other was referred to as Alexander's question: *"What new knowns would bring you to change things presumed?"* In other words, 'what new information from anywhere would cause you to revise or to reverse your judgment?' (Alexander's question was named because of the individual that raised it during a 1976 meeting considering whether to immunize the whole country against the swine flu.) The questions should flush out a deeper set of questions. These are good questions, but the lesson emphasizes a different approach. Simply this concept asks the question, *What if some assumption (belief, argument, conclusion, or assertion) were not the case?* This is similar to dialectic and what if thinking. The technique consists of four steps (see Table 17). Exceptions are generated until they get far-fetched or there is no more time for this step.

Table 17.
Finding Hidden Assumptions.

1. Select a critical part of the assessment -- even if there is high confidence.
2. Imagine that a "perfect" intelligence source (such as a crystal ball) indicates that this part of the assessment is wrong.
3. Explain how this part of your assessment could be wrong.
4. Imagine that the crystal ball now tells you that your new explanation is wrong and directs you back to step 3.

Freeman and Cohen (1994) describe an example of the technique and what it produces (see Table 18).

Detecting assumptions that are hidden is only part of the solution. A second part is to consider the plausibility of counter-explanations. One might know in a given case that some alternative explanation is not true; there is confirming data which indicates it is false. These explanations no longer need to be considered. Assessing the plausibility of the remaining explanations is a matter of judging the degree to which they could be true. Everyone can fall into a trap of giving more weight to the explanations that they would like to be true. That is exactly what this approach intends to counteract, to minimize what we would like to be true by

explicitly identifying counterarguments that have some possibility of explaining a different position.

Table 18.
Example of Finding Hidden Assumptions.

Suppose that an assessment (assumption, belief, conclusion, etc.) includes the claim that the enemy will cross the river at location x. The claim is based on indicators concerning the distance the enemy must travel to his supposed objective, the shallow depth of the river, and concealment opportunities along the bank. The officer is confident of this assessment; however stakes are high and there is time to critique the assessment, so he does so. He imagines the perfect intelligence source tells him that the enemy will not cross at location x, and demands that this failure be explained. Cycling through steps 3 and 4 could generate the following list of reasons why the enemy will not cross at location x.

The enemy anticipates that our force will be at location x.
The enemy will detect the movement of our force to location x.
There are good crossing sites that we missed.
The enemy doesn't have any river crossing assets; he can't cross the river at all. The enemy's river crossing assets are so good that he can cross elsewhere.
The enemy has a large enough force that he can accept casualties crossing elsewhere.
The enemy's objectives are different; he doesn't need to cross at all.
The enemy will use air assault to get across the river, rather than cross it.

Another important point to recognize is the difference between building a case and weighing evidence. Building a case tends to start with the conclusion and tries to defend it. In weighing and judging evidence we draw a conclusion after all the evidence has been considered. Since tactical situations see information continually come in, we must hold open the possibility that an initial assessment is subject to change based on new evidence that is accumulated. Sternberg & Lubart (1995) cite the same skill when referring to remaining open to new interpretation of events as more information becomes available.

Handling unexpected events.

A similar concern is what to do when incoming evidence does not fit the current assessment/understanding. Cohen et al. (in preparation) provide guidance for handling these unexpected events. When we receive information that does not conform to our expectations, we ignore it or pay it little attention. The most important aspect is to keep track of unexpected events. Individually they may be easy to disregard but several unexpected events may be cues to significant misunderstandings or miscalculated courses of action. We should track unexpected events, try to generate explanations consistent with current assessments, consider the plausibility of the explanations, and consider changing the overall assessment when explanations are no longer plausible or simultaneously true. The steps for handling unexpected events are explained in Table 19.

Table 19.
Handling Unexpected Events.

1. Track unexpected events.
2. Try to generate explanations consistent with current assessments.
3. Consider the plausibility of the explanations.
4. Consider changing the overall assessment when explanations are no longer plausible.

The third step is to consider plausibility, but how should one determine the plausibility of hidden assumptions or modified explanations. Possible actions to take are indicated in Table 20 (Cohen et al., in preparation). Table 21 gives examples for how assessing plausibility applies to a logistics base example.

Table 20.
Assessing Plausibility of Events.

1. Accept the assumption as a known risk.
2. Conclude assumption is plausible (or an alternative is plausible).
3. Confirm assumption's truth by examining existing or gathered information.
4. Make assumption true through proaction.
5. Develop or adopt a contingency plan in case the assumption is false.
6. Develop understanding or plan that does not depend on the assumption at all.
7. Remain flexible until the future becomes clearer.

Summary.

It is important to reveal beliefs that rely on hidden assumptions and to test the plausibility of alternate explanations.

In this lesson hidden assumptions were described, examples were provided for how they have occurred in the past, and what kinds of problems they have caused. Neustadt & May (1986) offered several ways of dealing with assumptions: explicitly look for presumptions (acknowledge that assumptions exist), consider whether experience or history validates them, ask the wager question, and ask Alexander's question.

An additional way of uncovering hidden assumptions was to apply the "perfect intelligence source" (crystal ball) to force an explanation for something other than what is

Table 21.
Plausibility Assessment Example.

Example assessment: You have concluded that your logistics base is safe from artillery.	
Ways to assess plausibility	Example
Verify assumptions.	Gather more information concerning enemy artillery range, camouflage methods, or close air support.
Shape the battlefield to ensure the assumptions are true.	Destroy lines of communication (LOCs) that might be used to resupply artillery. Target enemy air support bases.
Develop contingency plans.	Plan to defend against artillery shelling by using locating radar and counterbattery fires.
Change the course of action so the plan no longer depends on the assumption.	Move the log base further to the rear.
Change assumptions if a new explanation is plausible.	Ensure air defense weapons are employed to protect the log base.

assumed (or concluded). Exploring other possibilities gauges the strength of belief in an assessment.

One common and particularly dangerous reasoning problem is confirmation bias, or groupthink. A technique for handling unexpected events was covered to help counter confirmation bias. Using elements of this technique, especially tracking and recording surprising events will help discourage confirmation bias. Once alternate explanations are recognized, plausibility assessment and ways of dealing with them need to be assessed. Plausibility is based on judgment (experience, analogical, and inferential reasoning). Ways of dealing with the uncertainties include recognition of risk, collection of information, proaction to establish conditions, contingency planning, and maintaining the maximum freedom of action.

Practical Reasoning

When curriculum developers look to see what reasoning is and how it should be taught, it is not surprising that instruction turns to formal logic and rules. From a formal logic and classical school perspective, reasoning includes the study of deductive and inductive logic. These involve a closed system of thought; a focus on the form of links among knowledge, instead of considering the knowledge itself as important. The formalism in formal reasoning is not a very good parallel to the ways people naturally reason. Formal logic purports to be normative but whether formal logic is used much is in doubt. Trying to understand everyday reasoning by other than formal logic means is an alternate approach that can expand our ideas about how to improve.

Everyday, practical reasoning is an alternate approach to formal reasoning. Chapman (1993) explains that reasoning develops from resolving inconsistencies in beliefs. This process begins at a young age as largely a social interaction when an inconsistency between an internal belief (or concept) and the concept presented by another is noticed (Piaget, 1928). The opposing beliefs are considered and the reasons for and against are weighed. We learn to question and extend beliefs without external conflict, and we discover that reasons, like beliefs, are subject to reevaluation. The process can be characterized as a dialectical process. In contrast to formal reasoning where thinking develops from learning the rules of formal logic, everyday reasoning is an internal process of argumentation. This model of thinking is compatible with the skills covered in previous lessons: *Multiple perspectives* are different views that may produce belief inconsistency. *Adapting to the situation* is the ability to notice inconsistencies and to manage their resolution. *Finding hidden assumptions* is a dialectical process of considering beliefs or assumptions as false, for the sake of testing the coherence of understanding.

The identification of material for practical reasoning was the most difficult to determine in this current series of Practical Thinking lessons. If formal logic along with deductive and inductive rules are rejected and if everyday reasoning is a natural process of weighing evidence, then what should be offered instead? The approach taken was to form the instruction around five key teaching points.

1. *Knowledge is paramount in reasoning.* We do not always have knowledge. When we do not is when we need to reason. We can reason to fill in our gaps of knowledge, to conjecture what is important, what is possible, and what is unlikely. Learning more and thinking ahead are also good ways to prepare for uncertain futures, but will never completely prepare us. Uncertainty is a matter of course that we need to deal with. Searching for more facts is not the only strategy for dealing with uncertainty. Practical reasoning is appropriate as well. We can fill in our gaps of knowledge by creative and critical thinking.
2. *Standards of reasoning can be applied to guide our thinking or to consider the thinking of others.* Five standards are the focus of this portion of the lesson. Consideration of fairness, relevance, evidence, clarity, and consistency (FRECC) can help make thinking more sound. Being aware of adherence to or violation of these standards will lead to more critical thinking.
3. *Understanding typical reasoning fallacies is the first step to lessen their occurrence.* There are many types of reasoning errors that have been described. This lesson focuses on

six that affect our ability to generate objective conclusions from our experiences and beliefs.

4. *Attitudinal pitfalls can negatively color our thoughts, so the first line of defense is being able to understand how our attitudes influence reasoning.* Attitudinal pitfalls are described that help explain our psychological and emotional predisposition and reaction to events.
5. *Six simple questions are provided to help get one's thinking off to a quick start.* It is appropriate to use these questions when faced with uncertainty, when there is an over-willingness to accept what we hear, or when there is a lack of critical thinking.

This lesson explores how we can improve our reasoning when a practical model is applied. Instead of striving to reach perfect rationality and logical thought, practical reasoning examines qualities of good and bad reasoning and provides concepts for reasoning about unexpected events and other ways to guide our reasoning.

Characteristics of practical reasoning.

Practical reasoning deals with the construction, maintenance, use, and change of beliefs. It involves the application of our knowledge to think about everyday problems that have incomplete and *uncertain information*. We must *use what we already know to think about what is unknown*. Instead of striving to reach perfect rationality and follow the rules of logical form, practical reasoning examines qualities of good and bad reasoning and strives to reach sound conclusions.

War is the realm of uncertainty; three quarters of the factors on which war is based are wrapped in a fog of greater or lesser uncertainty. A sensitive and discriminating judgment is called for; a skilled intelligence to scent out the truth.

Carl von Clausewitz, 1976

Knowledge is paramount in reasoning. When we have knowledge that directly applies we can try to recall it. (Recall one of the metacognitive functions is to assess whether we might have knowledge about a particular problem we are thinking about.) When we do not have knowledge we can reason to fill in the gaps of our knowledge. We can conjecture about what is important, what is possible, what is unlikely. When we do not have knowledge we need to construct understandings, explore goals, solve problems, and decide. Learning more and thinking ahead are also good ways to prepare for uncertain futures, but will never completely prepare us. Uncertainty is a matter of course that we need to get better at dealing with. Searching for more facts is not the only strategy for dealing with uncertainty. Practical reasoning is appropriate as well. We can fill in our gaps of knowledge by creative and critical exploration.

Practical reasoning implies some degree of consideration (reflection and rationality) in that conclusions are not reached randomly or arbitrarily. However, practical reasoning is in contrast to organizing or testing reasons or arguments according to structured logical forms. Practical reasoning does not preclude logic (i.e., is not illogical) but does not concern itself with distinguishing between deductive and inductive logic and other principles of formal logic.

Practical reasoning is a process of exploration, not linear deduction or after-the-fact justification. Practical reasoning involves the assessment of plausibility.

Practical reasoning, like Practical Thinking, is something we all do. The assumption here is that reasoning (like learning) can be improved if it is made more explicit. This approach does not assume classical, formal theories of logic would be the basis to be more explicit, neither does it assume that everyone uses or should use the same process.

"Standards of reasoning."

This subcourse on Practical Thinking intends to emphasize the importance of being mindful and deliberate thinkers--but not necessarily analytical. Another way to improve our thinking and reasoning is to have "intellectual standards," principles of sound thinking against which individuals can check their own reasoning and that of others. The standards have been drawn from Paul (1993).

There are five standards that have been selected for discussion. These standards overlap, and although they are presented as standards for thinking they equally apply to standards for communication and group discussion. (The acronym, FRECC can be used to help remember them.)

Fairness - treating both or all sides alike without reference to one's own feelings or interests; *impartial* and *unbiased* both imply freedom from prejudice; *objective* implies a viewing of persons or things without reference to oneself, one's interests, etc.

Examples of fairness - (1) Even though the commander was inclined to favor his former battalion and give priority of fires to their breaching operation, he knew that protection of the flank was key and assigned first priority to the cavalry. (2) Putting a spin on the information (also known as framing):

'The liberal congressman piteously whined ...'
'The conservative congressman staunchly proclaimed ...'
'bold, audacious'
'hesitant, cautious'
'calculated risk'
'reckless abandon.'

Aid - Be a critical thinker, look for information that goes against one's own inclination, seek other viewpoints.

"We often mistake fluency and argumentation for thinking skill. Fluency and the power of coherent expression are tools of thinking, not thinking itself. . . . Very able pupils usually react to an idea by making an initial judgement ('I like it', 'It will never work' and so on). They then use reason and skilled argument to back up that initial judgement. The argument may be flawless, yet the thinking may be appalling because it includes those major perceptual errors of looking at only part of the situation or ignoring the magnitude of effects. We also confuse debating skills with thinking: 'I can prove you wrong, *therefore* I am right.'"

(de Bono, 1976, p 15)

Relevance - bearing upon or relating to the matter at hand, implies close logical relationship with, and importance to, the matter under consideration, (germane, pertinent, applicable).

Example - Irrelevance: A commander predicts that the enemy is likely to use chemical munitions in their withdrawal even though they never used them in their attack, because they are aggressively using smoke screens. Relevance: A commander predicts that the enemy is likely to use chemical munitions in their withdrawal even though they never used them in their attack. The reasons given include that their forces would not have to cover the affected area and the enemy's doctrine considers chemical warfare a last resort.

Aid - Ability to judge relevance can be developed with practice distinguishing relevant from irrelevant data, evaluating or judging relevance, arguing for and against the relevance of facts and considerations.

Evidence - Conclusions should be well evidenced. Critical thinkers distinguish the evidence or raw data upon which they base their interpretations or conclusions from the inferences and assumptions that connect data to conclusions. Uncritical thinkers treat their conclusions as something given to them in experience, as something they directly observe in the world. As a result they find it difficult to see why anyone might disagree with their conclusions. After all, the truth of their views is, they believe, right there for everyone to see!

Example of lack of evidence - Suppose one makes the argument that, 'We should join country X's fight to counter left-wing extremists because diplomats from X have requested military assistance.' (This argument has weak evidence because it relies only on complying with a request. The argument does not include evidence about the country's own ability to cope with the threat, whether the threat is any less favorable to world or national interests than is country X.)

Aid - Be aware of arguments that provide little or no evidence or evidence that comes only as value-laden, symbolic examples or broad generalizations. Recognize fundamental parts of conclusions that are assumed to be true, but for which contrary evidence might exist. Spend a comparable amount of effort to think of evidence against preferred choices or reasons in favor of nonpreferred choices. Apply the "perfect intelligence source" if it helps to generate additional explanations that broaden understanding.

Clarity - made easier to understand, to free from confusion or ambiguity, to be precise. Clarity is the opposite of ambiguity. Clarity can be considered with understandings, problem states, goals, means, and constraints.

Example of lack of clarity - Consider that a mission was to drive the enemy from a bridge. If given this mission, it is unclear what to do if there is no enemy at the bridge (find enemy somewhere else to attack?).

Aid - Explore what you mean and what others mean. Be precise and recognize when you are unclear about terms, even in your own thinking. Use redundancies in

communication to help clarify meaning, and clarify by indicating what you do not mean (not just what you mean). Use standard terms (defeat, destroy, attack).

Consistency - to think, act, or speak in agreement with what has already been thought, done, or expressed (or to identify explicit differences from previous positions). We often shift our meaning or interpretation as we think about a problem, or we inconsistently apply rules, rationale, or policies. Consistency goes hand in hand with coherence. A consistent argument (or consistent reasoning) will be cohesive and sensible across the range of thoughts to which it is applied. Human life and thought are filled with inconsistency, hypocrisy, and contradiction. We often say one thing and do another, judge ourselves and our friends by one standard and our antagonists by another, lean over backwards to justify what we want or negate what does not serve our interests.

Examples of inconsistency - (1) You see an advantage to COA 1 (which you have developed) as achieving a favorable combat power ratio. Although a similar advantage exists for COA 2 you ignore this or give it less consideration and concentrate on looking for evidence against COA 2. (2) Another source of inconsistency is not treating trade-offs appropriately. For example, a commander that calls for conflicting actions is not being consistent: 'I see a bold rapid action while maintaining maximum force security.'

Aid - Basic assumptions must be analyzed to evaluate the existence of inconsistencies. (Refer to the finding hidden assumptions lesson.) It is not necessarily a problem to be inconsistent, if you have become more precise by revising your meaning, if you have recognized the shift, and if you check to see what affect the shift has had on other conclusions.

Avoid errors.

There are two general categories of errors. The first type are fallacies of argumentation or reasoning, and the second are psychological or attitudinal pitfalls. The psychological pitfalls provide reasons why errors are made (intentionally or unintentionally), while the reasoning errors show misuses of logic. The following are examples of errors and are not a complete list of reasoning errors. If the errors are explicit so they can be identified, then you can be more alert to them so that they do not creep into reasoning. Also remember that the presence of a fallacy does not mean that a conclusion is false.

Fallacies.

There are numerous fallacies associated with logic (e.g., Michalos, 1986; Moore, 1967; Walton, 1987). For Practical Thinking the interest is in studying fallacies, not so to argue with others, but to avoid these subtle flaws in our own reasoning. Often when we are faced with unknown alternatives or seemingly equally good conclusions, we analyze the merits of one position over another by 'arguing with ourselves' to see which arguments or beliefs are strongest or weakest. The following are some particular fallacies that might affect this internal argumentation or judgment.

The aid for each of the fallacies is the same. It is to know the possibility of the error, to be alert to them, and to think critically with the standards established. The "scientific method" is another way to guard against the mis-assessment of events by using such practices as controlled observation, known samples, and predictions of outcomes. Specific concepts can be developed to follow objective habits of thought, like searching for hidden assumptions and handling unexpected events.

Magnitude error - When a claim is made that something will affect something else, this may be logically true, but the effect will not happen or will not happen to the extent implied. Unless one actually knows the magnitudes involved it is easy to construct an apparently logical argument which is nonsense. A magnitude error cannot be identified by looking at the form of the argument; it is detectable only if one already has a larger base of knowledge in which to assess the argument.

Example - Economic sanctions are thought to cause a country to end aggressions with a neighboring nation, but actually the magnitude of the effect is quite insignificant.

Consider the advertising claim: 'Antiseptics kill germs. Germs act on decaying food to cause mouth odour. If you use an antiseptic mouthwash you will have fresher breath.' This all seems very logical. But the magnitudes are quite wrong. The antiseptic is diluted so quickly in the mouth that it will kill germs for only a minute at most. Germs multiply so quickly that they will replace themselves very rapidly. In any case the concentration of antiseptic that will kill germs in a test-tube in the laboratory is very different from the concentration obtained in a mouthwash.

(de Bono, 1976, p 73)

Lack of knowledge - (also known as *ad ignoratiam*), conclude a proposition is false merely because the truth has never been established.

Examples - (1) Suppose you conclude that a proposed river crossing will be unopposed because there is no information about the enemy being anywhere in the area. You might fall into the trap of concluding that the enemy is not present because there are no reports of enemy activity, but there may be no reports because there are no intelligence requirements or sources focused on that area. (2) Sometimes the proof or denial of a claim is shifted to the critic, e.g., the S2 states that the enemy is preparing for a counterattack because of the disposition of enemy reserves, but the executive officer (XO) claims that they cannot be counterattacking because he does not think that would be practical. The XO passes the burden of proof back to the 2, stating 'prove me wrong,' while he has not provided any evidence to support his claim. The XO is using a lack of knowledge argument.

False dilemma - this or that, exclusive thinking when a position is stated such that one has to choose one of two or more alternatives (usually the choices are all unpleasant or stated in emotional terms such that the preferred one is obvious). The fallacy comes about because there is the assumption that one of two or more positions must be true.

Examples - (1) 'Without money to continue college, I'm going to end up in the gutter.' (2) 'We can continue with the plan or try to change horses in midstream.' (3) 'The enemy attacking our flank has to be taken care of by the Cav or with artillery.'

Hasty generalization - an observation is inferred to apply to a larger set of instances from a single observation or a small number of cases.

Example - Hooker, Commander of the Army of the Potomac, assessed that Lee was withdrawing when he was told Jackson's Corps was moving South when, in fact, Jackson was moving around his flank to attack Hooker's rear.

Hindsight bias - the knowledge of events after a decision or action shifts or recreates the memory of prior expectations and predictions, so people think they are more accurate than they really are and fail to learn what actually happened.

Example - After successfully conducting a relief in place the planner stated that he knew there was no doubt they could do it from the beginning, even though the enemy artillery was never located.

Confirmation bias - seek or weigh information that would confirm our perceptions, beliefs, or understandings greater than that which would deny them. Confirmation bias is a primary mechanism of groupthink (Janis & Mann, 1977). Groupthink is also referred to as the "Abilene paradox." Organizational characteristics that influence groupthink include high cohesiveness, insulation of the group from outside influences (i.e., autonomy), shortage of methodical procedures for search and appraisal, directive leadership, high stress with little hope of easily finding better solutions, and incomplete identification of goals, alternatives, risks, and contingency plans.

Examples - Many historically significant events can be described as instances of confirmation bias: Shuttle Challenger disaster, President Kennedy and his advisors for the Bay of Pigs, President Johnson and his advisors who supported escalation in Vietnam, Prime Minister Chamberlain's inner circle who supported appeasement to Hitler.

Psychological and attitudinal pitfalls.

A subset of attitudes were drawn from Moore (1967) to illustrate how psychological factors affect thinking.

Rationalization - People substitute acceptable reasons for real reasons. Often we find that we have committed to a situation that we later realize is not desirable. To resolve an inconsistency in our thinking we might naturally explain the inconsistency away by rationalization. Rationalizing can become a habit, using excuses rather than facing the real issues.

Example - Someone might want to drop out of a civic obligation because he does not want to give the required effort. If he drops out for that reason he will suffer loss of self-esteem -- it is painful to acknowledge laziness. So he "withdraws" and eases the potential psychological pain by rationalizing; it is easy to find acceptable reasons, like 'disagree with the way the chairperson holds meetings,' 'have other pressing obligations,' or 'would like to spend more time with family.'

Variations of rationalizing include,

sour grapes - People diminish what they wanted but could not have. You cannot reach the grapes, well they must have been sour anyhow. You did not get the promotion, 'well you would not like the stress of that job and you are too valuable in your current job.'

sweet lemon - People glorify what they are stuck with. The car you bought is a lemon; but even if it breaks down every other day it has the nicest paint job in town.

excuse making - People attribute problems to events out of their control. The property books in the company were all messed up, if you had not had to take emergency leave last June they would have never gotten out of hand.

blaming others - People attribute failure to others. The course of action did not last much past breaching the obstacle. But if the S2 had given you a better picture of the enemy, the plan would have worked elegantly.

criticizing others - People raise their own relative position by tearing down others. Jealousy is not an acceptable reason to dislike someone, so you find other faults. The Commander from B Company got the prime mission assignment. 'Why did not he close on the objective any sooner than he did?'

Aid - To reduce rationalizing, cultivate a good self image, one that is willing to face reality frankly and objectively. Be alert to possible rationalizations and take pride in catching yourself in them. Learn from mistakes, do not let them haunt you. Organizationally allow for frank, open assessments, and avoid fault-finding. Focus on outcomes instead of blaming. Reserve commitment to uncertain beliefs or actions until after you have thought more thoroughly, sought other's advice, and looked at other perspectives.

Mind sets - People tend to view a situation in a certain way. In its simplest form a mind set is a perceptual error. Mind sets account in part for our tendency to perceive what we expect to perceive. We understand the world and form concepts based on the patterns we determine. Sometimes it is hard to break apart those patterns.

Example - MG Ridgway (XVIII Airborne Corps) during the Battle of the Bulge (22 Dec 1944, following the Defense of Saint Vith) was locked into his airborne infantry perspective that the 7th Armored should fight surrounded in a "fortified goose-egg" position. He was finally convinced that it would be better for the armored forces to withdraw and reconstitute across the Salm River (Morelock, 1993).

Aid - To reduce mind sets identify and hold open possibilities. Cultivate a habit to stop and reconsider the course you are pursuing. Give more attention to contrary than to confirmatory evidence. Recognize the difference between skepticism and close-mindedness. Do not avoid mind sets by replacing decision with indecision. (For further advice refer to the lesson on multiple perspectives.)

Attitudes - predispositions to react favorably or unfavorably to a situation, depending on one's system of values. Positive and negative attitudes both influence our thinking. The danger is that often we are unaware of underlying attitudes and their influence on thinking and behavior. Attitudes are shaped by values, motivations, and expectations, among others. In most situations there is a good deal of latitude for how they are

interpreted. We often are subject to our own self-fulfilling prophecies, we take a negative or positive stance prior to an event and then interpret the event to be consistent with our expectation.

Example - Suppose ten years ago, you became familiar with a national health care system while visiting another country and the experience was positive, you are of an altruistic bent and believe that the US should provide for important needs of the poor. Then you are likely to favor the concept of national health care. If you never had any positive exposure to national health care and believe that government is basically inefficient at running large programs, then your attitude may lead to negative thoughts about national health care.

Aid - To counteract maladaptive attitudes, you must be vigilant for unsatisfactory conditions in your life to signal you to examine your attitudes and values.

Identification - The pitfall associated with identification is that we tend to accept uncritically the ideas of those with whom we have identified; we tend to borrow our attitudes, stereotypes, and values without stopping to question whether they are right or wrong, true or false. The student might pattern himself after that of his coach or professor. Admirable qualities might have a 'halo effect' over other qualities and we do not distinguish between them. From an extreme standpoint whatever this person does, says, or thinks is okay. Through identification we adopt false or conflicting ideas. The opposite of identification can occur too. Disassociation might occur when we try to distance our beliefs and actions from some particular group or individual.

Example - A student admired his former commander whose favorite book was Clausewitz *On War*. He cherished his own copy and often recommended it to others, but never attempted to read it himself.

Aid - As with other pitfalls you must be aware (vigilant) and examine critically all ideas before accepting them; think for yourself.

Guidelines for practical reasoning.

Sometimes we have a feeling that there is a problem in our reasoning or that of others. We might want to check it out, to reason more deeply about a problem, but we might not know how to get started. To "quick start" a deeper reasoning process we can rely on thought-provoking questions. Six questions for stimulating practical reasoning are:

What if? The what if question has both creative and critical components of Practical Thinking. It can be used to stimulate creative thinking, e.g., what if the impossible were possible? And stimulate critical thinking, e.g., what if tank noise could be muffled to be audible only at a close distance?

What else? Questions about "what else" help to form alternate and richer understandings. If this were not the case, what else could it be? Consider how contrary views might be true or where they may lead. For example, if the enemy does not intend to revert to the defense, what else could explain what is happening?

So what? Some assertions are very precise and make the invited inference to cases of interest. The concrete, specific nature of the assertion intends to appeal to preference for concrete concepts, but the application to broader or other specific instances may not be sound. To form and test conclusions, one can ask the "so what" question to check if the implied relationship actually is significant and has any practical value?

What specifics? Claims are often general, trying to appeal to broad interests. Checking claims with specific information is a good way to test them. This relates to the evidence part of the standards of reasoning. What specifics indicate that more restrictive firing range policies really will increase safety.

Is there a weak link? Looking for the Achilles heel in a reasoning chain is a way to check for another standard of reasoning, consistency.

What is unexpected? The unexpected prediction or result can clue one to incomplete or poor reasoning. We implicitly accept what outcomes are expected, but we often do not look for counter indications that would prove us wrong. Experts have a better idea of what to expect in terms of typical cases and the boundary conditions. The lessor expert often ignores uncertainty, but the more expert infers what the unexpected means.

Summary.

Practical, everyday reasoning has been contrasted with formal, logical reasoning to show why logic is not sufficient for improving reasoning. The single most valuable thing one can do ahead of time to improve reasoning is to acquire knowledge that will be needed. In the rapidly changing world, it may be difficult to anticipate what knowledge will be needed. The changing world creates great variability that also makes learning sufficient knowledge a daunting task.

Practical reasoning skills based on informal reasoning concepts are not the usual approach for teaching military and Army students. Practical, everyday reasoning provides an alternate approach to either a classical process model or a strict knowledge and experiential model. What is appealing about this approach is that it deals with common-sense. The lesson described five desired standards (qualities) of reasoning that should be incorporated into our reasoning habits. Several reasoning fallacies and psychological pitfalls were covered that should be recognized and prevented. Finally six guidelines in the form of questions are offered to help improve and maintain practical reasoning.

Integrative Thinking

Integrative thinking is based on cognitive complexity (Baker-Brown, et al., 1992; McDaniel & Lawrence, 1990; Streufet & Streufert, 1978) and reflective judgment (King & Kitchener, 1994) theories. It is in contrast to the other Practical Thinking skills, that sought to elaborate individual skills. Integrative thinking is a skill that brings overall meaning to the forefront. In lay terms, integrative thinking can be thought of as seeing the big picture or grasping the essence of things.

This lesson is designed to describe, illustrate, and practice the skill of integrative thinking. The lesson defines integrative thinking and describes it in terms of the characteristics of progressive levels of the skill. The students are given the opportunity to evaluate levels and characteristics of integrative thinking in the context of opposing commanders within an historical battle situation. Combining knowledge of past and present events is difficult in the complex, dynamic command domain of the MSF where there is so much information. The ability to grasp the essence of a situation is an important skill, but is not well-understood nor well-defined.

This lesson should provide a better understanding of what integrative thinking is and how the skill is obtained and applied. Integrative reasoning can be shown by practicing the other Practical Thinking skills that are essential to its development and how growth is dependent more upon motivation and study attitudes than upon special talents. There are two primary teaching points.

Reasoning applied to experience is the essential ingredient in developing integrative thinking skills. We should learn from experience, not just live through it. Integrative thinking is primarily the understanding of cause-and-effect relationships within subtle environmental influences. Unless we "think through" our experiences looking for these relational "rules" and comparing them across experiences, we gain little from them.

These relational knowledge structures (sometimes called "schemata") continue to develop over time with experience in the domain. As new experiences add to existing knowledge, two abilities apply: *Differentiation* is knowing when rules do not apply. *Integration* is knowing under what conditions certain rules relate to each other and when they can be combined. The processes of differentiation and integration result in the domain expert acquiring a large set of highly interrelated schemata at various levels of abstraction. Based upon past experiences, different situational events cue different memories which may, in turn, cue still others. Due to the size, complexity, and familiarity of domain knowledge structures, much of the reasoning of experienced individuals is often done unconsciously in a rapid fashion, the reasoner only becoming aware of the products of the reasoning. This phenomenon is often labelled as "intuition" but is, in fact, the result of a great deal of experience and learning.

This lesson describes the nature and acquisition of integrative thinking and gives the student the opportunity to test their level of integrative thinking in battlefield decision making. Concepts for raising integrative thinking levels are described.

Definition of integrative thinking.

Integrative thinking is the ability to comprehend the relationships among events or objects whose association is not obvious to the unskilled observer. It is a critical skill in battle command because of the large number of interacting factors on the battlefield and the frequent necessity for rapid decision making. Synthesis is a related term that can be used interchangeably with integration. Integration involves the generation of plausible and rational explanations or solutions in complex situations based upon knowledge gained through experience and study.

The integrative thinking concept can be illustrated by giving partial information and discussing what the known information means. For example one approach is to present a somewhat novel situation array of unit symbols and ask students to give possible explanations of what it means. The diagram has only unit symbols without unit boundaries, directions of movement, or underlying terrain features. Specific probing questions can be raised like, what type of unit is this, what different missions might they have, what is the terrain, what might the enemy be doing, and so on. A number of teaching points can be made with this activity. For officers with greater experience, possible explanations can be generated more quickly, but there might be less fluency of ideas. Less experienced officers will probably have more trouble filling in the gaps and understanding what the pattern possibly means. The plausibility of alternate explanations can also be explored. Differences in integrative thinking ability ought to be represented in a class of students from different branches with certain branches doing better than others on problems familiar to them. There are parallels to this simple classroom activity and research that has examined expert-novice differences. For example, the novice x-ray technician will typically diagnose a collapsed lung lobe as a tumor because both present the same darkened region on the x-ray. The experienced technician, however, will take into account other related cues such as the overexpansion of the lobes surrounding the collapsed one to correctly diagnose the condition (Chi, Glaser & Farr, 1988).

Research comparing novices with experts in such fields as computer programming, physics and chess, show that the novices' memory of problems is organized primarily around observable objects and relationships such as similar wording, stated variables, or types of chess pieces. The experts' memory for problems is organized instead around principles and meanings. The expert has developed knowledge that permits the understanding of a situation in terms of abstract relationships not apparent to someone less knowledgeable. As a military example, consider two people who have just read historical accounts of two events: Napoleon at Mantua and Germany's shifting of forces from the Western to the Eastern Front in WWI. One person knows about and is able to apply the abstract principle of interior lines. The other person does not have this knowledge. The knowledgeable person readily sees the similarity between the two events. The unfamiliar person may not see any similarity. The unfamiliar person sees that one is a specific battle while the other a war strategy, or this person sees one using a natural obstacle and the other using wide physical separation. The unfamiliar person compares the two events only on surface features like this.

Relation of integrative thinking to Practical Thinking.

Just having "lived through" a CGSC class, a SIMEX, or some duty assignment does not guarantee that someone has learned something that can be applied elsewhere. Learning does not mean "getting by" or memorizing something in order to regurgitate it later. True learning

involves integrating an experience into one's knowledge so that it is available to be used in comprehending similar situations and solving similar problems even if they occur years later. To do this, we must think about what we have experienced. The exercise of Practical Thinking techniques is a major part of this learning.

Three rather simple general rules apply here. First, the more we think about an experience, the more apt we are to remember it. This is true not only because of the general amount of practice it receives, but also because the more different ways we think about something, the more things it becomes associated with in memory. Thus, the more environmental cues are available to recall it. Second, true learning is nearly always goal-driven. If you set objectives for what you want to learn from a course or skills you want to pick up from a duty assignment, then your thinking is focused and you have something to measure your progress against. Third, the quality of our thinking about an experience determines the validity of the knowledge we derive. The exercise of Practical Thinking supports all three of these rules.

For example, suppose you had been in a simulation exercise where the result did not come out the way you would like. Your reaction might have gone one of several ways. First you might have considered the outcome of the exercise just a case of bad luck and tried to forget about it. In this case you would learn very little from the experience. Or another reaction might be that the experience troubles you quite a bit. You might hold a lot of negative feelings and wake up at night thinking about what you should have done differently. In this case you might reach some simple conclusion like you should never attempt to bypass a minefield. You thought a lot about it, but your thinking was emotionally charged with little rational reasoning. From now on, you are apt to attempt to breach any minefield you encounter regardless of the circumstances. A third reaction would be to apply some of the principles of Practical Thinking to this experience:

"What must it have looked like from the enemy's perspective?
From my subordinates' perspectives?
What wrong assumptions did I make?
Were there any biases in my thinking?
How could I have better controlled my thinking during the operation?
What principles and rules of warfare did I violate and why?"

The result of such a rational self-analysis of the experience is that memory for the event is enhanced and stored under many different knowledge structures. The relationships among these different categories of knowledge are examined and established. These learned relationships are now available not only for application in similar situations but, because of the rational way they were derived, for testing in those situations as well.

Acquisition of integrative thinking.

The above example illustrates how the sort of relational knowledge required for integrative thinking is acquired. From the viewpoint of the cognitive psychologist, considered experience of any kind, be it on-the-job, classroom or self-development, can change our knowledge of the objects, attributes, and relationships within that domain.

We develop and alter our working definitions of the domain objects through these experiences. For example, for the typical inexperienced civilian, mention of the word "tank" in a

military context probably triggers some mental visualization gained from the movies or television, perhaps of a WW II Sherman. For the supply officer its mention may recall the fuel consumption rate for the M1. For the armor officer, what a "tank" means is so rich and stored in so many different knowledge structures that there is no consistently specific meaning that is recalled. For this person a more specific context might be needed before they are willing to conjure up any image at all.

Much of what creates this diversity in object definitions are the number, types and definitions of attributes the mind has associated with the object. To use the example of the tank again, the inexperienced civilian's attributes may include: military, vehicle, metal, runs on "rollers", shoots a big gun, all of which can be comprehended in a single visualization. For the supply officer, who may have a very complex understanding of the physical attributes of the M1, the primary attributes recalled are probably in terms of fuel and ammunition, various spare part consumption rates, and the physical requirements for resupply. For the armor officer, the attributes would include these plus a host of maintenance and operational characteristics.

Objects and attributes can further be combined into concepts.

"Concepts are mental representations of classes (e.g., one's beliefs about the class of dogs or tables), and their most salient function is to promote cognitive economy (Rosch, 1978). . . . Another important function of concepts is that they enable us to go beyond the information given (Bruner, Goodnow & Austin, 1956). . . . Concepts, then, are recognition devices; they serve as entry points into our knowledge stores and provide us with expectations that we can use to guide our actions. . . . A third important function of concepts is that they can be combined to form complex concepts and thoughts (e.g., Osherson & Smith, 1981)." (Smith, 1988, pp 19-20)

The more detailed and varied the object definitions and attributes assigned to them are, the more accurate and varied the cause-and-effect relationships between the objects and their environment can be. About all the inexperienced civilian may be able to say about the use of the tank is that it can knock down brick walls, but is easily defeated by Audie Murphy with a hand grenade. The experienced supply officer is able to study the terrain over which the tanks must travel and types of operations they will probably be engaged in over that terrain and make a reasonable estimate of the actual fuel, ammunition and spare part resupply rates they will require. The experienced armor officer can look at that same terrain and mission requirements and infer movement rates, choke points and obstacles, observation and engagement ranges, overwatch positions, support requirements, probable losses, probability of successful mission accomplishment, and so forth.

What this suggests is that there is no substitute for knowledge in being able to do accurate and comprehensive integrative reasoning. This knowledge is developed by Practical Thinking about experiences.

Two seemingly opposite but highly related skills develop as a result of acquiring this knowledge. One is the ability to *integrate*. The other is the ability to *differentiate*--the ability to correctly decide when a rule, procedure, or action does not apply--factors that cause relationships to be broken. These two processes support each other in the continued building and application of domain knowledge. For instance, the strategy of taking the offensive is well ingrained as one of the principles of war. The officer learns its effectiveness through classroom teaching, historical examples, exercise and battlefield application. It becomes part of the

knowledge structure, applied where it seems applicable in COA decisions. As experience with different operations grows, the officer learns there are situations where offensive mindedness will probably not work--the application of the principle begins to be differentiated.

An example of this happened a few years back when a division was going through a war fighting exercise (WFX). The scenario took place in mountainous terrain in northern Iran. The Commander was expected to go after the enemy aggressively. Instead, because of the terrain, he decided to let the enemy come to him, much to the chagrin of the training personnel. The division was able to defeat the enemy with relatively few casualties. Knowing under what conditions typical relationships will not apply is, perhaps, a step beyond knowing the relationships themselves and is another mark of expertise gained through reasoned experience. In fact, it is a further refinement of relational knowledge and very much a part of integrative thinking.

Integrative thinking and expertise.

There are many personality and character qualities that either enhance or inhibit the effective application of knowledge. However, the possession of domain knowledge, organized in the mind in a way that it is readily recalled and used in problem solving is a necessary, if not sufficient, ingredient to become an expert in job performance.

Many studies have found no significant relationship between domain expertise and IQ (intelligent quotient) as long as IQ is above some baseline (for example, Glover, Ronning & Reynolds, 1989; Sternberg, 1986). Studies have also found that expertise in one domain does not enhance one's ability to quickly become an expert in another, unrelated domain (Gaines, 1987; Sternberg, 1986). What this suggests is that the development of expertise involves interest, motivation, and hard work (also see Simonton, 1994)--all of which set necessary conditions for learning from experiences.

But as was shown earlier, the application of Practical Thinking techniques to learning experiences is a major determinate of how knowledge gets organized in the mind. Conscious, goal-directed control of thought processes with a concerted effort to discover and eliminate biases in reasoning and to understand the problem from many perspectives are the best safeguards against developing misunderstandings which are often difficult to correct.

Beyond this, research suggests that experts are good practitioners of Practical Thinking. Some of the findings that suggest this are:

1. Experts are proactive in seeking information and look more for disconfirming information than non-experts (Bazerman, 1985).
2. Experts actively challenge assumptions and question information sources (Kirschenbaum, 1992).
3. Experts are more flexible than non-experts, willing to adjust their understandings and decisions based on new information (Shanteau, 1988).
4. Experts plan ahead, budget their time (de Lisi, 1992).

All of these are suggestive of someone with good Practical Thinking skills.

Integrative thinking and intuition.

Two other research findings about expertise are that experts are faster at solving problems in their domain than non-experts (Gentner, 1988) and that the more competent experts become, the less able they are to describe the knowledge they used to solve a problem (Sternberg & Frensch, 1992). These two findings relate to the phenomenon of *intuition* which Webster defines as "the act or faculty of knowing without the use of rational processes: immediate cognition."

Consider a couple of common skills. Adults tie their shoes quickly and effectively without thinking about it and can perform the task while occupied with some other thought or conversation. If required to teach a young child how to do it, the average adult has to "go through the motions" to remember how to explain it. This is because it is such a well-practiced skill that it no longer requires conscious reasoning unless something goes wrong in the process. Even such a complex skill as driving a car under various conditions becomes habituated to the point where we can find ourselves not remembering the last several miles of a familiar trip because we were deep in thought.

Consider a common staff skill such as interpreting a terrain map. The skilled practitioner may glance at such a map and make a qualitative comparison between possible avenues of approach with little conscious reasoning. This is because the attributes of a standard terrain map and the relationships between avenue width, vegetation, obstacles, slope, types of units accommodated, and movement rates are so familiar to some through learning and use that they do not have to be consciously considered.

For the expert, much of what the rest of us have to consciously ponder and agonize over already exists in highly developed, integrated and reinforced knowledge. Environmental cues activate this knowledge producing an interpretation, understanding or solution that is the only thing that reaches conscious awareness. This is also a highly efficient process because the "stream of consciousness" is necessarily linear--one thought at a time, whereas unconscious "reasoning" does not appear to have this limitation. Having never reached conscious awareness, the expert is unable to recount the reasoning process involved. Although he or she may be able to infer the process after the fact by recalling the same knowledge structures.

So what we call "intuition", for the domain expert at least, is not some mystical conjuration nor a special quality available only to the gifted, but ought to be the result of much reasoned learning and practice.

Ways to improve integrative thinking and develop expertise.

Although the acquisition of integrative thinking ability and expertise in general will probably never be an easy or rapid process, here are some general guidelines that will help.

1. *Resolve uncertainties.* If you experience something in the classroom, in studying, or on the job that you do not understand, make an attempt to understand it. Ask questions, seek other sources, and think about it. This is not only the foundation for gaining expertise, it is also the primary reason why so few people become experts in their field. They do not take the time to resolve uncertainties.

2. *Look before you leap.* Spend more time in understanding a problem before you generate a solution. This is what experts do and it is directly linked to integrative thinking. If you do not know the nuances in a situation and how they differ from similar situations you have experienced, you do not have the basic information to reason about cause and effect. Experts typically spend more time than novices trying to understand a problem, when the problem is unfamiliar to them.
3. *Use practical thinking techniques.* Think about what might cause things to interact. What sets the expert apart from others in almost every domain is the ability to perceive patterns and to reason causally. The application of the techniques covered in the other lessons on Practical Thinking will be useful for this. For instance, the crystal ball technique to find hidden assumptions allows you to reason about alternative causes for an event. Looking at the problem from multiple perspectives will also broaden the alternative relationships to be considered. When these relationships are being learned, conscious control of thought processes (using something like the GO FITE WIN technique) can help improve efficiency, completeness, and objectivity.
4. *Practice patience.* If deliberate attention is not a familiar way to think, it may come as a surprise that when you start thinking deeper, performance may actually worsen for a time. This is because well entrenched behaviors no longer allow just "getting by." It is like trying to change your golf swing to correct some error. Until the improved style becomes habituated, your game will probably get worse.

Motivation and attitude.

A retired General Officer who was an acknowledged expert tactician, told of when he drives down the road and sees a hill; he instinctively thinks about how he would attack it. You must love what you are doing to become an expert at it (Glover, Ronning & Reynolds, 1989). There is no substitute for this. Its motivation that keeps you thinking about your profession when you would not "have" to, or doing extracurricular reading, or not giving up and taking the easy solution when you know there must be a better one. As was said before, becoming an expert is not primarily a matter of IQ, but of long hours and effort. It is desire that separates the expert from the mere competent.

Shortcomings of experts.

Like in a lot of things, the experts' strengths also play a part in their weaknesses. Experts can arrive at decisions faster because much of their reasoning is so well practiced that it is done without reaching conscious awareness. Experts tend to do a lot of conscious reasoning only about rare events, ones for which they have no existing knowledge structures that will provide a ready solution. The typical process in familiar situations is that some set of cues in the situation triggers particular knowledge structures that contain interpretations or solutions early on in the process. This tentative interpretation or solution then drives the quest for confirming or disconfirming information and knowledge. Based on this further reasoning, the solution is refined or rejected for something else.

There are fallibilities that experts must remain aware of (metacognition) in this process. First of all, there are people who develop rich relational knowledge structures based primarily

upon "musing" about the subject with little empirical evidence to support their suppositions. Such people have a mindset to form elaborate interpretations of a situation based upon very little information. The more detailed and interconnected these interpretations become, the harder it is to change them based upon external evidence to the contrary. Such a person must be cued by failures in their "mental models" to pay more attention to external evidence.

The second fallibility is related to the first but is a more basic human shortcoming. Research has shown that simple linear models that only account for the most common relationships in a domain outperform experts on complex problems. A primary reason for this is that humans tend to jump to conclusions about the existence of a relationship based upon having seen one piece of evidence, or very little at best. We do not take into account the frequency of occurrence (base rate) in inferring a relationship (Johnson, 1988; Schustack, 1988). So a person can develop a belief that a definite relationship exists based upon one experience that was an anomaly. The model, that simply takes into account the probability, or base rate, of occurrence will thus be better most of the time. There are two things you can do to avoid this error. First of all, be aware of it, use the external sources available to you to help you determine probabilities, or at least, relative frequency. Secondly, what humans *are* good at is causal reasoning, determining why a relationship exists. So something like the crystal ball technique can be used to test what else could account for the apparent relationship before jumping to conclusions.

Levels of integrative thinking.

The fact that no one can become an expert overnight in a complex domain suggests that there are levels of development in acquiring domain knowledge. The following explanation divides the development of domain knowledge into five stages or levels of ability and describes them in terms of the types of knowledge structures that are prevalent, how decisions are typically made at that level, and other characteristics (see Figure 7). Progression through these levels is primarily a matter of interest and effort.

Level I. Reliance on Authority. *"I only know what I read."*

The neophyte has probably read one book or talked to one experienced person and this is his or her source of knowledge.

Knowledge structures are simple facsimiles of what is retained about what the expert says.

Decisions simplify the problem to make it fit what has been appropriated from the source.

For example, someone buying a car at this stage of knowledge might reason something like, "My father always drove a (car model X) and we have always driven one. I see no reason to change now." There is no reasoning beyond quoting an authority figure and tradition.

Level II. Awareness of Complexity. *"No two people seem to agree and I don't know who's right."*

The layperson has now read other sources and/or talked to several experienced people who disagree on major points.

Conflicting, unintegrated knowledge structures may exist at this time.

Most decisions will probably still be derived from the original knowledge source as there

is no clear basis for refuting it, although now some biased justification is probably offered.

At this point, some ambiguity is introduced, but is more annoying than instructive. Exceptions to known rules are perceived and at least brought to mind, but no synthesizing knowledge structures exist to judge them.

With few exceptions, this is a transitional level--conflict causes a resolution of one sort or another.

Someone at this second level who is buying a car might reason something like, "You can get a lemon no matter what you buy, so we might as well go with what we're use to." The person realizes that it might not work out, maybe they've heard some horror stories from (car model X) owners, but they have no knowledge to further reason about it.

Level III. Reflection. *"It all depends, you just have to decide for yourself."*

The novice is attempting to resolve conflicting points of view and spending time consciously thinking about it.

Integrated knowledge structures are just beginning to form, and are very dynamic at this point, in a state of flux, so opinions are likely to change frequently.

Decisions now involve a great deal of conscious thought and effort, balancing and comparing different alternatives, which complicates and sometimes delays the decision. Justifications for decisions are typically disjointed and limited to the specific problem context.

There is now conscious consideration of ambiguities.

Exceptions to known rules are now openly considered and influencing the building of knowledge structures.

Uncertainty is now a motivator of thought.

At this level in the car buying problem, the reasoning might go something like, "There is a \$2000 difference in the asking price between the (first car model) and the (second car model), but the higher priced one gets a little better gas mileage. I don't know, maybe we'd better wait until they've been out awhile to see how each one holds up." This person knows two conflicting criteria on which to judge the two alternatives, but does not know how to resolve them. They also realize that other criteria exist but can't define them.

Level IV. Emerging Synthesis. *"I'm beginning to understand how it all works together."*

The journeyman is developing a broad understanding of the domain and is able to reason across situations using general principles.

More stable integrative knowledge structures are emerging and gaining both breadth and depth as successful applications and new experiences are added to them. More abstract knowledge structures are emerging that are applicable to a variety of situations.

Decisions now include elements of information not observable in the problem context. Broad ideas are used that help define and interpret the situation. There is a clearly recognizable explanatory theme. Ideas are integrated to define subcomponents of the problem. Comparisons between alternatives are made on the weight of evidence, utility, and pragmatic considerations. Justifications for decisions use evidence that is not all context-specific.

Ambiguities are now sought after as part of the reasoning process.

Exceptions to accepted rules are more readily incorporated into more differentiated and

integrated knowledge structures.

Uncertainties continue as a motivator for thought and better knowledge structures make resolution faster and more effective.

There is the emergence of the ability to make predictions as more refined knowledge structures take into account situation dynamics.

In the car buying example, someone at this level might reason something like, "With the low interest rates right now, the \$2000 difference in price doesn't mean as much as the last time we bought a car, so the better mileage of the (first car model) makes a bigger difference. The experts say the (first car model) is generally better built, but the way my son drives, (second car model's) better handling on the curves and braking has got to count for something." This person has the highly relational knowledge structures that permit's seeing how variables relate to each other. They are able to bring in more general and abstract factors like interest rates as well. The reasoning has now expanded to dynamic factors, like visualizing their son driving the car.

Level V. Mastery. *"I'm confident now that I can figure out almost any problem you can give me."*

The expert has a highly practiced deep and broad understanding of the domain and can handle a wide variety of problems routinely.

Knowledge structures of the domain are highly interrelated and exist over a broad spectrum of abstraction from situation-specific memories to broad principles and relationships applicable over the entire domain. At this point, the knowledge structures are relatively stable, changing mostly by broadening to take in new, unique experiences. Reasoning has a large unconscious element as well-practiced knowledge structures are activated and associated rapidly based upon cues from the environment. Decisions are based upon constructing cause-effect relationships that typically involve restructuring the problem from various points of view. Interpretations are arrived at by analogy, application of broad principles, and deep and broad knowledge of the domain. When faced with novel situations for which they have no ready answer experts are still typically more accurate than others because they have such a broad knowledge base to draw upon to form new associations and because of the quality of their reasoning processes. Handling and use of ambiguities, exceptions to rules, and uncertainties are much like the journeyman but they become more comfortable with these situations based upon increased experience and successful performance.

The highly integrated reasoning of the expert leads to improved predictions as they better comprehend the dynamic relationships among variables.

At the expert level, the reasoner is able to synthesize overarching viewpoints because they are able to comprehend the commonalities and differences between events or alternatives using their interrelated knowledge structures and practiced reasoning skills.

In the car buying problem, the "expert" (dynamic reasoning, not technical) might reason something like this, "We intend to keep this car for at least three years. Our son will have to buy his own car in less than a year, so we won't need to consider him. That also means the type of driving we will do will change considerably, mostly shorter trips to work and shopping--urban driving. The reduced mileage should keep up the resale value of the car, and even though (first car model) has a higher initial price, its much higher trade-in value will definitely offset the difference plus some. Also, the better high speed handling of the (second car model) doesn't mean much in urban driving anyway and the better MPG of the (first car model) is even more important with the stop and go driving." There is dynamic and predictive reasoning going on

here. There is a realization of an overarching truth that causes a reevaluation of the dynamics of the problem--their son won't be driving the car. All factors are now synthesized at this level to produce a single integrated picture.

Synthesis					Overarching viewpoints
Prediction				Recognize dynamics	Improved predictions
Ambiguity		Bothersome	Conscious consideration	Sought out	Increased use
Exceptions to rules		Perceived but not judged	Openly considered	Readily used	Increased use
Decisions	Simplify	From existing knowledge	Thought & effort	Use new information	Use different perspectives
Knowledge structures	Copy others	Unintegrated Conflicting	Initial integration	Breadth, depth abstraction	Highly interrelated
Experience	Neophyte	Layperson	Novice	Journeyman	Expert
	Reliance on authority	Awareness of complexity	Reflection	Emerging synthesis	Mastery
	Levels of Integrative Thinking				

Figure 7. Characteristics of integrative thinking levels.

Summary.

Integrative thinking is an advanced skill of understanding the relationships among events and objects where the relationships have not been made explicit before. Integrative thinking is a process. It does not rely on what one reads or hears but on how they think. Four ways were discussed to improve integrative thinking: resolve uncertainties, look before you leap, apply Practical Thinking techniques, and practice patience.

Five levels of integrative thinking are distinguished: reliance on authority, awareness of complexity, reflection, emerging synthesis, and mastery. The higher levels of integrative thinking involve the ability to deal with complexity and dynamics. They involve reflecting, knowing exceptions to rules, being flexible, withholding judgment, and making predictions. Uncertainty is not seen as burdensome. When there is uncertainty it is used to develop better understandings and to scope possibilities. Information that is not readily associated with a problem is brought to bear to assess situations or develop new solutions. The broad, deep, and well-practiced knowledge structures that good integrative thinkers use allow more 'sophisticated' reasoning. Integrative thinking synthesizes over-arching understandings and viewpoints.

Summary of Teaching Points

There were many teaching points and philosophies throughout the six Practical Thinking lessons. The following summarize some of the recurring ones.

Thinking is a uniquely personal commodity or resource. Improving thinking is not going to be done by listening to a collection of facts or reading about it. Improving it takes more than adhering to a sequence of procedural steps or mathematical algorithms. Improving thinking takes mindful effort; it cannot be left as a mystical, intuitive process that some have and some do not. Intuition is important to Practical Thinking, but it is primarily a label we use when we do not know precisely how experience and reasoning come together. Explicit consideration of thinking, reflection, and mindful effort can lead to improvement in thinking. Effort is required especially as an adult when thinking patterns and short cuts are deeply ingrained.

Improving thinking will take conscious, personal effort -- time to pause to think, to reflect, to introspect, to commit to form hypotheses about how to think. To improve thinking takes intrinsic motivation to want to find better ways of thinking, reasoning, deciding, and problem solving. The Practical Thinking lessons presented these foundational points and offered ideas and concepts for improving thinking. Many of these concepts may not be right for everyone, or some people may already consciously recognize and use them. Perhaps some people's thinking is personally advanced beyond the point where the lessons and their concepts are useful. Perhaps the concepts will bother others and motivate them to actively seek better concepts than those proposed here.

A metacognitive model was presented that was offered as a way of considering learning and preparing in advance for critical, time compressed situations. Metacognition requires an active, reflective, and generative learner and thinker. Conscious and deliberate effort to manage thinking can become a habit. One key aspect of managing thinking has to do with adapting thinking to contextual factors of a situation. GO-FITE-WIN can help remind us of important questions for "decision triage." *GO*: What are the *goals* of thinking? What *obstacles* need to be overcome? *FITE*: How *familiar* is the situation? How *important* is the outcome? How much *time* is available? What level of mental *effort* is required? *WIN*: What's important now?

Improving thinking will require the exploration of different ways of viewing the world. This premise will not always be consistent with conformance to doctrine and superiors, but the changing world requires clear, practical thinkers to anticipate what impending changes imply. Practical Thinking advocates breadth of thinking, possibility thinking, and critical thinking as ways to achieve good results.

Some educational factions or practitioners might equate critical thinking with cynicism and negativism, but this is a short-sighted view. Examining the weaknesses or potential flaws is a basic step in improving plans and safeguarding against potential problems. Just pointing out a potential flaw does a service, even if no solution is apparent. Perhaps the increased uncertainty will prompt additional questioning and problem solving. Or the recognition of uncertainty may increase vigilance and openness to realize new or modified options. Experts spend more time searching for a beneficial perspective on the problem when there is uncertainty.

Intuition was explained to be due to processes of learning, experience, and reasoning. Intuition is not some mystical gift. Intuition can be explained from knowledge that becomes abstracted and generalized; however, the precise mental processes are not clear. We do not

know beforehand that we know something or how we know it, but the knowledge affects how we feel and can provide insight to understand and create new solutions.

Critical thinking can reveal "beliefs" that rely on hidden assumptions. Hidden assumptions might be masking hidden problems or narrowing perspectives unnecessarily. Once multiple possibilities are identified the plausibility of the alternate explanations need to be tested.

Keeping track of unexpected events is a compatible skill. Certain beliefs or assumptions will go unrecognized and can disrupt expectations. Typically unexpected events are ignored as each occurs. People prefer closure so they tend to dismiss the oddities that do not fit with their understanding. Collectively the unexpected events might suggest something with quite different meaning. This is why unexpected events should not be dismissed as they occur, but tracked over time.

Our judgment, insight, or "intuition" can give a feeling to be concerned about our conclusions or those of others. The suspicious feeling may not be associated with any specific knowledge that indicates what might be wrong. To help "quick start" one's reasoning to identify critical problems, or to simply safeguard conclusions six questions can be applied to the problem: what if, what else, so what, what specifics, is there a weak link, what is unexpected? The questions can be used when there is a lack of critical thinking by others, which is a symptom of groupthink.

Integrative thinking is a term applied to the skill of seeing the big picture and deciding accordingly. Integrative thinking characteristics that are desired include the ability to resolve complexity, understand situation dynamics, reflect on meanings and future states, apply exceptions to rules, recognize that uncertainty is useful--not burdensome, and predict. Integrative thinkers introduce information that is not readily associated with the problem. They produce and use broad, deep, and well-practiced knowledge structures that allow more 'sophisticated' reasoning. Most importantly they combine these characteristics to synthesize over-arching viewpoints. Achievement of advanced integrative thinking is due in a large part to concentration on learning everything possible from all experiences.

These premises about thinking relate to attitudes. If attitudes are not simultaneously addressed the skills will not be used and improved. Thinking, or the lack of it, can be better understood by examining the attitudes that influence our desired beliefs. Some of these attitudes include fear of failure, ego maintenance, rationalization, and identification. If organizations do not cultivate healthy attitudes, then Practical Thinking skills will not contribute or flourish. Even in an environment that promotes multiple approaches, multiple perspectives, exploration of different interpretations, and open criticism, absolute decisions will still be needed. Practical Thinking can contribute to making the rapid, life-threatening decisions that are required of our Army's leaders.

Teaching Practical Thinking

Practical Thinking was incorporated as a subcourse in the Battle Command Course, A308. The Battle Command Course is described in the advance sheet booklet for A308. The advance sheets provide students with the goals, scope, learning objectives, and homework assignments, among other items. Figure 8 describes what the Battle Command course is about.

Description of Subcourse

Eight meetings were scheduled for the subcourse, totalling 17 hours of instruction time. (About 30 hours of instruction were originally requested to cover the topics.) The eight scheduled lessons included an overview (Lesson 1, 1 hour), taking multiple perspectives (Lesson 4, 3 hours), adapting thought to situations (Lesson 6, 1 hour), finding hidden assumptions (Lesson 9, 3 hours), characteristics of expertise (Lesson 11, 1 hour), practical reasoning (Lesson 12, 3 hours), integrative thinking (Lesson 16, 3 hours), and skill practice (Lesson 19, 2 hours). The lessons followed the concepts described in the previous sections of this report.

The primary topics of the lessons are outlined in Table 7. Developers and instructors of the subcourse included three ARI researchers and one CGSC instructor from the Leadership Instructional Department.

Relationship to the Battle Command Course

The implementation of the Practical Thinking instruction was complicated by the fact that it was combined with other experimental instruction.

Scheduling.

ARI lessons were scheduled for convenience on the A308 calendar, rather than for any consideration to an instructional model. As a result, continuity, coherence, and reinforcement of the Practical Thinking concepts may have suffered.

Class hours.

Several changes in the time for Practical Thinking occurred. Lesson 9 was shortened from three to two hours. Also Lessons 11, 16, and 19 were changed from 3 blocks to 1 block, and instead of 6 hours, there was only three hours available. Actual instruction for Practical Thinking totalled 12 hours, about 30 percent less than the 17 hours originally scheduled. The changes were made to allocate more time for other A308 activities including class meetings, SIMEX planning, and briefing preparations.

Conflicting goals.

The possibility of conflict with the other goals and initiatives of A308 was anticipated. There were many initiatives in A308 that were not always in harmony. Other initiatives

GOAL

A308 is designed to increase the students understanding of the art of tactical battle command and how it will be practiced in the 21st century.

SCOPE

A308, Battle Command, is a 180-hour elective that is designed to prepare students to function as competent and confident leaders on the battlefields of the 21st century. It builds on previous Command and General Staff Officer Course (CGSOC) instruction and will familiarize students with the decision support systems, equipment, and tactical organizations that the Army is developing to meet future warfighting requirements.

This course will be in three phases and will span both terms 2 and 3. These phases are designed to mold a group of students into a high-performance staff. The course will consist of 22 lessons which will be broken out among these 3 phases. The class will meet three times a week during the afternoon modules. Throughout this course the students will be assigned to specific positions within the mobile strike force (MSF) and will develop the expertise needed to excel in those positions. The MSF will be the tactical vehicle for developing the students. The A308 class members will serve as the MSF commanders and staff for the Prairie Warrior (PW) 95 exercise. The Army Research Institute (ARI) will have a unique role in this course. They will discuss with students new concepts in making decisions. The class will discuss the human dimensions of decisionmaking and will explore new concepts for making decisions utilizing the battle command tools provided. The guest speakers will address critical decisions that they had to make during their careers. Students will receive background information on those decisions, and we will discuss them prior to the arrival of the guest speaker.

The first phase (Jan-Feb) will focus on core doctrine required of all area of concentration (AOC) combat arms (CA) and combat service support (CSS) students. In addition we will discuss the battle command concept and human dimensions of command, and we will introduce the student to the MSF. Students with a CA AOC will be taught the key doctrinal concepts of A301, 304, and 305. Students with a CSS AOC will be taught the key doctrinal concepts found in A459. The core doctrine instruction will end on 2 February 1994. A308 will then focus on the MSF and its decision support systems. Students will learn to use the battle command tools being developed for the 21st century. Students will also learn to function as the MSF staff and its supporting major subordinate commands (MSCs) and how to employ the MSF on the battlefield. At this point simulation exercises (SIMEX) using corps battle simulation (CBS) will be the principle means of instructing the students.

The second phase (Mar) will address specific battle command competencies needed to support the MSF. Again a SIMEX will be used to help develop these competencies. We will discuss insights into the art of battle command that are evolving from current experimentation, research, and leader development programs. Guest speakers will be brought in to discuss with the students key decisions they made as commanders and how they came to make them.

The third phase (Apr-May) will consist of the competencies and skills addressed in the second phase. April will focus on SIMEX3, which will be the dress rehearsal for the PW 95 exercise. ARI will conclude its instruction with a series of practical exercises designed to reinforce the concepts that the students have been taught. A final set of guest speakers will be brought in to discuss with the students key decisions they made as commanders. The course will end with a two-day after action review (AAR). This phase will end on 10 May, and the students will transition into the PW 95 exercise.

(p 1, U.S. Army Command and General Staff College, 1995)

Figure 8. Course description for Battle Command.

included the introduction of new organizational structure; new staff structure; new employment doctrine and tactics, techniques, and procedures; projection of 2015 weapon and system capabilities; test bed for automated decision support systems; and simulation-based exercises.

The Practical Thinking concepts received little command and organizational emphasis compared to these initiatives. There was minimal reference to Practical Thinking by other A308 instructors during working sessions and command post exercises. Also Practical Thinking instructors were encouraged not to interact with the MSF students other than during Practical Thinking classes. There was little participation by other A308 instructors in the Practical Thinking lessons. Only one of the four homeroom instructors took part in the class discussions. The students' attentions were directed toward the warfighting innovations of the MSF, rather than the explicit development of leaders.

Even though many of the students acknowledged utility of the Practical Thinking concepts, many felt that they were discouraged by the instructors and command environment from practicing many of the concepts, such as thinking "outside the box" or applying a new perspective.

Challenges

This subcourse involved the challenge of developing material from a theoretical and research base to a very applied and complex domain of battle command. The need for this course originated from many chances to observe battle command performance, and the concepts were developed from naturalistic and everyday reasoning paradigms. The result was the selection of topics and content that were considered to be relevant. Supporting materials were selected from a wide range of sources including critical thinking, creativity, informal and everyday reasoning. Although many of the concepts existed in texts and research reports, none of the material, with the exception of finding hidden assumptions, had been applied and developed for a military context and none had been previously related to the MSF. It was a significant challenge to develop materials that were consistent and relevant for cognitive skill development, emerging theories of naturalistic decision making, and battle command problems.

Instructor Assessment

The subcourse authors and instructors thought that overall the pilot implementation was promising. Most material appeared to be well-received by the students, though there was a notable difference in the interest students showed.

Lessons.

Instructors felt that different lessons stood out as best, probably reflecting their own interest and enthusiasm for particular material. The most difficult lesson was unanimously judged to be adapting to situations (metacognition). It was easy to fall into solving the problem instead of focusing on how to think about one's mental strategy. The abstract nature of metacognition made it difficult to demonstrate the skill's potential value. Instead of having a separate lesson, the teaching points on metacognition could be incorporated into the review of exercises. Alternatively, the lesson could focus on the extreme situations where nonroutine

procedures and skills must be invoked. Several instructors tried this with discussions of heuristics to use for critical, time compressed situations.

The practical reasoning lesson is arguably the most central component of the Practical Thinking subcourse, yet could be assessed as least meeting author expectations in content. The point of the lesson has important theoretical implications, but explicit skills to guide reasoning were difficult to determine. The lesson was received well, but it did not go far enough in helping to build reasoning skill. Instruction could be strengthened by more explicit relationship of the components (reasoning standards, attitudinal pitfalls, and reasoning fallacies) to the students' own reasoning.

The students' application and evaluation of the Practical Thinking concepts could be improved by increasing the personal experience that the students have with the concepts. This could be achieved by requiring the application of the skills outside of class and then reporting back about discovered advantages and disadvantages. Also individual problem assignments and short discussion papers for all lessons would give instructors the opportunity to provide feedback to each student.

Readings.

Initially the philosophy was to use readings (see Table 22) sparingly to minimize students' study load. Plus materials corresponding to everyday reasoning and specific lesson topics were scarce. With the reduction in class time that was experienced mid-way through the course, special readings were prepared by the lesson author that directly addressed the rationale and description of the lessons. The concepts were then reviewed, applied, and evaluated during class time. These focused read-aheads put the students and instructors on common ground and allowed a better pace to critically apply and evaluate the concepts. All the readings were judged by the students responding to the ARI end of course evaluation to be clear and relevant to the lessons. In future lessons, focused read-aheads for all topics, combined with out-of-class assignments should improve acquisition of the skills.

Class size.

The 18 to 19 students that were in each instructor's early classes made it difficult to conduct the exercises and discussions as desired. When class sizes were smaller (8 to 12) the quality and quantity of discussion increased remarkably. In a larger group it was difficult to elicit comments from every person or even from every group. Some individuals were reluctant in the larger classes to participate, perhaps because the discussions were not as well focused.

Material and time.

There was not enough time to cover all the material and exercises prepared for a class. Instructors adapted the teaching of the lesson to fit the time available. Often instructors did not include prepared exercises or sufficiently review thinking practices with students after exercises because of the lack of time. The amount of material to be covered may have been greater than what the students were used to.

Table 22.
Reading Materials for Students.

Lesson	Reading/Handout
Introduction	Strategies of Decision Making. Klein, G. (1989). <i>Military Review</i> . pp 56-64.
Multiple perspectives	The Planners. Regan, G. (1987). <i>Someone had blundered</i> . London: Batsford. pp 76-99.
	Techniques for Multiple Perspectives. Lesson author description. p 1.
Adapting to situations	GO FITE WIN. Lesson author description. p 1.
Finding hidden assumptions	Probing presumptions. Neustadt, R. E. & May, E. R. (1986). <i>Thinking in time</i> . New York: Free Press. pp 134-156.
Practical reasoning	Practical Reasoning. Lesson author description. pp 1-8.
Integrative thinking	Integrative Thinking. Lesson author description. pp 1-6.

Self-Awareness.

Some students seemed to lack an appreciation that they would be subject to problems of thinking. If so, it would not be unexpected that they felt that the skills were not compelling enough to consider trying and adopting. Assessment of students' *thinking* is a difficult issue. Negative assessment could discourage the student about something as important and personal as her or his thinking style. On the other hand little or no assessment may only reinforce poor tendencies. A self-diagnostic instrument would be useful to give an individual some insight into his or her style of thinking and accompanying pitfalls.

Qualifications.

Teaching Practical Thinking requires a switch for both students and instructors. Practical Thinking is not so much taught as it is modeled and encouraged by instructors and self-learned by students. Instruction needs to reinforce critical thinking and the production of different ideas. Practicality, suitability and plausibility are important aspects of judgment in Practical Thinking, but not at the cost of lessening the development of critical insight and broad views. Regardless of who instructors are, training would be beneficial on how to best facilitate and diagnose critical and creative thinking during exercises.

Student Assessments

At the end of the subcourse a six page evaluation survey was distributed. Twenty students replied to this survey. Students gave predominantly positive ratings for the interest of

the topics, the mix of theory and application, the level of difficulty, and the coverage of the topics (see Table 23). The students who responded rated the usefulness of the concepts for MSF SIMEXs as 2.8 (on a 5 point scale, with 2=not very useful, 3=of use). They rated the usefulness as 3.2 for future command and staff assignments and everyday situations (3=of use, 4=of considerable use).

Given the limited integration, reinforcement, and attention that was afforded the Practical Thinking instruction, it still had a positive effect. On the average, student self-reports reflected a gain of 12.5 percent in expertise for the six lessons (see Figure 9). Of the students who responded to an end of course survey, eighty percent (16 of 20) felt that the course should definitely be included in future CGSOC classes.

The overall comments offered by students ranged from "this is needed by all CGSOC students" to "don't waste my time." Most comments indicated that the material has merit and potential applicability. Many of these positive comments also provided suggestions about how to improve the implementation. The course was seen as too fragmented in its implementation in A308. One respondent indicated a preference for a military instructor.

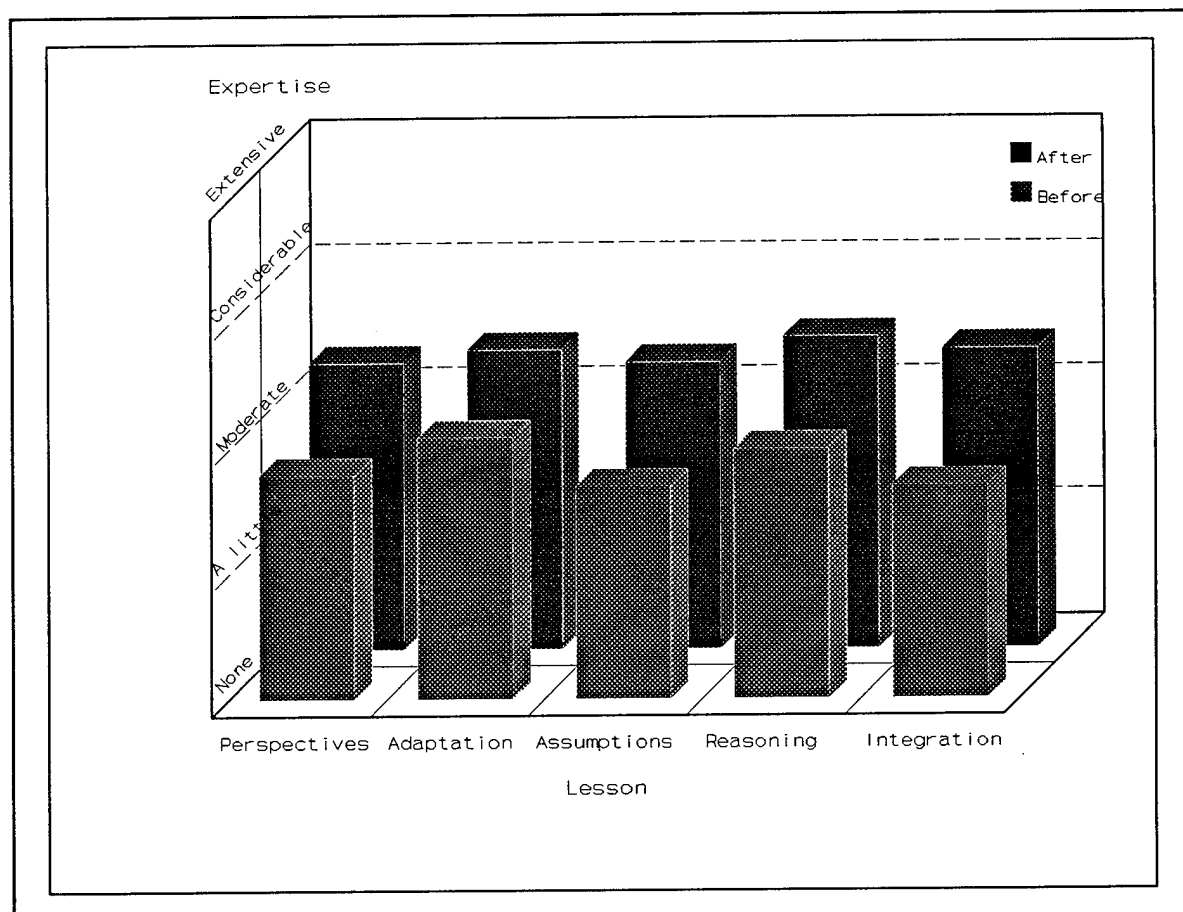


Figure 9. Self-reported expertise before and after instruction.

Table 23.
Frequency of Student Assessment Ratings for Practical Thinking Lessons

Rating Categories	Lessons				
	Multiple perspectives	Adapting to situations	Finding hidden assumptions	Practical reasoning	Integrative thinking
Mostly already familiar	11	12	8	9	5
Somewhat new	7	5	9	9	10
Mostly new	0	1	1	0	3
Not interesting	3	4	3	3	4
Somewhat interesting	12	14	12	12	10
Very interesting, thought-provoking	3	0	3	3	4
Too abstract	2	1	1	2	3
Mix of theory and application was about right	15	15	15	14	14
Too applied	0	3	1	1	0
Too difficult	0	0	0	0	0
Appropriate level of difficulty	13	12	14	13	14
Too simple	5	6	4	5	4
Too much of topic covered	0	0	0	1	1
Appropriate coverage of topic	13	14	13	12	12
Too little of topic covered	3	3	3	4	3
Too much time	5	6	4	4	3
Appropriate amount of time for material	10	9	10	11	11
Too little time	3	2	3	3	2
Need more practice	3	2	3	3	2
Appropriate amount of practice	11	11	11	11	12
Need less practice	3	4	3	3	3
Need more discussion	3	3	3	5	4
Appropriate amount of discussion	9	8	9	7	9
Need less discussion	5	6	5	5	4

Four of the 20 regarded the intent and approach of the practical thinking lessons nonessential. They felt that the instruction would be appropriate earlier in their careers and that thinking as a Major is so ingrained that there is not much chance of changing it. There were additional unfavorable comments on the overall course and the Practical Thinking subcourse recorded on a CGSC evaluation (Evaluation and Standardization Division, in preparation).

Those indicating that the course should be offered in the future were mixed about the type of class. Some thought it should remain a part of A308. Some were adamant that A308 was not the place for it. These students thought that (1) the MSF did not allow the Practical Thinking concepts to flourish, (2) there were too many other agendas in the MSF, and (3) the existing command environment constrained the implementation. (The "relatedness" of the subcourse to the rest of A308 was rated a 2.7 on a 5 point scale, between "slightly unrelated" to "somewhat related".)

One student found it surprising that the concepts of practical reasoning were taught, but then suppressed during wargaming. This student continued, "The Army's institutional culture and institutional dogmas continue to ignore the benefits of such concepts and training." Others thought it should be a core course that all students would benefit from. Others wanted additional material for continued self-development. Some examples of the positive comments follow.

"Provide to entire CGSC academic environment."

"All CGSC students could use this information and practical experience before going to units."

"I wish I could get future lesson plans and classes to continue my professional development. The ARI portion of A308 was the most beneficial."

"The skills needed for integrative thinking requires years, not just a few classes. Need follow through instruction and self-development packets."

"Focus on thinking first. This will help bridge the technology gap early. I thought all of the ARI instruction was very useful and I wish there could have been more. I got more from the ARI instruction than I did from A308 in terms of preparing me for my next duty assignment."

Identifying Additional Skills

The current set of topics for the Practical Thinking instruction is not complete. To get an idea what additional skills might be appropriate, students were surveyed on 15 new topics generated by the subcourse author. The students were asked which would be most important to include in future classes. The students were given a four point rating scale from *very unimportant* to *very important*. They preferred the more applied topics (see Table 24), specifically, visualizing the battlefield, maintaining focus in crisis situations, and applying practical thinking to leadership. The next highest rated skills fell into a group that would be more compatible with the emphasis already included. They were learning and memory, implementing creative ideas, discovering problems, asking questions, and resolving conflicts. These topics were close behind the top three skills.

Developer Assessment

As indicated in the summary of cognitive instruction programs, Sternberg (1984) proposed criteria for selecting a program of instruction. He provided nine guidelines for selecting cognitive instruction programs:

1. The program should have a sound psychological basis for what skills to teach and an educational theory for the way they will be taught.
2. The program must accommodate the specific population that it is designed for. Students must be able to relate the skills to themselves and to the world in which they live.
3. The program should provide explicit training in the cognitive and metacognitive skills. An important factor in metacognition is teaching when to use the skills.
4. The program should adequately motivate the students.
5. The program should take into account individual differences.
6. The program should make explicit links between the skill and the real world.
7. A program should be chosen based on a demonstrated track record in similar situations.
8. The program should have a well-tested curriculum for teacher training.
9. Expectations should be appropriate for what the program can accomplish.

Since this Practical Thinking program was developed, it is appropriate to consider these criteria for assessing the first trial of this material.

Table 24.
Ratings of Importance of Future Lesson Topics

Topic	Average Rating
Maintaining focus in crisis situations	3.3
Visualizing the battlefield	3.3
Applying practical thinking to leadership	3.2
Improving learning and memory skills	2.9
Implementing creative ideas	2.8
Discovering and recognizing problems	2.8
Asking questions to explore possibilities	2.7
Managing and resolving conflicts	2.7
Making predictions	2.6
Forming/testing hypotheses & working assumptions	2.6
Understanding the role of personality and emotions in thinking	2.6
Mentally simulating planned actions	2.5
Improving shared understanding	2.5
Using individual thinking skills in groups	2.5
Use representation techniques to structure problems	2.3

Instructor assessment of Sternberg's criteria.

1. *Psychological and educational theories.* The first of Sternberg's criteria recommended that the program be based on a psychological theory of the intellectual processes it seeks to train and on an educational theory of the way in which the processes should be taught. This development focused more on the rejection of conventional instructional models, such as normative decision theory and formal logic, than adhering to any one alternative model. The

program was associated with improving cognitive skills that conformed with naturalistic and everyday reasoning approaches. These areas are not particularly finite to provide absolute guidance for instructional programs. A naturalistic approach is not meant to be prescriptive and should not be expected to lay out specific thinking processes. Perhaps the most notable accomplishment of this Practical Thinking program was the advancement of the identification of skills corresponding to the theories appropriate for battle command.

Considering the educational basis, the cognitive instruction program tried to follow an andragogical model instead of a pedagogical one. The intention was to increase students' responsibility in the learning process and to rely on their intrinsic motivation and self-awareness for adoption and improvement of skills. The actual application did not conform to these principles as closely as was hoped. Future instruction should take greater latitude in trying alternative instructional practices for this subject matter.

2. *Target population.* The second of Sternberg's criteria recommends that the program should be appropriate to the student populations for which it is targeted. The instruction was geared for mid-career staff officers and future commanders of battalions and higher echelons. Many tactical examples were used to convey teaching points. A wide range of Army examples were included across the subcourse, relating to previous experiences students might have had at platoon and company levels and might likely have in the future as staff or commander at battalion and higher levels. Also common, everyday examples were included that everyone in the population were sure to understand (such as driving a car, dieting, sports, etc.). Yet there did seem to be some disconnects with the students. There were signs that some students did not accept the instruction as worthwhile. This could have been due to a variety of reasons, including those already mentioned, e.g., lack of organizational emphasis, competing demands, lack of fit with the rest of the battle command elective, or approaches that differed from the decision making approaches taught elsewhere.

3. *Cognitive skill training.* The third criterion calls for explicit training in cognitive and metacognitive skills. The program development emphasized this approach as indicated in rationale and description of the lessons. This application was good considering that it was the first attempt to make battle command thinking skills explicit. Undoubtedly, great improvements can be made in the identification and instruction of the skills, especially the metacognitive ones.

4. *Motivating students.* Sternberg also recommended that a program should be responsible to the motivational needs of the students. Some believe that it is impossible to motivate others, you can at best only show them how to motivate themselves. The students were shown the purpose of the lesson and skills and the value of overcoming the problems and obstacles. The majority of the students were probably not highly motivated when it came to the Practical Thinking instruction. Their concerns were more immediate as they served on the semblance of a division staff and interacted daily with the Division Commander who directed their attention on specific actions.

5. *Individual differences.* The fifth criterion deals with individual differences. Sternberg feels that a program should be sensitive to individual differences. The instruction did this by emphasizing that thinking skills are individually and situationally dependent. Students were encouraged to examine their own skills. This was a strong point of this program, but could be improved if students could be tested and feedback provided on their thinking styles and abilities.

6. *Links to the real world.* The training should have direct links to the real environments in which they will be used. The approach taken in this program was to illustrate and exercise the skills in representative command and staff settings, like the National Training Center. There is an inherent problem in that thinking skills consist of subtle processes that are not usually thought about by the thinker. When the skills are made explicit they can be linked to real-world problems (or at least analogs of real-world problems). Because of differences in individual knowledge and reasoning abilities, the links could appear to be more artificial than real.

7. *Successful program.* Sternberg's next criterion indicates that programs should be selected based on a good track record. In this Practical Thinking program, teaching points were based on the requirements analysis and in part the identification of good ideas from other programs. There was no entire existing program that was appropriate for this application. The lessons were a good first cut at a set of topics. The material within topics needs to be screened to focus on a smaller set and this set explored in more depth during lessons. With the experience from this first trial, experience-informed judgments can be made about material that has greater potential than others. Future applications should take into account the experiences with this program.

8. *Teacher training.* Another selection criterion proposed by Sternberg is that the program should have a curriculum for teacher training. Since the developers were the teachers in the quick response development, it was not as critical to have an explicit training program. The teachers reviewed the material together for each lesson and shared ways of personalizing the lessons. Currently teacher training consists of extensive background reading. Beyond training, there is probably a critical selection factor for teachers. Key to future uses of this program will be teachers who understand and generally agree to the Practical Thinking philosophies. Teachers should have the ability to encourage discussions using the characteristics of critical and creative thinking. Also they should be able to assess these skills and give feedback as they occur.

9. *Realistic expectations.* From the beginning it was anticipated that the expectations of the cognitive skills instruction might be greater than a limited first application could deliver. The difficulties of cognitive instruction were identified in the requirements section of this report. We said that developing cognitive instruction will be difficult because:

Theories of cognition are not well integrated or differentiated.
Any change in behavior will be difficult to observe and will occur over the long term.
Changes to thinking will initially cause delays and more effort.

These anticipated limitations were borne out. Assessing the skills covered in the instruction were relegated to occasional observation during simulation exercises and self-report methods.

Summary.

The major accomplishment of this work is the development of the cognitive skill instructional material. This instruction provides a unique application of an alternate view of thinking, reasoning, and deciding to battle command and the consideration of new Army technologies and organizations.

As Nickerson (1984) points out, "Putting greater emphasis on the teaching of thinking

skills in the classroom is a healthy development in U.S. schools. It should be recognized, however, that the quest is an ambitious one and that a great deal of experimentation will be required before truly satisfactory results can be obtained." (p 36). This last statement sums up nicely the status of the Practical Thinking program.

Recommendations for Cognitive Skill Instruction

The Practical Thinking concepts were not embraced by all students, but overall the favorable impressions outweighed the negative. The subcourse authors and instructors learned valuable lessons about increasing the relevance and utility of the concepts and detected good and bad ways to present the material. The generally positive reaction leads ARI to conclude that the concepts should be continued to be explored and implemented. There are several new efforts that are suggested by this application.

Assessment of Thinking

While it might be important to test intelligence or thinking abilities, objective testing may have limited application for Practical Thinking. Much of the rationale of this instruction (especially the integrative thinking lesson) is that Practical Thinking is not uniquely associated with high intelligence (IQ). Perhaps instead of testing intelligence, what ought to be assessed is the style and dispositions of thinking. Existing tests of critical thinking (e.g., Cornell Critical Thinking Test [Ennis & Millman, 1985] and the Watson-Glaser critical thinking appraisal [Watson & Glaser, 1980]) rely on the rules of formal logic for most of their test constructs. These tests are easy to score but miss the point of critical thinking and multiple perspectives, because they only give credit to a single answer that presumably corresponds to the "rational" model of systematic and logical thought (e.g., see Norris, 1991). Also they do not incorporate rich enough situations or context to make the test items representative of everyday thinking. Instead of assessing objective reasoning, it may be sufficient to differentiate among thinking styles. Existing frameworks and measures of thinking style are not particularly broad, only assessing a single or few dimensions corresponding to narrow theories. There are no known instruments that take a more comprehensive approach for measuring the styles of everyday thinking. Frameworks and survey methods need to be developed to be able to gather diagnostic information about the instruction. Particularly important to determine if there are individuals that are not reachable with the Practical Thinking approach.

Implementation of Practical Thinking

Practical Thinking will possibly never be the favorite of some students, no matter how much the subject matter, presentation, or integration with tactics are improved, however, the value of developing problem solving skills should not be ignored. One important question that we hoped to get insight into was the appropriate place for Practical Thinking in officer education. We asked the students to rate the appropriateness of including creative and critical thinking concepts in the various Army schools. The responses covered the range of Army schools. Tied for the highest were the service academies and the Army War College. Next was the School for Advanced Military Science (SAMS) and tied for fourth were CGSOC and the officer basic course. Most striking about these results was that the average ratings of appropriate timing for the instruction were about equal. The implication is that elements of Practical Thinking could continue throughout a leader's career. Perkins (1984) points out a supporting point that "[B]y far the better, although more difficult, path is to revise normal schooling to foster creative thinking in all subjects" (1984, p. 22). Similarly, the Practical Thinking concepts are suitable in all phases of Army education and many types of CGSOC classes.

First, repeating the application in the Battle Command Course, A308, is appropriate. Now that various Practical Thinking concepts have been tried, it is clearer how to make teaching points more practical. Some topics need to be more focused and covered in greater depth. A 20 hour block of instruction (see Table 25) should allow adequate time to address fundamental concepts and for students to have more time to try out and assess some new ways of thinking appropriate to the MSF. Inclusion into A308 would benefit from front-loaded scheduling, continuity in lesson schedules, deliberate integration with MSF activities, and reinforcement during SIMEXs. The last two imply that the MSF course authors and instructors should become more familiar with Practical Thinking and support its application. The proposed 20 hours of classtime should be augmented by placing more of the learning responsibility on the students with increased writing and practical exercise assignments.

Since the affinity for this material was split, a second line of implementation would be to provide Practical Thinking as a stand-alone elective. Those students who are interested in improving their thinking would make a good target audience for the course. An elective would be a good mode for continued exploration and formation of the concepts.

Another option is to incorporate the concepts of Practical Thinking into the leader development curriculum. Merging of these concepts into those in C710 and A716 would further reinforce the understanding and utility of alternate ways of thought. Some concepts have already been transitioned into leader development courses.

One change may be increased attention to individual instruction on thinking instead of using the group instructional model. GEN Franks' request was to determine how to formally transmit the art of battle command and teach it at our institutions. This is only one way of approaching the goal of improving leaders' thinking, reasoning, and decision making. An equally

Table 25.
Proposed Topics for Future Practical Thinking Lessons

Hours	Topic
2	Introduction (where used, why important, critical thinking & standards, creative thinking)
4	Multiple perspectives (barriers, creativity, when to use)
2	Metacognition (decision triage, crisis decision making, reorganization, value of concepts)
2	Hidden assumptions (what else, detailed exercise, unexpected events)
2	Practical reasoning (uncertainty)
2	Integrative thinking (quick start questions)
2	Visualization (prediction)
2	Diagnostic (before & after testing)
2	Review & assessment
20	Total

or more feasible approach may be to find ways of addressing cognitive skills through the self-development pillar of leadership development. Since the nature of this subject is more abstract and introspective than history and other topics taught using professional reading programs, ways to make the skills more explicit need to be explored. Self-development of cognitive skills might be a necessary piece to complement the staff instructional model.

Critical and creative thinking requirements most likely vary across an officer's career and certainly differ from individual to individual. It would be appropriate to consider a program of Army cognitive skill instruction geared to different ranks of officers. A series of modules on Practical Thinking would be appropriate to develop and apply across Army and other military schools. A simple approach would be to try the application at a lower level and a higher one.

Finally, without efforts like this trial subcourse there would not be opportunities to develop different instruction and to assess the attempts to discern what changes merit further consideration. If the development of Practical Thinking skills is to be successful it cannot be viewed as a one shot effort.

"Another problem with special-purpose programs is the very limited time usually invested. . . . The deeper difficulty may be that schooling in general works against the creative pattern of thinking. Accordingly, instruction designed to foster creativity has to make up for the shortcomings of normal instruction. . . . schooling is too 'right answer' oriented and has little tolerance for the maverick." (Perkins, 1984, p 21)

The implications from a cognitive skills approach are many. Should the naturalistic, everyday reasoning perspective catch on and be adopted beyond its role as an alternative to standard Army decision making instruction, and used to replace the limited procedural models, significant changes would result in command and staff procedures, training methods, and the design and use of decision support systems. Searching for new perspectives on how battle commanders and staffs do battle command, led to this instruction. This effort should not be considered as the closing of a chapter, but the sketching of a new map for bringing the Army's already-competent leaders to an even higher level.

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