Technical Report 1093

Tacit Knowledge in the Workplace

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March 1999

United States Army Research Institute for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the U.S. Total Army Personnel Command

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Research accomplished under contract
for the Department of the Army

Yale University

Technical Review by

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REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
March 1999	Final	September 1992 – December 1998

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Tacit Knowledge in the Workplace	MDA903-92-K-0125
	5b. PROGRAM ELEMENT NUMBER 0602785A

6. AUTHOR(S)	5c. PROJECT NUMBER
Robert J. Sternberg (Yale University); George B. Forsythe (USMA); Jennifer Hedlund (Yale University); Joseph A. Horvath (IBM); Trueman Tremble (ARI); Scott Snook (USMA); Wendy M. Williams (Cornell University); Richard K. Wagner (Florida State University); Elena L. Grigorenko (Yale University)	A790
	5d. TASK NUMBER 1111
	5e. WORK UNIT NUMBER C03

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Yale University Department of Psychology P.O. Box 208205 New Haven, CT 06520-8205	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. MONITOR ACRONYM
U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, VA 22333-5600	ARI
	11. MONITOR REPORT NUMBER Technical Report 1093

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

COR: Rex Michel

14. ABSTRACT *(Maximum 200 words)*:

This is the final product of a six year effort to define, assess and measure tacit knowledge for leadership among U.S. Army officers. Tacit knowledge is defined as knowledge grounded in experience, intimately related to action, and not well supported by formal training and doctrine. Tacit knowledge for leadership was researched at three different levels of command and developed into assessment inventories for each level. The assessment inventories have been construct validated and proven to predict certain leadership effectiveness ratings at each level and to do so better than measures of verbal reasoning ability, tacit knowledge for business managers, or experience. The report describes the constructs of "practical intelligence" and "tacit knowledge", other research related to them, the general methods used in assessing tacit knowledge, and the development of the Tacit Knowledge for Military Leaders inventories. There is also a chapter on the practical implications for leadership development and training. An expanded version of this report will appear as a commercially available book entitled, Practical Intelligence in Everyday Life by the same authors.

15. SUBJECT TERMS

Practical intelligence Tacit knowledge Leadership knowledge Leadership Leader effectiveness Leader training

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	211	Rex R. Michel DSN 552-9790

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March 1999

Army Project Number
2O262785A790

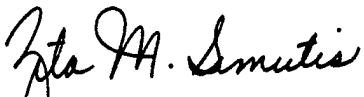
Personnel Systems and Performance Technology

FOREWORD

It has long been understood that expertise in any profession consists of more than formal schooling. What proficient practitioners have learned by actually doing their job is typically understood to be what gives them their performance edge. But this experiential skill and knowledge is rarely available in a form that can be shared with others to teach them what the expert knows. In fact, this kind of knowledge may not exist in the practitioner's mind in a fashion that can be abstracted from the situations in which it is applied. A means of capturing this "tacit" knowledge is needed to train less experienced people and help them assess their own "tacit" knowledge.

Army leadership experts from the Department of Behavioral Sciences and Leadership at the United States Military Academy and cognitive psychologists from Yale University expert in tacit knowledge have combined efforts under the direction of the Army Research Institute on a six year project to capture and instrument leadership tacit knowledge among Army commanders. The project has produced inventories for assessing leadership tacit knowledge at the platoon leader, company commander and battalion commander levels that are documented in detail elsewhere.

This report describes the Tacit Knowledge for Military Leadership project in the greater context of practical intelligence and tacit knowledge research in general. It clearly shows the contribution this joint effort has made to our understanding of a vital but elusive aspect of human performance.



ZITA M. SIMUTIS
Technical Director

EXECUTIVE SUMMARY

Research Requirement:

(a) To disseminate the methodology, results and products of the Tacit Knowledge for Military Leadership project to a wide audience of researchers, educators, trainers, and practitioners. (b) To describe the contribution of the Tacit Knowledge for Military Leadership project to the understanding of tacit knowledge and practical intelligence in general.

Procedures:

The constructs of "practical intelligence" and "tacit knowledge" are defined and described. The methodology used to identify, assess, measure and validate tacit knowledge is discussed using a number of domains. The unique contribution of the Tacit Knowledge for Military Leadership (TKML) project is demonstrated by comparing it with a similar project involving the tacit knowledge of civilian business managers. The TKML research is then described in detail. The implications of this work for tacit knowledge research, leadership development and training are then discussed. An expanded version of this document, containing a more detailed description of the theory, will be published as a commercially available book under the title of Practical Intelligence in Everyday Life, giving it a wide dissemination to many interest groups.

Findings:

The context of tacit knowledge is first set by reviewing the history of research into human intelligence, showing how theories of intelligence have evolved from a single general construct to recognition of different types of intelligence. Then "practical intelligence" as a type of intelligence is described followed by a discussion of how it relates to civilian business management. At this point the role of tacit knowledge in practical intelligence is introduced including a model of the cognitive operations of tacit knowledge. This is followed by a description of the methodology the authors have used to measure tacit knowledge. After describing the measurement of tacit knowledge in the civilian workplace, the Tacit Knowledge for Military Leadership(TKML) project is described. The processes and results of identifying, assessing, instrumenting and validating Army officer leadership tacit knowledge are presented in some detail. The report closes with a discussion of how the TKML products can be applied in self-assessment, classroom instruction and developing leadership skills in units.

Utilization of Findings:

This technical report provides a means of informing the defense community of the construct of tacit knowledge and the methods and results of research conducted to measure its effects. The commercially available book, Practical Intelligence in Everyday Life, which will contain the same content plus additional contextual explanations, will disseminate this information to a wider audience.

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Chapter 1
The Nature of Intelligence

Intelligence is generally defined as the ability to adapt flexibly and effectively to the environment. Although theorists of intelligence might disagree as to the exact details of this definition, most would accept the general idea that intelligence serves the purpose of adaptation. The origins of the contemporary study of intelligence were largely based in school settings (e.g., Binet & Simon, 1905; Spearman, 1904). The field has stayed, for the most part, school-based. Our goal, however, is to understand intelligence as it relates to performing everyday, real-world tasks. We begin by reviewing various theories of and approaches to studying intelligence.

History of Intelligence Testing

Certainly one of the most influential books of all time has been Charles Darwin's *Origin of Species* (1859). In it, Darwin proposed that the evolution of species and the development of humans could be traced to an evolutionary process of natural selection. The book profoundly affected many different kinds of scientific endeavors, one of which was the investigation of human intelligence and how it develops. Darwin suggested that the capabilities of humans were in some sense continuous with those of lower animals.

Darwin's cousin Sir Francis Galton was probably the first to explore the implications of Darwin's book for the study of human intelligence. Galton (1883) suggested that two general qualities distinguish people who are more intelligent from those who are less so. The first is energy, or the capacity for labor. Galton suggested that intellectually able people in a variety of fields are characterized by remarkable levels of energy. The second quality is sensitivity. According to Galton, the smarter we are, the more we are sensitive to the stimuli around us.

For seven years--between 1884 and 1890--Galton ran a service at the South Kensington Museum in London where, for a small fee, people could have their intelligence tested. The tests consisted of a hodgepodge of measures such as a whistle to measure the highest pitch a person could perceive and a gun cartridge filled with different materials to determine if the person could detect different weights. Most of us would question the idea that our ability to detect high pitched sounds or varying weights is an indicator of our intelligence. But at the time, people took these tests seriously, including a psychologist named James McKean Cattell, who brought Galton's ideas to the United States. Cattell (1890) devised a similar test that included squeezing an instrument and inflicting pressure until the person experienced pain. A student of Cattell's, named Wissler (1901), found that scores on this test were unrelated to college grades, which raised questions about the validity of intelligence tests of the Galton and Cattell variety.

From an evolutionary perspective, Galton's ideas made sense. At one time, animals and humans with acute sensory ability likely had a selective advantage over those who did not. But in our time, sensory acuity is no longer a major factor leading either to reproductive advantage or to survival in general. The tests that followed

approached intelligence from a different perspective.

In 1904, the minister of public instruction in Paris created a commission to find a way to distinguish truly mentally "defective" children from those who were not succeeding in school for other reasons. The goal of the commission was to ensure that children would be placed in classes for the mentally retarded only if they were "unable to profit, in an average measure, from the instruction given in the ordinary schools." Alfred Binet and his colleague Theodore Simon devised tests to meet this placement need.

Binet and Simon's (1916) conception of intelligence and of how to measure it differed quite a bit from Galton's and Cattell's. Referring to the others' tests as "wasted time," Binet and Simon spoke of the core of intelligence as "judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of intelligence."

Most people recognize Binet only for his test; but he also had a theory of intelligence. He suggested that intelligent thought has three distinct elements, which he called *direction, adaptation,* and *criticism*. *Direction* involves knowing what has to be done and how to do it. *Adaptation* refers to customizing a strategy for performing a task, then keeping track of that strategy and adapting while implementing it. *Criticism* is the ability to critique your own thoughts and actions.

Binet's ideas, like Galton's, were imported to the United States. Lewis Terman, a professor of psychology at Stanford University, created an Americanized test based on Binet's theory and tests (Terman, 1916). The Stanford-Binet is still a leading competitor in the intelligence-testing business (Thorndike, Hagen, & Sattler, 1986). The Stanford-Binet Intelligence Scale, Fourth Edition (SB IV), is the most recent in a series of scales that dates back to 1905. The first revision (i.e., the second edition) of the Stanford-Binet appeared in 1937 (Terman & Merrill, 1937), and a third edition in 1960 (Terman & Merrill, 1960) The test can be given to children as young as two, and up to any age, although the actual standardization of the test was conducted only on people up to twenty-three years of age. There are fifteen subtests in all, only six of which are given throughout the entire age range of the test. The subtests break down into four categories: verbal reasoning, quantitative reasoning, figural/abstract reasoning, and short-term memory.

The Wechsler Scales represent an alternative to the Stanford-Binet and are the most widely used intelligence scales. They are based on the same kinds of notions about intelligence as the Stanford-Binet. There are three levels of the Wechsler: the third edition of the Wechsler Adult Intelligence Scale--III (WAIS-III; Wechsler, 1997), the third edition of the Wechsler Intelligence Scale for Children (WISC-III; Wechsler, 1991), and the second edition of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-R; Wechsler, 1989).

The Wechsler tests yield three main scores: a verbal, a performance, and an overall score. The verbal score is based on tests such as *vocabulary* as well as *verbal similarities*, in which the test taker has to say how two things are similar. The performance score is based on tests such as *picture completion*, which requires identification of a missing part in a picture of an object, and *picture arrangement*, which requires rearrangement of a scrambled set of cartoonlike pictures into an order that tells a coherent story. The overall score combines the verbal and the performance scores.

The movement in intelligence testing over the past few decades has been toward more theory-based approaches. Several tests have been developed based on the theory of fluid and crystallized intelligence (Cattell, 1971; Horn, 1994). Fluid intelligence is involved in flexible thinking and ability to solve novel problems. Crystallized intelligence represents accumulated knowledge. Tests designed specifically to assess fluid and crystallized intelligence include the Kaufman Adolescent and Adult Intelligence Test (KAIT; Kaufman & Kaufman, 1993) and the Woodcock-Johnson Tests of Cognitive Ability-Revised (Woodcock & Johnson, 1989). Another theory-based test is the Das-Naglieri Cognitive Assessment System (Das & Naglieri, 1997). This test is based on the theory of Luria, discussed below, which proposed that the brain comprises three units: (a) a unit of arousal, (b) a sensory-input unit, and (c) an organization and planning unit. The Das-Naglieri test yields scores on attention planning, simultaneous processing, and successive processing.

Another direction in intelligence testing is the increased attention to typical rather than maximal performance and dynamic assessment. Traditional tests of intelligence emphasize maximal performance; that is, exerting extensive intellectual effort to maximize one's score. Typical-performance tests (Ackerman, 1994; Ackerman & Heggestad, 1997) are intended to supplement traditional intelligence tests by measuring interest and preference for intellectual activities, in other words, what level of intellectual effort is more typical of one's performance on everyday tasks. These tests have the advantage of reducing stress and of measuring intelligence in the kind of situations in which it typically is displayed. At the same time, the validity of such tests both with respect to other tests and with respect to external criteria remains to be shown. To date, correlations with other measures have been modest.

Finally, dynamic testing is an approach that assesses one's potential ability. The idea of dynamic testing originated with Vygotsky (1978) and was developed by Feuerstein (1979) and Feuerstein et al. (1985). It is based on the notion that there is a difference between one's latent capacity and actually developed ability, which Vygotsky refers to as the zone of proximal development. Dynamic tests attempt to measure learning at the time of the test, but it is difficult to define a score that precisely captures the notion of the zone of proximal development. There are potential limitations in terms of standardizing and validating dynamic tests, which raise questions as to their general applicability to the field of intelligence testing (Grigorenko & Sternberg, 1998). Yet we have found in our own work that dynamic tests can provide incremental prediction of school and other performances over and above what is provided by static tests

(Grigorenko, Sternberg, & Ehrman, 1999). We thus believe these tests have great potential, but that this potential has yet to be fully realized.

Although there have been changes in the way intelligence is tested, many questions remain as to what these tests actually measure (Sternberg, 1990). There is also some question as to what the companies that produce most of the tests are interested in finding out (Sternberg & Kaufman, 1996). Tests are used in numerous settings (e.g., schools, military, corporations) and for a variety of purposes (e.g., placement, selection). Given the reliance on intelligence tests, it is important to consider the various ways in which intelligence is defined, both by laypersons and scientists. We review the various theories of intelligence that are recognized today.

Theories of Intelligence

Intelligence theorists do not agree about much, and strangely enough, they probably agree least as to what intelligence is, beyond the ability to adapt flexibly to the environment. We consider here some of the alternative views, based on the framework of Sternberg (1990).

Implicit Theories

In implicit theorizing about intelligence, one asks people what they believe intelligence to be, in order to discover an "ordinary-language" definition. This approach was suggested by Neisser (1979), and was implemented by Sternberg, Conway, Ketron, and Bernstein (1981). They asked samples of laypeople in a supermarket, a library, and a train station, as well as samples of academic researchers who study intelligence, to provide and rate the importance and frequency of characteristics of intelligent individuals. Factor analyses of the frequency ratings showed three major aspects of people's conceptions of intelligence: the ability to solve practical problems (e.g., balancing a checkbook), verbal ability (e.g., writing and speaking well), and social competence (e.g., getting along with other people).

There are limitations, however, with this ordinary-language view of intelligence. One is with respect to age. Siegler and Richards (1982) asked adult participants to characterize intelligence as it applies to people of different ages. They found that adults tended to view intelligence as increasingly less perceptual-motor and as increasingly more cognitive with increasing age. Thus, coordination of hand and eye was seen as more important to the intelligence of an infant whereas reasoning ability was more important to the intelligence of an adult. When children are asked to characterize intelligence, their answers differ from those of adults. Yussen and Kane (1985) asked children at roughly 6-7, 8-9, and 11-12 years of age what their conceptions of intelligence are. They found that older children's conceptions of intelligence included more aspects than younger children's and that older children were less likely than younger children to think that certain kinds of overt behavior signal intelligence.

Another limitation of implicit theories of intelligence is with respect to culture. Different cultures perceive intelligence in different ways, and a view held in one culture

may be diametrically opposed to that held in another culture. Western notions of intelligence, for example, differ in many ways from those of other cultures. In contrast to Sternberg et al.'s (1981) findings, Yang and Sternberg (1997) found that Taiwanese Chinese conceptions of intelligence included five factors: (a) a general cognitive factor, (b) interpersonal intelligence, (c) intrapersonal intelligence, (d) intellectual self-assertion, and (e) intellectual self-effacement. Chen (1994) found three factors underlying Chinese concepts of intelligence: nonverbal reasoning ability, verbal reasoning ability, and rote memory. Chen's methodology was different from and perhaps less sensitive than Yang and Sternberg's, which may account for the difference in results. In addition, Gill and Keats (1980) noted differences between Australian University students, who viewed academic skills and the ability to adapt to new events as intelligence, and Malay students, who considered practical skills, speed, and creativity to be indicators of intelligence.

Studies conducted in Africa also provide a useful contrast to Western societies. Serpell (1982) found that Chewa adults in Zambia emphasize social responsibility, cooperativeness, and obedience. Kenyan parents view responsible participation in family and social life as important aspects of intelligence (Super & Harkness, 1982). In Zimbabwe, the word for intelligence, *ngware*, means to be prudent and cautious (Dasen, 1984). The emphasis on social aspects of intelligence seems to be a part of both Asian and African cultures, much more so than is emphasized by the conventional Western view, although there is variability in conceptions of intelligence within the latter (Okagaki & Sternberg, 1993).

Although there is greater emphasis in African and Asian cultures on social aspects of intelligence than in the U.S., these cultures still recognize the importance of cognitive aspects. In a rural village in Kenya, Sternberg and Grigorenko (1997a), working with Wenzel Geissler from the Bilharziasis Laboratory of Copenhagen, Catherine Nokes, Donald Bundy, and Ruth Prince from Oxford, and Frederick Okatcha from Kenyatta University in Nairobi, found that children who learned how to apply natural herbal medicines to their various ailments were viewed as more adaptive and intelligent than those who have not acquired this knowledge. Moreover, their knowledge of these natural herbal medicines was *negatively* correlated both with school achievement and scores on conventional tests of crystallized abilities, suggesting that those who display higher levels of intelligence relevant to a particular contextualized situation actually may do worse on standardized measures of intelligence.

Whether or not intelligence actually is the same across and even within cultures, it is certainly not perceived as the same (Berry, 1984). Most theorists of abilities, however, have argued that whatever the differences may be across cultures, there are at least some aspects of intelligence that are the same. For reviews of some of these issues, see Laboratory of Comparative Human Cognition (1982) or Sternberg and Kaufman (1998). We consider next some of the major explicit theories of intelligence.

Explicit Theories

Explicit theories of intelligence are those proposed by psychologists (or other scientists) and tested by comparing the theories' predictions to data collected from human participants. Explicit theories involve various approaches to studying intelligence. We organize these approaches into psychometric, cognitive, biological, contextual or cultural, and systems theories.

Psychometric. One of the earliest views of intelligence, going back to the beginning of the century, is that intelligence can be understood in terms of hypothetical mental entities called 'factors.' These factors are alleged to be the sources of the individual differences we observe in people's performance in school, on the job, and even in their social interactions. Psychometric theories are so-called because they are based on the measurement (-metric) of psychological (psycho-) properties. Usually, such theories are tested by the measurement of individual differences in people's psychological functioning. The individual-differences approach has people perform a large number of tasks that seem to predict intelligent performance (in school or on the job), including recognizing meanings of words, seeing verbal or figural analogies, classifying which of several words does not belong, solving simple arithmetic problems, completing series of numbers, or visualizing spatial relationships between abstract forms. The psychologist uses data from these and similar tasks to analyze patterns of individual differences in task performance. These data are analyzed using factor analysis in order to identify the basic underlying factors of human intelligence.

The earliest factorial theory of the nature of human intelligence was formulated by Spearman (1904), who also invented factor analysis. His theory is called the two-factor theory. Spearman (1927) suggested that intelligence comprises two kinds of factors--a general factor and specific factors. General ability, or *g*, is required for performance of mental tests of all kinds. Each specific ability, as measured by each specific factor, is required for performance of just one kind of mental test. Thus, there are as many specific factors as there are tests, but only a single general factor. Spearman suggested that the ability underlying the general factor could best be understood as a kind of mental energy.

Thomson (1939) suggested an alternative interpretation. He disputed Spearman's claim that the general factor represented a single underlying source of individual differences. Instead, he proposed that the appearance of a general factor was due to the working of a multitude of mental bonds, including reflexes, learned associations between stimuli, and the like. Performance of any particular task activates large numbers of these bonds. Some bonds will be required for the performance of virtually any task requiring mental effort, and these bonds in combination will give rise to the appearance of a general factor.

Thurstone (1938), like Thomson, accepted Spearman's hypothesis of a general factor, but he disputed its value. He argued that it is a second-order factor or phenomenon, one of little importance. What are really important, according to Thurstone,

are factors that he called primary mental abilities. Thurstone suggested that they include verbal comprehension (measured by tests such as knowledge of vocabulary), word fluency (measured by tests requiring rapid word production, e.g., a listing of as many words as possible with *c* as their third letter), number skill (measured by tests of arithmetical reasoning and computation), spatial visualization (measured by tests requiring mental manipulation of geometric forms), perceptual speed (measured by tests requiring rapid visual scanning, e.g., skimming a page looking only for instances of the letter *a*), memory (measured by tests of recall and recognition of previously presented information), and reasoning (measured by tests such as completing a number series).

Guilford (1967) parted company from the majority of factorial theorists by refusing to acknowledge the existence of any general factor at all. Instead, he proposed that intelligence comprises 120 elementary abilities (the number later increased to 150, Guilford, 1982), each of which involves the action of a mental operation upon some sort of content (e.g., figural, symbolic, verbal) to produce an intellectual product. An example of an ability in Guilford's structure of intellect model is cognition of verbal relations. This ability involves recognition (mental operation) of a conceptual connection—a relation (product)--between two words (verbal content), for example, that a *peach* is a kind of *fruit*.

Probably the most widely accepted factorial description of intelligence is a hierarchical one. A good example of this class of description was proposed by Vernon (1971). He suggested that intelligence can be described as comprising abilities at varying levels of generality. At the top of the hierarchy is general ability as identified by Spearman; at the next level are major group factors, such as verbal-educational ability (needed for successful performance in courses such as English or history) and practical-mechanical ability (needed for successful performance in courses such as craftsmanship and car mechanics); at the next level are minor group factors, which are obtained by subdividing the major group factors; and at the bottom of the hierarchy are the specific factors as proposed by Spearman. This description of intelligence may be viewed as filling the gaps between the two extreme kinds of factors proposed by Spearman: between the general and specific factors are group factors of intermediate levels of generality.

This hierarchical model of intelligence is also reflected in two more recent theories by Carroll (1993) and Horn (1994). Carroll conducted a factor analysis of over 460 data sets collected between 1927 and 1987 that represented more than 130,000 people from various backgrounds, including country of origin. Based on these data, he proposed a hierarchical model of intelligence that consists of three strata: Stratum I includes narrow, specific abilities (e.g., spelling ability, speed of reasoning); Stratum II includes various group-factor abilities (e.g., fluid and crystallized intelligence); and Stratum III represents a single general factor of intelligence. The factors identified in Carroll's model do not necessarily represent new aspects of intelligence, but the massive data set used lends considerable support to his model.

Biological. Whereas the psychometric approach seeks to identify the ways in which individuals differ in terms of various mental abilities, the biological approach seeks to understand the internal locus of abilities, whether in terms of current functioning (the brain and central nervous system) or in the transmission of functioning (the genes). Various biological theories of intelligence have been proposed.

Earlier biological theories of intelligence tended to be global in nature. One of the most influential of these theories was that of Hebb (1949), who distinguished between two basic types of intelligence, Intelligence A and Intelligence B. Intelligence A is innate potential. It is biologically determined and represents the capacity for development. Hebb described it as "the possession of a good brain and a good neural metabolism" (p. 294). Intelligence B is the functioning of a brain in which development has occurred. It represents an average level of performance by a person who has matured. Although some inference is necessary in determining either intelligence, Hebb suggested that inferences about intelligence A are far less direct than inferences about intelligence B. Hebb argued that most disagreements about intelligence are over intelligence A, or innate potential, rather than over intelligence B, which is the estimated mature level of functioning. Hebb also distinguished an intelligence C, which is the score one obtains on an intelligence test. It is the basis for inferring either of the other intelligences.

Hebb's main interest was in intelligence A, and his theory, the neuro-psychological theory of the organization of behavior, can be seen in large part as an attempt to understand what intelligence A is. The core of Hebb's theory is the concept of the cell assembly. Hebb proposed that repeated stimulation of specific receptors slowly leads to the formation of an assembly of cells in the brain. More intelligent people have more elaborate sequences of cell assemblies.

Another biologically based theory that has had an influence on intelligence research and testing is that of Luria (1980). Luria suggested that the brain is a highly differentiated system whose parts are responsible for different aspects of a unified whole. In other words, separate cortical regions act together to produce thought and action of various kinds. Luria suggested that the brain comprises three main units. The first unit consists of the brain stem and midbrain structures, and is responsible for arousal. The second unit of the brain is responsible for sensori-input functions. The third unit includes the frontal cortex, and is involved in organization and planning.

Some biological theories focus on the relation between hemispheric specialization and intelligence. Theories of hemispheric specialization can be traced back to a country doctor in France, Marc Dax, who in 1836 noted a connection between loss of speech, now known as aphasia, and damage to the left hemisphere of the brain. His claim was expanded upon by Broca (1861).

This finding by Dax has been followed up by many researchers, most notably Sperry (1961). Sperry argued that each hemisphere of the brain behaves in many respects like a separate brain. He concluded from his research that visual and spatial functions are primarily localized in the right hemisphere, whereas linguistic functions are primarily

localized in the left hemisphere. However, there is some debate as to whether language is completely localized in the left hemisphere (e.g., Farah, 1988; Gazzaniga, 1985). Levy (1974) further applied Sperry's theory to information processing, suggesting that the left hemisphere tends to process stimuli analytically, whereas the right tends to process it holistically. Continuing with this line of reasoning, Bogen (1975) suggested that the difference in processing of stimuli in the two hemispheres can be characterized in terms of what he refers to as propositional versus appositional information processing. "Propositional" applies to speaking, writing, and other verbal activities that are dominated by the left hemisphere, whereas "appositional" emphasizes the figural, spatial, non-verbal processing of the right hemisphere. The right hemisphere, in his view, understands patterns and relationships that are not susceptible to propositional analysis and that may not even be logical.

Gazzaniga (1985) has taken a different position and argues that the right hemisphere of the brain is organized modularly into relatively independent functioning units that work in parallel. Many of these modules operate at a level that is not even conscious, but which parallels our conscious thought and contributes to conscious processing. The left hemisphere tries to assign interpretations to the processing of these modules. Thus, the left hemisphere may perceive the individual operating in a way that does not make any particular sense or that is not particularly understandable. In other words, our thoughts are relatively distinct from our understanding of them.

Some biological theorists have pursued the notion that intelligent people act and think faster than less intelligent people. They attribute this difference to the speed of neural functioning, or nerve-conduction velocity.

This perspective on intelligence was originally supported by reaction-time studies (e.g., Jensen, 1982). These studies showed that greater variability in response rate to a stimulus (e.g., a light) was associated with lower scores on ability tests. More recent studies have attempted to measure conduction velocities more directly. Reed and Jensen (1992) used performance during a pattern-reversal task (e.g., using a checkerboard where the black squares changed to white and the white squares to black) to measure two medium-latency evoked potentials, N70 and P100. The correlations between the latency measures and IQ were small (in the range of -.1 to -.2) but significant in some cases. Correlations were negative because longer latencies corresponded to lower IQs. Vernon and Mori (1992) measured nerve-conduction velocity in the median nerve of the arm using electrodes. They found significant correlations between conduction velocity and IQ (around .4). However, they were unable to replicate these findings in later studies (Wickett & Vernon, 1994).

One of the more popular biological approaches is to examine the relation between brain activity and intelligence. Most research in this area uses evoked potentials (EPs) to measure brain activity. Evoked potentials are electrical responses of the brain during neural transmission. McCarthy and Donchin (1981) found that one evoked potential (P300) seems to reflect the allocation of cognitive resources to a given task. P300 is so-

named because it is a positively charged response occurring roughly 300 milliseconds after the stimulus is presented.

Schafer (1982) has suggested that the tendency to show a large P300 response to surprising stimuli may reflect individual differences. More intelligent individuals should show greater P300 responses to unfamiliar stimuli, as well as smaller P300 responses to expected stimuli, than would less intelligent ones because they do not need to devote as much attention to familiar stimuli. Schafer reported a correlation of .82 between individual differences in evoked potentials and IQ. This level of correlation appears not to be generally replicable.

Hendrickson and Hendrickson (1980) have suggested that errors can occur in the passage of information through the cerebral cortex. These errors, which probably occur at synapses, are alleged to be responsible for variability in evoked potentials. Thus, it would follow that individuals with normal neural circuitry that conveys information accurately will form correct and accessible memories more quickly than individuals whose circuitry is "noisy" and hence makes errors in transmission. They have shown a strong level of correlation between complexity of an evoked potential measure and IQ. The meaning of this correlation, however, is unclear and it has not replicated.

One of the most interesting areas of biological research on intelligence involves examining the rate of cortical glucose metabolism. In two studies, Richard Haier and his colleagues have studied cortical glucose metabolic rates using PET scan analysis while participants solved Raven Matrix problems or played the computer game Tetris (Haier et al., 1988; Haier et al, 1992). In both studies they found that more intelligent participants showed lower metabolic rates, suggesting that more intelligent individuals expend less effort when working on these tasks. The direction of this relationship, however, remains to be shown. It is not clear whether smarter people expend less glucose, or lower glucose metabolism contributes to higher intelligence.

Finally, researchers have explored the role of genetics in determining intelligence (see Sternberg & Grigorenko, 1997b, for an in-depth review). Based on the existing research, it appears that approximately half the total variance in IQ scores is accounted for by genetic factors (Loehlin, 1989; Plomin, 1997). The percentages vary with age, however, with heritability of IQ generally increasing with age. It is also important to note that many researchers argue that the effects of heredity and the environment cannot be separated clearly (Bronfenbrenner & Ceci 1994; Wahlsten & Gottlieb, 1997), and that research attention should be devoted to understanding how heredity and environment work together to determine or influence intelligence (Jensen, 1997; Scarr, 1997). In any case, heritability can vary with population and environmental circumstances, so that any values of the heritability coefficient have to be considered in the context of the circumstances under which they are obtained.

There are many different biological approaches to studying intelligence. These approaches have yielded interesting insights about the relation between abilities and the brain. Researchers have been exploring both quantitative (e.g., Vernon & Mori, 1992)

and qualitative (e.g., Levy, 1974) differences between people. Although the above studies have been characterized as strictly biological, it is important to point out that not everyone who takes a biological perspective considers it to be the only way to understand human abilities. Biological measures can help to elucidate cognitive processing, just as cognitive processing can help to elucidate biological functioning. We discuss some cognitive views of intelligence next.

Cognitive. Cognitive approaches to intelligence complement rather than contradict biological ones. According to the cognitive perspective, as people think, they execute a set of mental operations, and these operations plus the system that generates them constitute the bases of intelligence.

The cognitive approach, as well as the psychometric approach, has its origins in the work of Spearman (1923). Spearman proposed three fundamental qualitative principles of cognition. *Apprehension of experience* is the perception of a stimulus and the relation of it to the contents of long-term memory, what we today call "encoding." *Eduction of relations* is the interrelation of two stimuli so as to understand their similarities and differences, what we now refer to as "inference." And *eduction of correlates* is the "application" of an inferred relation to a new domain. Spearman suggested that the analogy problem is an ideal test for studying these cognitive principles, because in an analogy such as LAWYER is to CLIENT as DOCTOR is to _____?, a participant has to encode each term of the analogy, infer the relation between the LAWYER and CLIENT, and apply this relation to DOCTOR to compete the analogy using PATIENT.

The cognitive approach proposed by Spearman lay dormant until Cronbach (1957) called for the merging of the correlational and experimental disciplines of psychology. It was not until the 1970s that research stemming from this call for unification began to emerge.

Research by Hunt and his colleagues (e.g., Hunt, Frost, & Lunneborg, 1973; Hunt, Lunneborg, & Lewis, 1975) showed that tasks that formerly had been studied by cognitive psychologists also were applicable for understanding human intelligence. Hunt and his colleagues suggested that verbal ability could be understood in large part in terms of speed of access to lexical information stored in long-term memory, and, to test their claim, used a task earlier proposed by Posner and Mitchell (1967).

Hunt et al. (1975) used a letter-comparison task in which participants are shown a pair of letters, such as "A A," "A a," or "A B," and are asked to indicate, as quickly as possible, if the two letters are identical in appearance or if the two letters are identical in letter name. The difference in response time between the two tasks is viewed as the speed of access to lexical information in long-term memory. The difference score is used to subtract out sheer speed of accessing the visual information inherent in the letters. Hunt et al. considered this difference to be a measure of verbal ability. They showed that scores on these information-processing tasks correlated about -.3 with scores on

psychometric tests of intelligence, with faster response times associated with higher intelligence.

An alternative approach, called the cognitive-components approach, focused on the time it took to perform individual mental processes in more complex tasks, such as analogies and series completions. Sternberg (1977) proposed a method of studying intelligence called componential analysis. The first part of this method involved isolating the information-processing components and strategies used to solve a cognitive task hypothesized to relate to intelligence. Using problems like Spearman's verbal analogy, Sternberg determined whether or not each participant used the processes of encoding, inference, and application, how long each took, and how susceptible each process was to error. The second part involved correlating component scores with psychometric test scores hypothesized to correlate and not correlate with the target cognitive processes. For example, one might expect components of analogical reasoning to correlate with scores on psychometric tests of inductive reasoning but not with scores on psychometric tests of perceptual speed. Using this method, Sternberg (1983) showed that the same cognitive processes are involved in a wide variety of intellectual tasks, and he suggested that these and other related processes underlie scores on intelligence. The limitation of this approach is that more complex tasks do not lend themselves to this type of decomposition because participants do not solve the problems in a linear way.

Alternative cognitive approaches have been used to study more complex tasks. The most prominent of these is the study of artificial intelligence. Artificial-intelligence approaches use the computer as a metaphor for understanding human intelligence.

For example, Newell and Simon (1972) used a computer program, called the General Problem Solver, to model problem solving that involved a series of clearly defined steps to problem solution. At the same time, other researchers (e.g., Minsky, 1968; Winograd, 1972) were developing programs of semantic information processing. Schank (1972) proposed a model of "conceptual dependency" to understand how concepts could be related to one another. This model served as the basis for script theory (Schank & Abelson, 1977), which attempts to account for how we know what to do in certain situations. A script is a schema that consists of a set of actions that we typically follow in a given situation.

Perhaps the most influential of the artificial-intelligence approaches has been the development of expert systems. The general characteristics of expert systems include: a language processor facilitating communication between user and system, a knowledge base that is subdivided into knowledge of facts and rules, an interpreter that applies these rules, a scheduler that controls the sequence of application, a consistency enforcer that modifies conclusions when new data contradict old data, and a justifier that can explain the system's line of reasoning (Hayes-Roth, Waterman, & Lenat, 1983). These approaches typically do not simulate human cognitive processing, but rather attempt to create the most effective and efficient processor. Some theorists, however, have tried to create programs that simulate human intelligence. Most notable among these is Anderson's (1983, 1986) ACT model. Anderson has used his model to compare human

information processing to a computer program. All of the traditional artificial-intelligence theories are based on the assumption that human intelligence is, at its core, a serial symbolic-processing system, and as such, computers can provide a good model for what is unique about human intelligence. However, more recent connectionist models assume massive parallel processing (e.g., McClelland & Rumelhart, 1988).

Contextual. Although cognitive approaches have provided insight about the relation between mental processes and representations and human abilities, many scientists argue that they are too narrow to capture the broad nature of intelligence. Contextual approaches to intelligence attempt to take into account the complexity of the construct. Consistent with the difference found in implicit theories of intelligence, they take the position that intelligence cannot be understood outside a cultural context.

The most extreme position is that of radical cultural relativism (Berry, 1974). This view rejects the assumption that there are psychological universals across cultural systems. Intelligence should be studied within each culture separately, within the system in which its meaning was created. According to this approach, it is inappropriate to take a standardized test and translate it from one culture to another.

One way to understand different concepts of intelligence is to study implicit theories. As discussed above, this type of study involves asking people what the term "intelligence" means to them. Based on a review of numerous studies that attempted to understand intelligence in this way, Berry (1984) concluded that conceptions of intelligence vary substantially across cultures. We have also examined such conceptions. We showed in several studies reviewed earlier that conceptions of intelligence vary among Asian, African, and even within U.S.subcultures (e.g., Okagaki & Sternberg, 1993; Sternberg & Grigorenko, 1997a; Yang & Sternberg, 1997). But there were also commonalities in these definitions of intelligence. For example, all of the groups agree that cognitive functioning plays at least some part in human intelligence.

Less extreme contextual views recognize both the differences and similarities in conceptions of intelligence. The Laboratory of Comparative Human Cognition (1982) proposed a kind of conditional comparativism by which comparisons between cultures are possible so long as tasks are made equivalent for members of the different cultures. For example, Luria (1976) found that when he asked Russian peasants "From Shakhimardan to Vuadil it is three hours on foot, while to Fergana it is six hours. How much time does it take to go on foot from Vuadil to Fergana?" they responded with answers like "You're wrong . . . it's far and you wouldn't get there in three hours" (p. 129). Simply changing the names of locations does not make the task equivalent. In a similar vein, cross-cultural studies of memory (Wagner, 1978) have shown that whether people do well on memory tasks depends very heavily on the familiarity of the content. People tend to do better with more familiar content, so that the relative scores of two cultural groups will depend in part upon what kinds of materials are used in testing.

The contextual approach has been criticized for not making clear what is meant by "context." Berry and Irvine (1986) have proposed a four-level model of context that

specifies, at least in part, what context means. At the highest level is ecological context, which is the natural cultural habitat in which one lives. The second level is the experiential level, or the pattern of recurrent experiences that provide the basis for learning. The third level is the performance context, comprising the limited set of environmental circumstances that account for particular behaviors at specific points in space and time. And the lowest level is the experimental context, which refers to the context in which research or testing occurs.

Varied contexts at any of these levels can have an effect on the outcomes of a task, including intelligence tests. Ceci and Bronfenbrenner (1985), for example, found that the pattern of performance on a time-estimation task varied for children who were studied in a laboratory or home environment. They concluded that data obtained in a laboratory do not necessarily transfer to a home environment, or vice versa. Other investigators have found that performance on traditional ability tests as given in school settings (e.g., IQ tests, arithmetic tests) correlates poorly with performance on everyday, practical tasks (e.g., handicapping horses, Ceci & Liker, 1986; comparative grocery shopping, Lave, 1988; and street vending, Nuñes, Schliemann, & Carraher, 1993). We discuss this research further in the next chapter on practical intelligence. Sternberg and Wagner (1986) obtained similar findings with business executives, salespersons, and college professors, as is reviewed in Chapter 6.

Contextual approaches clearly show that context is important to the study of intelligence. Contextual differences emerge at various levels, from broad cultural differences to differences in the specific setting in which a task is performed. In measuring intelligence, we need to be sensitive to the potential differences that may artificially produce different scores for different groups or for the same individuals in different environments. But understanding the contextual influences alone does not answer all our questions about intelligence. Ideally, theories should take into account both cognition and context. Developing a more integrative approach to studying intelligence is the objective of systems theories.

Systems. System theorists view intelligence as a complex system. Their theories attempt to incorporate diverse elements from various approaches that we have considered so far. Two such theories are Gardner's (1983, 1993) theory of mulitple intelligences and Sternberg's (1985, 1997) triarchic theory of successful intelligence.

Gardner (1983) proposed that intelligence is not a unitary construct, but rather that there are distinct and independent multiple intelligences. His theory of multiple intelligences (MI theory) originally posited seven multiple intelligences. The first, linguistic intelligence, is involved in reading and writing, listening and talking. The second, logical-mathematical intelligence, is involved in numerical computations, deriving proofs, solving logical puzzles, and in most scientific thinking. The third, spatial intelligence, is used in marine navigation, as well as in piloting a plane or driving a car. The fourth, musical intelligence, is used in singing, playing an instrument, conducting an orchestra, composing, and, to some extent, in appreciating music. The fifth, bodily-kinesthetic intelligence, involves the ability to use one's body or various portions of it in

the solution of problems, in the construction of products, or in athletics. The sixth, interpersonal intelligence, is involved in understanding and acting upon one's understanding of others. And the seventh, intrapersonal intelligence, is the ability to understand oneself -- to know how one feels about things, to understand one's range of emotions, to have insights about why one acts the way one does, and to behave in ways that are appropriate to one's needs, goals, and abilities. More recently, Gardner (1998) proposed an additional intelligence, that of naturalistic intelligence, which is the ability to discern patterns in nature. He also has suggested existential and spiritual "candidate" intelligences.

Sternberg (1997) argues that most conventional conceptions of intelligence are too narrow, and thus deal with only a small portion of intelligence as a whole. They fail to address what he refers to as successful intelligence, or the ability to adapt to, shape, and select environments to accomplish one's goals within the context of one's society and culture. The theory attempts to link cognition to context through three parts or subtheories.

The componential subtheory addresses the relation of intelligence to the internal world. It specifies the components that people use to process information. For example, metacomponents are used to plan, monitor, and evaluate an activity. Performance components are involved in the actual execution of activities. And knowledge-acquisition components help individuals to learn how to do things in the first place. The three kinds of components interact and provide feedback to one another. For example, if one travels to a foreign country, metacomponents plan and supervise the trip, while performance components coordinate day-to-day actual needs. Knowledge-acquisition components are used to learn about the country, both in preparation for and during the trip.

The experiential subtheory postulates that the above components are applied to tasks with which we have varying levels of experience. At one extreme we have tasks that are extremely novel and that we have never encountered before. At the other extreme we have tasks that are so familiar we can accomplish them with little intellectual effort. Therefore, tasks that are relatively unfamiliar are relevant to measuring intelligence. But tasks that are totally novel (e.g., giving calculus problems to first-grade children) are poor measures of intelligence because the individual simply has no experience to bring to bear. Well-learned, or automated tasks (e.g., reading, driving) are also important for understanding intelligence because they are part of everyday functioning. Intelligence involves a balance among coping with relative novelty and eventually rendering tasks automatic so that they can be done with little conscious effort. Take, for example, the very practical skill of driving. Initially, when one learns how to drive, one needs to focus intensely and avoid distractions. One may be able to do just one thing at a time. Eventually, when one has automatized performance, one may be able to drive, carry on a conversation, listen to the radio, and let one's mind wander, all at the same time.

The contextual subtheory states that the information-processing components are applied to experience in order to serve one of three functions in real-world contexts. The first, adaptation to environments, refers to changing oneself to suit the environment in

which one lives. The second, shaping of environments, refers to changing the environment to suit oneself. And the third, selection of environments, refers to choosing a new environment when one is unable to make the environment work through adaptation or shaping. The successfully intelligent person is able to perform all three of these functions as necessary.

Underlying this theory is the notion that intelligent people are those who recognize their strengths and weaknesses, and who capitalize upon their strengths while at the same time they compensate for or correct their weaknesses. People attain success, in part, by finding out how to exploit their own pattern of strengths and weaknesses. These strengths and weaknesses can be related to three broad kinds of abilities that are important to successful intelligence: analytic, creative, and practical (Sternberg, 1988, 1997).

Analytic ability involves critical thinking. It is the ability to analyze and evaluate ideas, solve problems, and make decisions. Creative ability involves going beyond what is given to generate novel and interesting ideas. Practical ability involves implementing ideas. It is the ability involved when intelligence is applied to real-world contexts. In the next chapter, and in the remainder of this report, we focus on the practical aspect of intelligence. We consider in more detail what practical intelligence is and what role it serves in understanding successful performance in everyday life that conventional approaches to understanding intelligence fail to accomplish.

Chapter 2
The Nature of Practical Intelligence

Practical (or everyday) intelligence is different from the kind of intelligence associated with academic success. There are any number of ways in which we see this difference in our everyday lives. We see people who succeed in school and who fail in work, or who fail in school but who succeed in work. We meet people with high intelligence-test scores who seem inept in their social interactions. And we meet people with low test scores who can get along effectively with practically anyone. Laypersons have long recognized a distinction between academic intelligence (book smarts) and practical intelligence (street smarts or common sense). This distinction is confirmed by research on the implicit theories of intelligence held by both laypersons and researchers. As mentioned in Chapter 1, Sternberg et al. (1981) found that people distinguish between practical problem-solving ability (e.g., adding up a restaurant check), verbal ability (e.g., reading and writing), and social ability (e.g., interpersonal skills).

Academic versus Practical Intelligence

There may be any number of reasons for the apparent difference between academic and practical intelligence. We argue that a major source of this difference is the sheer disparity in the nature of the kinds of problems one faces in academic versus practical situations. Building on a distinction made by Neisser (1976), academic problems tend to be (a) formulated by others, (b) well-defined, (c) complete in the information they provide, (d) characterized by having only one correct answer, (e) characterized by having only one method of obtaining the correct answer, (f) disembedded from ordinary experience, and (g) of little or no intrinsic interest.

Practical problems, in contrast to academic problems, tend to be (a) unformulated or in need of reformulation, (b) of personal interest, (c) lacking in information necessary for solution, (d) related to everyday experience, (e) poorly defined, (f) characterized by multiple "correct" solutions, each with liabilities as well as assets, and (g) characterized by multiple methods for picking a problem solution. Given the differences in the nature of academic and practical problems, it is no surprise that people who are adept at solving one kind of problem may well not be adept at solving problems of the other kind. Researchers have confirmed this distinction between practical and academic intelligence and have shown that there is little relation between the two.

Practical intelligence is one of the three components of Sternberg's (1988, 1997) triarchic theory of intelligence. It is the ability to acquire and use knowledge that has relevance to real-world problems. Practical intelligence is defined more broadly as the ability to adapt to, shape, and select environments in the pursuit of personally valued goals. Adaptation involves changing oneself to suit an existing environment; shaping involves changing an environment to suit oneself; and selection involves finding a more suitable environment than the current one. The concept of practical intelligence takes into account the distinction presented above between academic and practical tasks. The

abilities emphasized in formal schooling have limited value if they cannot be used to address practical, everyday problems.

Research on Practical Intelligence

A number of studies have addressed the relation between practical and academic intelligence. These studies have been carried out in a wide range of settings, using a variety of tasks, and with diverse populations. We review some examples of research on problem solving and reasoning. For more thorough reviews see Ceci and Roazzi (1994), Rogoff and Lave (1984), Scribner and Cole (1981), Sternberg and Wagner (1986, 1994), and Voss, Perkins, and Segal (1991). Taken together, these studies show that ability measured in one setting (e.g., school) does not necessarily transfer to another setting (e.g., real-world task).

Several studies compared performance on mathematical types of problems across different contexts. Scribner (1984, 1986) studied the strategies used by milk processing plant workers to fill orders. Workers who assemble orders for cases of various quantities (e.g., gallons, quarts, or pints) and products (e.g., whole milk, two percent milk, or buttermilk) are called assemblers. Rather than employing typical mathematical algorithms learned in the classroom, Scribner found that experienced assemblers used complex strategies for combining partially filled cases in a manner that minimized the number of moves required to complete an order. Although the assemblers were the least educated workers in the plant, they were able to calculate in their heads quantities expressed in different base number systems, and they routinely outperformed the more highly educated white collar workers who substituted when assemblers were absent. Scribner found that the order-filling performance of the assemblers was unrelated to measures of school performance, including intelligence test scores, arithmetic test scores, and grades.

Another series of studies of everyday mathematics involved shoppers in California grocery stores who sought to buy at the cheapest cost when the same products were available in different-sized containers (Lave, Murtaugh, & de la Roche, 1984; Murtaugh, 1985). (These studies were performed before cost per unit quantity information was routinely posted). For example, oatmeal may come in two sizes, 10 ounces for $.98 for 24 ounces for $2.29. One might adopt the strategy of always buying the largest size, assuming that the largest size is always the most economical. However, the researchers (and savvy shoppers) learned that the largest size did not represent the least cost per unit quantity for about a third of the items purchased. The findings of these studies were that effective shoppers used mental shortcuts to get an easily obtained answer, accurate enough to determine which size to buy. A common strategy, for example, was to mentally change the size and price of an item to make it more comparable with the other size available. For example, one might mentally double the smaller size, thereby comparing 20 ounces at $1.96 versus 24 ounces at $2.29. The difference of 4 ounces for about 35 cents, or about 9 cents per ounce, seems to favor the 24-ounce size, given that the smaller size of 10 ounces for $.98 is about 10 cents per ounce. These mathematical shortcuts yield approximations that are as useful as the actual

values of 9.80 and 9.33 cents per ounce for the smaller and larger sizes, respectively, and are much more easily computed in the absence of a calculator. When the shoppers were given the M.I.T. mental arithmetic test, no relation was found between test performance and accuracy in picking the best values (Lave et al.; Murtaugh).

Ceci and colleagues (Ceci & Liker,1986, 1988; Ceci & Ruiz, 1991) studied expert racetrack handicappers. Ceci and Liker (1986) found that expert handicappers used a highly complex algorithm for predicting post time odds that involved interactions among seven kinds of information. By applying the complex algorithm, handicappers adjusted times posted for each quarter mile on a previous outing by factors such as whether the horse was attempting to pass other horses, and if so, the speed of the other horses passed and where the attempted passes took place. By adjusting posted times for these factors, a better measure of a horse's speed is obtained. It could be argued that the use of complex interactions to predict a horse's speed would require considerable cognitive ability (at least as it is traditionally measured). However, Ceci and Liker reported that the use of these interactions by handicappers was unrelated to their IQ.

A subsequent study attempted to relate performance at the racetrack to making stock predictions in which the same algorithm was involved. Ceci and Ruiz asked racetrack handicappers to solve a stock market prediction task that was structured similarly to the racetrack problem. After 611 trials on the stock market task, the handicappers performed no better than chance, and there was no difference in performance as a function of IQ. Ceci and Roazzi (1994) attribute this lack of transfer to the low correlation between performance on problems and their isomorphs. "Problem isomorphs" refers to two or more problems that involve the same cognitive processes but use different terminology or take place in different contexts.

The same principle that applies to adults appears also to apply to children. Carraher, Carraher, and Schliemann (1985) studied Brazilian children who, for economic reasons, often worked as street vendors (see also Nuñes, 1994). Most of these children had very little formal schooling. Carraher et al. compared the performance of these children on mathematical problems that were embedded in a real-life situation (i.e., vending) to problems presented in an academic context (e.g., 2 + 4 = ?). The children correctly solved significantly more questions that related to vending than math problems that were academic in nature. When the academic problems were presented as word problems (e.g., If an orange costs 76 cruzeiros and a passion fruit cost 50, how much do the two cost together?), the rate of correct responses was substantially better, but still not as high as when the problems were presented in the context of vending.

This lack of transfer also appears to work in the reverse direction. For example, Perret-Clermont (1980) found that school children had no problem solving paper-and-pencil arithmetic questions, but could not solve the same type of problem in a different context (e.g., counting bunches of flowers). That is, school children may fail to transfer the academic knowledge to everyday problems.

Roazzi (1987) found similar results when comparing street-vendor children to middle-class school children. He compared the performance of children on a class inclusion task. To assess the performance of the street-vendor children, the researcher posed as a customer and asked questions about the items to find out if they understood the relationship among classes and subclasses of food (e.g., mint and strawberry chewing gum as part of the class "chewing gum"). At a later time the same children were given a formal test with the same logical structure, but irrelevant to their street-vending jobs. The middle-class children were given the same two tests. Street-vendor children performed significantly better on the class-inclusion task in the natural than in the formal context, whereas middle-class children were more successful on the formal version of the task.

Additional research has shown that the use of complex reasoning strategies does not necessarily correlate with IQ. Dörner and colleagues (Dörner & Kreuzig, 1983; Dörner, Kreuzig, Reither, & Staudel, 1983) studied individuals who were asked to play the role of city managers for the computer-simulated city of Lohhausen. A variety of problems were presented to these individuals, such as how best to raise revenue to build roads. The simulation involved more than one thousand variables. Performance was quantified in terms of a hierarchy of strategies, ranging from the simplest (trial and error) to the most complex (hypothesis testing with multiple feedback loops). No relation was found between IQ and complexity of strategies used. A second problem was created to cross-validate these results. This problem, called the Sahara problem, required participants to determine the number of camels that could be kept alive by a small oasis. Once again, no relation was found between IQ and complexity of strategies employed.

In another series of studies by Wason, Johnson-Laird, and colleagues (Johnson-Laird & Wason 1972; Johnson-Laird, Legrenzi, & Legrenzi, 1972; Wason, 1966), the ability to solve conditional reasoning tasks varied across contexts. The task used involved asking participants to decide whether or not a particular rule is true (e.g., "If a card has a vowel on one side, then it has an even number on the other side"). According to formal logic, the appropriate response is to search for examples that could falsify the rule (e.g., in the series E, M, 2, and 5, a correct response would be to check E and 5). But some participants seek to verify the rule. Johnson-Laird and colleagues found that the use of verification or falsification strategies to solve to conditional reasoning tasks varied depending on the context. For example, Johnson-Laird et al. presented the task in the context of mail sorting in which the rule was "If a letter is sealed, then it has a 50-lire stamp on it." They found that even though participants were instructed to verify the rule, they selected cards that would falsify the rule. The participants' choice of strategy was attributed to their implicit understanding that overpayment is less of a concern to postal workers than underpayment. Therefore, practical concerns may influence the type of strategy (falsify or verify) that is considered appropriate. Abstract reasoning tasks do not provide such a context.

The above studies indicate that demonstrated abilities do not necessarily correspond between everyday tasks (e.g., price-comparison shopping) and traditional academic tasks (e.g., math achievement tests). In other words, some people are able to solve concrete, ill-defined problems better than well-defined, abstract problems that have little relevance to their personal lives, and vice versa. Few of these researchers would

claim, however, that IQ is totally irrelevant to performance in these various contexts. There is evidence that conventional tests of intelligence predict both school performance and job performance (Barrett & Depinet, 1991; Schmidt & Hunter, 1998; Wigdor & Garner, 1982). What these studies do suggest is that there are other aspects of intelligence that may be independent of IQ and that are important to performance, but that largely have been neglected in the measurement of intelligence. We also observe this incongruity between conventional notions of ability and real-world abilities in theoretical approaches to understanding performance in the workplace, which we address in the next chapter.

Chapter 3
Practical Intelligence in the Workplace

Theoretical approaches to understanding performance in work settings also exhibit a distinction between academic and practical abilities. We find an increasing emphasis on the importance of practical intelligence to understanding job performance, particularly in the field of management. In this chapter, we review some of the approaches to understanding management that highlight the importance of practical abilities.

For the last 50 years, the field of management has been split in two. The split is between those who perceive managers to be rational technicians whose job is to apply the principles of management science in the workplace (Taylor, 1947), and those who view managers as craftsmen who practice an art that cannot be captured by a set of scientific principles (Schön, 1983). This split has had profound implications for managerial theory, practice, and training (Wagner, 1991).

This chapter is divided into two parts. In the first part, we review rational approaches to managerial problem solving and consider some perceived limitations of these approaches. The goal of this part is to provide an historical perspective from which to view the development of alternative approaches. In the second part, we review approaches that emphasize the art of managerial problem solving. Our focus here is on approaches that attempt to examine practical intelligence or competence as it is applied in the workplace to solve managerial problems.

Rational Approaches to Management

The management science movement has produced a number of approaches that collectively are referred to as *rational* approaches to problem solving (Isenberg, 1984). The hallmark of rational approaches to managerial problem solving is a set of problem-solving principles with near universal applicability. Two examples of rational approaches will be described for purposes of illustration.

The Rational Manager

Kepner and Tregoe (1965) proposed a system for solving managerial problems in their classic text on rational management that consists of five key principles:

1. Problems are identified by comparing actual performance to an expected standard of performance. The most important thing effective managers do continuously is to compare what should be happening with what is happening. A problem is identified by a significant discrepancy between what is happening and what should be happening.

2. Problems are defined as deviations from expected standards of performance. Problem definition is based on an analysis of the discrepancy between actual and expected

performance that alerted a manager to the existence of a problem in the first place. For example, assume that the normal percentage of defective jeans produced in a Texas plant is 5%. If the percentage of defective jeans increases to 15%, the problem is defined as "a tripling in the percentage of defective jeans produced at the Texas plant."

3. Prerequisite to identifying the cause of a problem is generating a precise and complete description of the problem. Describing a problem precisely and completely consists of describing four things. What is happening? Where is it happening? When is it happening? To what extent is it happening? To provide a boundary for the problem, an effort is made to also describe what is not happening, that is, what is not problematical.

4. The cause of the problem will be found by comparing situations in which the problem is found to similar situations in which the problem is not found. Problems rarely affect everything. Most problems can be isolated to a particular plant, shift, product, time, and so forth. Searching out potential causes of the problem involves identifying what differentiates the situation in which the problem is found from similar situations in which the problem is not found. This is the key to determining the cause of the problem. For example, searching for a problem isolated to night shift workers would begin with an analysis of differences between day and night shift workers, their supervision, and the nature of their work.

5. Problems are the result of some change that has caused an unwanted deviation from expectations. Assuming the problem is of recent origin, something must have changed to produce it. Thus, a quality control problem might have begun when a new employee was hired on the suspect shift. Perhaps the new employee has been poorly trained or is careless.

Kepner and Tregoe illustrate the application of their principles using a problem involving rancid butterfat. The example begins with the vice-president of a butterfat manufacturer receiving a call from a customer of her Midwestern plant informing her that butterfat is turning rancid during the manufacture of various food products. The vice-president defined the problem in terms of a deviation from the expected standard. The problem therefore was that some bags of butterfat produced in the Midwestern plant turn rancid before they should.

Having identified that a problem existed and defined it, the next step was to describe the problem as precisely and completely as possible. By talking with individuals on the scene, the vice-president learned four important facts: (a) the problem was limited to bags of butterfat that were produced at the company's Midwestern plant; (b) the problem affected only the single customer; (c) the problem butterfat was limited to 20% of the bags that the customer used; and (d) the problem began about a week ago.

Having generated a precise problem description, the next step was to search for what differentiated when the problem occurred from when it did not. This investigation

revealed that the customer was the Midwestern plant's largest customer, a consequence of which was that the customer's bags were handled differently from those of other customers. The bags for the large customer were stacked in cubes on pallets before being frozen for shipment. However, this did not really explain the problem because the customer's bags had been handled this way for several years, yet the problem appeared only a week ago. Second, the Midwestern plant's quality control inspector was a new employee who began a week ago. However, even if the quality control inspector was not doing his job, that would only explain why it was a customer rather than plant personnel who discovered the problem, and not why a plant that typically turns out good butterfat began turning out bad butterfat. Third, a new, more cost-effective freezer was brought on line a week ago in the Midwestern plant that is used to freeze the bags of butterfat before shipping. If the new machine were not working as effectively as the old one, it is possible that some of the bags of butterfat were not completely frozen, and thus could turn rancid. However, why would only the one customer be affected?

A potential cause was identified by combining the facts that the customer's bags were stacked and a new freezer was in operation. The vice-president asked the plant manager to insert temperature probes into one of the cubes, some near the center of the cube and some near the outside, and then use the new freezer to freeze the cube. The results of this test indicated that the bags near the outside froze very quickly, but the bags near the center were not cooled at all. The frozen bags on the outside of the cube insulated the inner bags from the cold of the freezer. The problem was solved by having bag handlers leave at least one inch of space between the columns of bags as opposed to their previous method of stacking them into a solid cube. A subsequent test using temperature probes showed that the space between columns resulted in all bags being frozen completely.

The Proactive Manager

A second example of a rational approach to managerial problem solving is provided by Plunkett and Hale (1982). Their system of managerial problem solving is based on the following seven steps:

1. State the problem. The first step in problem solving is to state the problem and the desired resolution. Problem identification and formulation are assumed to be perfunctory parts of the problem-solving process, as was true for the previous approach.

2. Describe the problem. The second step is to describe the problem carefully. Key facts to be determined include: (a) what object, unit, or person appears to be affected by the problem; (b) what exactly is wrong; (c) where the problem is found; (d) when the problem began; and (e) how many of the total number of objects, units, or persons that could be affected by the problem actually are affected.

3. Identify differences between affected and unaffected objects, units, or persons. The cause of the problem is identified by examining differences between affected and unaffected objects, units, or persons.

4. Identify changes that are associated with the problem. When something is operating at the expected level of performance, it will continue to do so unless something changes. Whatever changes will be the origin of the problem.

5. Generate likely causes. Once changes that are associated with the problem have been identified, the problem solver attempts to determine how a particular change, either alone or in combination with other changes or factors, might have caused the problem.

6. Consider most likely cause. Here the problem solver determines whether the most likely cause provides an adequate explanation for the problem, focusing on whether the cause can explain why the problem appears in some situations and not in others.

7. Verify most likely cause. The goal here is to find some independent means to verify that one has uncovered the actual cause of the problem rather than a potential cause.

Rational approaches to managerial problem solving such as those proposed by Kepner and Tregoe (1965) and Plunkett and Hale (1982) have a number of obvious strengths. First, the approaches are explicit, and thus readily communicated to others. Second, the approaches are general, applying universally to all problems and potential problem solvers. The same principles apply regardless of the nature of the specific problem or of the characteristics of the manager who is responsible for solving the problem. The generality of rational approaches to managerial problem solving has served as a rationale for creating a class of general managers who can move from position to position and yet be effective problem solvers. This provides an organization with considerable flexibility in staffing managerial positions. Third, the approaches are based on principles of logic and scientific reasoning. Managers attempt to minimize bias and avoid jumping to conclusions prematurely. They generate alternative potential explanations of a problem, and they search for independent confirmation of the explanation they settle on.

Given these obvious strengths, it is perhaps surprising that rational management appears to be on the decline. For example, rational approaches receive little consideration in handbooks of managerial problem solving (e.g., Albert, 1980; Virga, 1987). What has limited the influence of rational approaches to managerial problem solving?

One problem for rational approaches is evidence that effective problem solvers often deviate from rational approaches in significant ways. For example, Mintzberg's (1973) influential studies of what managers actually do, as opposed to what they are supposed to do or what they say they do, showed that managers rarely if ever employed rational approaches. Rather than following a step-by-step sequence from problem definition to problem solution, managers typically groped along with only vague impressions about the nature of the problems they were dealing with, and with little idea of what the ultimate solution would be until they had found it (Mintzberg, Raisinghani, & Theoret, 1976). Isenberg (1984) reached a similar conclusion in his analysis of how

senior managers solve problems. The senior managers he studied did not follow the rational model of first defining problems, next assessing possible causes, and only then taking action to solve the problem. Instead they worked from general overriding concerns, and they worked simultaneously at a number of problems. The senior managers often took action throughout the problem-solving process. In fact, evaluating the outcomes of their preliminary actions appeared to be one of their more useful tools for problem formulation.

A second problem for rational approaches to managerial problem solving is growing skepticism about the power of general principles of problem solving in the absence of content knowledge of the problem-solving domain (McCall & Kaplan, 1985). Proponents of rational approaches have argued that one of their major strengths is that managers can apply them without having prior knowledge of, or experience with, the problems they confront. For example, Kepner and Tregoe (1965) find it notable that a particular manager was able to solve a problem with ". . . no special know-how or detailed technical information about this problem. He relied instead on a thorough knowledge of the process of problem analysis" (p. 130).

The growing awareness of the limitation of rational approaches to managerial problem solving has led to an interest in closer study of the art of managerial problem solving, focusing on how practical intelligence or competence actually is applied in the workplace.

Applying Practical Intelligence in the Workplace

We now turn to a description of alternative approaches for studying the application of practical competence in the workplace. The first approach to be considered, that of Isenberg (1986), suggests that managers deviate from the rational model especially in terms of their propensity to act before the facts are in.

Thinking While Doing

Isenberg (1986) has used a variety of methods for studying how experienced managers solve problems. For example, he compared the thinking-aloud protocols of 12 general managers and 3 college students who planned to pursue business careers, as they solved a short business case. The case involved the Dashman company (Harvard Business School Case Services, 1947):

> Mr. Post was recently appointed vice-president of purchasing. The Dashman company has 20 plants, and in an effort to avoid shortfalls in essential raw materials required by the plants, Mr. Post decided to centralize part of the purchasing process the plants must follow. Mr. Post's experienced assistant objected to the change, but Mr. Post proceeded with the new procedures anyway. He sent a letter describing the new purchasing process to plant managers responsible for purchasing, and received supportive letters from the managers of all 20 plants. However, none of the managers complied with the new purchasing process.

The case was presented in parts on cards. The participants' task was to identify Mr. Post's problems and determine what he should do about them. Their verbal protocols were transcribed and coded into categories that covered encoding information (e.g., ponders specific information, clarifies meaning, evaluates information), reasoning (e.g., causal reasoning, conditional reasoning, analogical reasoning), and planning action (e.g., makes reference to goals when planning, puts self in place of another when deciding what to do, establishes contingencies). In addition to coding the verbal protocols, the effectiveness of the participants' solutions to Mr. Post's problems was rated by several professors at the Harvard Business School who had used the Dashman case in their teaching over the years. Compared to a control group of students, the experienced managers: (a) began planning action sooner; (b) asked for less additional information; (c) made more inferences from the data; and (d) were less reflective about what they were doing and why. In many cases, managers began suggesting problem solutions after reading only half of the cards containing the case, even though they were not under time pressure and additional information was available merely by turning over the remaining cards. Thus, experienced managers behaved differently than a rational model of managerial problem solving would suggest. They were action-oriented very soon into the problem-solving process. Their analyses were cursory, rather than exhaustive, and were based on their personal experience with analogous problems rather than on more formal principles of problem solving. Consistent with Mintzberg (1973), these results suggest that managers are people of action rather than of analysis. Peters and Waterman (1982) noted that effective organizations capitalize on managers' penchant for action by promoting a "bias for action."

Isenberg (1984) has documented other ways that managers depart from traditional conceptions of managerial problem solving. The traditional view is that managers carefully choose a strategy, formulate well-specified goals, establish clear and quantifiable objectives, and determine the most effective way to reach them. Whereas the traditional view might present an accurate picture of how junior managers approach problems, senior managers do their jobs differently. Using detailed interviews and observation, Isenberg demonstrated that senior managers work from one or a small number of very general concerns or preoccupations.

Nonlinear Problem Solving

Solving managerial problems by proceeding linearly through the stages of problem recognition, analysis, and solution is the exception rather than the rule. Typically, problem solving is recursive, with repeated delays, interruptions, revisions, and restarts (Mintzberg et al., 1976). For example, few of the problems presented to managers are correctly formulated. Most problems are formulated in ways that make reaching a solution nearly impossible. Whether a formulation is the optimal one is rarely apparent until attempts have been made at finding and implementing solutions.

Identifying potential problem solutions also becomes a recursive operation. Managers produce solutions bit by bit, as they are guided only by a vague notion of some ideal solution. Managers often do not know what the ultimate solution will look like until

it has been completely crafted together. The recursive nature of problem solving continues through to the implementation of solutions. Solutions cannot be implemented without authorization, and for important problems, managers usually must seek authorization from others. The authorization process can be recursive, cycling back and forth among several levels of the organization and the manager. To make matters worse, interruptions and delays are common to all phases of managerial problem solving.

McCall and Kaplan's (1985) extensive interviews with working managers confirm Mintzberg's observations about the nonlinear character of managerial problem solving, especially when the problems are important ones. McCall and Kaplan characterize the process as convoluted action. Convoluted action occurs over significant time periods, typically months or even years as opposed to days or weeks. There are many people involved, with different interest groups competing for their stake in the outcome. Exhaustive searches are carried out to find solutions to problems, each of which is scrutinized before implementation is considered.

An advantage of convoluted action is that it appears to meet organizational needs. Problems often are caused by and affect a web of interrelated groups and individuals in an organization. Solutions to such problems must involve the cooperative efforts of many parties if they are to succeed. Convoluted action provides the opportunity for all interested parties to attempt to influence the process. A disadvantage of convoluted action is the frequency with which the process breaks down before a solution is identified and implemented. Because so many individuals are involved, and because each has the opportunity to derail or at least delay the process, it is not an unusual outcome for a solution to be put on the shelf rather than be implemented, if the process even makes it to the point of solution implementation. Problems are much more likely to be solved through convoluted action if they have a "champion" who refuses to let the problem-solving process derail until it has been completed (Peters & Waterman, 1982).

Not all problem solving in organizations involves convoluted action. Some problems simply cannot wait for convoluted action to run its course. These problems require quick action, the characteristics of which are just the opposite of those of convoluted action (McCall & Kaplan, 1985). The goal of the manager is to implement a solution to the problem as quickly as possible. The manager takes sole responsibility for deciding on a solution and makes the decision unilaterally, although others may be consulted for advice if they are available. The search for information and alternative solutions is necessarily cursory. There simply is not time to get all of the information that might be helpful, so the manager must focus on a few key facts and must rely heavily on past experience.

An advantage of quick action is that action is not thwarted by problems that are not clearly understood, and more may be learned about the nature of some problems by studying the reaction to a quick action than by analysis without action. A political advantage of quick action is that it informs others in the organization that the problem is being dealt with. The obvious disadvantages of quick action include the fact that the chances of choosing an ineffective or even a deleterious solution are nontrivial, and that the manager who takes quick action is likely to bear complete responsibility for a failure.

McCall and Kaplan (1985) identified several characteristics of managers who seem to be able to make quick action work. They rely on one or two individuals who can provide trustworthy information about the problem. They drop everything and attend to the problem directly rather than delegating parts of the problem-solving process. And though it may seem counterintuitive, they avoid taking unnecessary quick action. When presented with an emergency, their first response is to question why this must be handled today, as opposed to tomorrow or next week. Usually, only one aspect of the problem is really urgent, and that aspect can be dealt with by some limited response that will buy some time for addressing the complete problem.

Reflection-in-Action

Schön (1983) describes the environment that managers confront as being dynamic situations involving many complex, interwoven problems, each of which must be restructured to make it soluble. Because problems are complex and interconnected and environments are turbulent, rational analytic methods will not suffice. What is required is a manager who can imagine a more desirable future, and invent ways of reaching it.

Much of managerial competence appears as action that is nearly spontaneous, and based more on intuition than on rationality (Schön, 1983). When asked to explain their behavior, managers either are at a loss for words, or will make up an explanation that may be fictitious, perhaps not intentionally, but only in the spirit of trying to satisfy the questioner. To use Schön's own words, "Our knowing is ordinarily tacit, implicit in our patterns of action and in our feel for the stuff with which we are dealing. It seems right to say that our knowing is *in* our action" (p. 49).

Schön is not the first to make this observation. For example, Barnard (1938/1968) believed such knowledge to come from nonlogical processes that cannot be expressed in words but that are demonstrated in judgment and action. Thus, people are able to make quite accurate judgments of things such as the distance to the pin in golf and the trajectory to throw a ball so that it reaches its intended target, yet they are not able to describe how they make their judgments.

Although managers cannot accurately describe how they are able to do what they do, many do occasionally attempt to reflect on their actions as they perform them. These *reflections-in-action* are on-the-spot examinations and testing of a manager's intuitive understanding of a situation, often in the form of a reflective conversation with the situation (Schön, 1983). They are the cornerstone of Schön's analyses. For example, a manager might ask herself why she feels uneasy about a decision she is about to make, or whether she might come up with a new way of framing an intractable problem. Although the practice of reflection-in-action is widespread among managers, managers rarely if ever reflect on their reflection-in-action.

One of the best examples of the importance of reflection-in-action is provided by marketing. Businesses depend on their ability to identify, create, and adapt to markets. The study of market phenomena is a highly specialized one; the field of marketing

research has generated quantitative models of market phenomena and methods for predicting the response of a particular market to a particular product. However, the vast majority of the work managers do during the course of product development and marketing requires them to transcend the techniques and knowledge of market research. One reason for the limited effectiveness of market research on product development is a mismatch in timing. To be of much use in development, knowledge about a product's potential markets needs to be available early in product development, before considerable resources have been invested in a particular design. Yet market researchers cannot make accurate predictions until the product has been fully developed and can be test marketed. Market researchers can ask individuals how interested they would be in a yet to be developed product that will do x, y, and z, but the individuals' responses are poor predictors of their subsequent behavior, should the product subsequently appear in a store.

As an example, Schön (1983) describes the marketing of a new type of tape by the 3M Corporation shortly after World War II as an example of reflection-in-action. The 3M Corporation had developed a clear cellulose acetate tape that was coated on one side with an adhesive. The intended use of the tape was for mending books that might otherwise be thrown away, hence the name Scotch Tape. The initial marketing plan, which reflected the intended use of mending books, did not succeed because not many people were interested in mending their books. However, some Scotch Tape was being bought by consumers who used it for a variety of other purposes such as wrapping packages or holding curlers in their hair. The marketing managers reacted by ditching the original marketing plan, and bringing out different types of Scotch Tape, each designed optimally for a particular use such as wrapping packages or curling hair.

In summary, managerial problem solving often is not characterized by a linear progression through the stages of problem formulation, solution search, and solution implementation, but may be characterized by either a recursive and interrupted cycling through the various stages (i.e., convoluted action), or a compressed response that truncates part of the problem-solving process (i.e., quick action). The results of the approaches that have been discussed suggest that managers do not follow a rational model of first reflecting and then acting. Schön (1983) suggests that managers do reflect, but this reflection occurs primarily during as opposed to prior to taking action.

A common theme of these more practical approaches to understanding managerial problem solving is that the rational theories espoused in business schools do not necessarily apply in real-world managerial situations. Managers seem to learn how to adapt to various demands of each situation—to take quick action and to adjust one's plan of action as necessary. But what is it that successful managers learn that enables them to respond effectively? In the next chapter, we present one approach to understanding real-world problem-solving ability, an approach that focuses on the knowledge individuals gain from their everyday experiences.

Chapter 4
Understanding Practical Intelligence: The Role of Tacit Knowledge

What distinguishes people who are more successful from those who are less successful in their everyday lives? Sternberg and his colleagues have taken a knowledge-based approach to addressing this question. They have found in their research that much of the knowledge needed to succeed in real-world tasks is tacit. It is acquired while performing everyday activities, but typically without conscious awareness of what is being learned. And although people's actions may reflect their knowledge, they may find it difficult to articulate what they know. The notion that people acquire knowledge without awareness of what is being learned is reflected in the common language of the workplace as people speak of "learning by doing" and of "learning by osmosis." Terms like professional intuition and professional instinct further imply that the knowledge associated with successful performance has a tacit quality.

The term tacit knowledge, introduced by Polanyi (1966), has been used to characterize the knowledge gained from everyday experience that has an implicit, unarticulated quality (Neisser, 1976; Schön, 1983; Sternberg, 1985, 1997). Sternberg and his colleagues (Sternberg, 1988, 1997; Wagner & Sternberg, 1985) view tacit knowledge as an aspect of practical intelligence. It is knowledge that reflects the practical ability to learn from experience and to apply that knowledge in pursuit of personally valued goals. Tacit knowledge is needed to successfully adapt to, select, or shape real-world environments. Because tacit knowledge is an aspect of practical intelligence, it provides insight into an important factor underlying the successful performance of real-world tasks. Research by Sternberg and his colleagues (see Sternberg, Wagner, & Okagaki, 1993; Sternberg, Wagner, Williams, & Horvath, 1995), which we review in later chapters of this report, has shown that tacit knowledge can be applied to understanding performance in a variety of job domains.

Support for the importance of the concept of tacit knowledge is found also in research on expertise and implicit learning. Research with experts in a variety of knowledge-intensive domains has shown that reasoning and problem solving in such domains depend upon proceduralized skills and schematically-organized knowledge, both of which may operate outside of focal awareness (see Chi, Glaser, & Farr, 1988). Furthermore, expert knowledge appears to reflect the structure of the operating environment or situation more closely than it does the structure of formal, disciplinary knowledge (Groen & Patel, 1988).

Research on implicit learning focuses on the phenomenon of learning without intention or awareness. Tacit knowledge may be, but need not be, acquired implicitly. Arthur Reber and his colleagues' work on the acquisition of stochastic grammars and of event sequences suggested that human beings are capable of acquiring knowledge of a very complex nature without conscious intention or awareness of learning (Reber, 1967, 1969; Reber & Millward, 1968). Researchers subsequently applied the paradigm to study learning of meaningful information (e.g., information about other people and information about the behavior of an economic system) and replicated the basic pattern of results

(Broadbent & Aston, 1978; Broadbent, Fitzgerald, & Broadbent, 1986). The research on implicit learning suggests that knowledge can be acquired in the absence of awareness or intention to learn, and thus has a hidden or tacit quality.

In this chapter, we begin by discussing the type of theoretical concept we consider tacit knowledge to be. Next, we describe the characteristic features of tacit knowledge and how it is distinguished from related concepts. Then, we consider how tacit knowledge is represented at different levels of abstraction. We present a cognitive model that relates the key features of tacit knowledge to the acquisition, storage, and retrieval of knowledge in and from memory.

Tacit Knowledge as a Theoretical Concept

In research by Sternberg and his colleagues (Sternberg et al., 1993, 1995; Wagner & Sternberg, 1985), the term tacit knowledge has been used to characterize a type of knowledge, the possession of which distinguishes more from less practically-successful individuals. In order to understand better the theoretical concept of tacit knowledge, we begin with a distinction between nominal and natural concepts.

Nominal concepts are used attributively. For example, we use the term "bachelor" to attribute certain features (i.e., male, adult, unmarried) to some objects or persons. The instances of a nominal concept often share features that are both necessary (i.e., all valid instances must have these features) and sufficient (i.e., having these features is enough to qualify something as a valid instance). Membership in a nominal concept is "all or none"—either an instance possesses the critical features or it does not.

Natural concepts, in contrast, are used ostensively. For example, we use the term "furniture" to refer to objects that we view as equivalent (e.g., dresser, chair, table). The instances of a natural concept share characteristics features, but these features are not necessary or sufficient for membership. Membership in a natural concept is not "all or none," but rather instances are judged in terms of their strengths of resemblance to the concept. This means that some instances (those with high resemblance) will be judged as better examples of the concept than will other instances (those with low resemblance). For example, most people would agree that "arm chair" is a more typical example of the concept "furniture" than is "bean bag chair."

Tacit knowledge is a natural concept. It is used to denote a type of knowledge that is held together by the resemblance of items to one another and not by a set of individually-necessary and jointly-sufficient features. This lack of necessary and sufficient features does not mean that as a concept tacit knowledge is incoherent or meaningless. Two people may not be able to identify the critical features that all items of furniture share, but they can still agree that furniture exists and that a coffee table is furniture and a toaster oven is not.

Because tacit knowledge is a natural concept, we do not expect that judgments about what is and is not tacit knowledge will be "all or none." Rather judgements should depend on the item's strength of resemblance to the concept. Some knowledge will seem

to represent a particularly clear example of tacit knowledge and other knowledge will seem marginal. For marginal items, individuals may disagree about whether the item is a valid instance of tacit knowledge. Given a high level of agreement among judges, the tacit quality of knowledge items can be determined with some degree of confidence.

We describe below three key features that are commonly shared by items of tacit knowledge. These features are used to judge the resemblance of items to the concept. In other words, items that possess these features are more likely to be characteristic of tacit knowledge.

The Features of Tacit Knowledge

We identify three key features of tacit knowledge. These features of tacit knowledge relate to (a) the conditions under which it is acquired, (b) its cognitive structure, and (c) the conditions of its use. First, tacit knowledge generally is acquired on one's own with little support from the environment (e.g., through personal experience rather than through instruction). Second, tacit knowledge is viewed as procedural in structure. It is associated with particular uses in particular situations or classes of situations. Third, because it generally is acquired through one's own experiences, tacit knowledge has practical value to the individual. We expand upon each of these features below.

Tacit Knowledge Typically is Acquired Without Environmental Support

Tacit knowledge generally is acquired on one's own. That is, it is acquired under conditions of minimal environmental support. By environmental support, we mean either people or media that help the individual to acquire the knowledge. As such, tacit knowledge tends to be unspoken, underemphasized, and poorly conveyed relative to its importance for practical success.

When people or media support the acquisition of knowledge, they facilitate three knowledge-acquisition components: selective encoding, selective combination, and selective comparison (Sternberg, 1988). When an individual is helped to distinguish more from less important information (selective encoding), to combine elements of information in useful ways (selective combination), and to identify knowledge in memory that is relevant to the present situation (selective comparison), the individual has been supported in acquiring knowledge. In performing real-world tasks, individuals often must engage in these processes on their own in order to make sense of and respond to situations. The resulting knowledge may reflect the use of these processes, but the individual may not be able to express how the knowledge was acquired.

Tacit Knowledge is Procedural

The second feature of tacit knowledge is its close association with action. Tacit knowledge takes the form of "knowing how" rather than "knowing that." Anderson (1983) has characterized these two respective types of knowledge as procedural and declarative. More precisely, procedural knowledge is knowledge that is represented in a

way that commits it to a particular use or set of uses. It is knowledge that guides behavior, usually without being readily available to conscious introspection. People may not know they possess and/or may find it difficult to articulate such knowledge. We view procedural knowledge as a superset of tacit knowledge. All tacit knowledge is procedural, although not all procedural knowledge is tacit.

The characterization of tacit knowledge as procedural derives from our research. We have found that when individuals are queried about the knowledge they have acquired through their experiences, they often begin by articulating general rules in roughly declarative form (e.g., "a good leader needs to know people"). When these general statements are probed, they often reveal themselves to be more abstract or summary representations of a family of complexly specified procedural rules (e.g., rules about how to judge people accurately for a variety of purposes and under a variety of circumstances). These procedural rules, we believe, represent the characteristic structure of tacit knowledge and serves as the basis for identifying and measuring tacit knowledge. We can represent tacit knowledge in the form of condition-action pairings:

IF <antecedent condition> THEN <consequent action>

For example, the knowledge of how to respond to a red traffic light could be represented as:

IF <light is red> THEN <stop>

Of course, the specification of the conditions and actions that make up proceduralized knowledge may be quite complex. In fact, much of the tacit knowledge that we have observed seems to take the form of complex, multicondition rules (production systems) for how to pursue particular goals in particular situations. In other words, tacit knowledge is more than a set of abstract procedural rules. It is context-specific knowledge about what to do in a given situation or class of situations. For example, knowledge about confronting one's superior might be represented in a form with a compound condition:

IF <you are in a public forum>
AND
IF <the boss says something or does something that you perceive is wrong or inappropriate >
AND
IF <the boss does not ask for questions or comments>
THEN <speak directly to the point of contention and do not make evaluative statements about your boss, staff or your peer's character or motives>
BECAUSE <this saves the boss from embarassment and preserves your relationship with him.>

Tacit Knowledge is Practically Useful

The third characteristic feature of tacit knowledge is its instrumental value in attaining people's personal goals. The more highly valued the goal is, and the more directly the knowledge supports the attainment of the goal, the more useful is the knowledge. For example, knowing that seeking input from subordinates makes them feel valued is practically useful for those supervisors who want their subordinates to feel valued, but not practically useful for supervisors who do not value this goal.

We do not believe that practically useful knowledge must be acquired in any particular context or forum. Useful knowledge is, of course, acquired in classrooms, from experience on the job, through mentoring relationships, and through self-study. We distinguish practically useful knowledge not from formally acquired knowledge but, rather, from knowledge (however acquired) that is not relevant to the practical goals that an individual values.

Tacit Knowledge Involves Coherent Relations Among its Features

The three features of tacit knowledge, acquisition on one's own, procedural structure, and practical value, are related to one another in a non-arbitrary way. That is, we can explain why these features go together in the specification of a meaningful natural concept of tacit knowledge.

First, there is a natural correpondence between the features of procedural structure and practical value. Procedural knowledge tend to be practically useful—it contains within it the specification of how it is to be used. Declarative knowledge, in contrast, is not specific with respect to use and, as a consequence, may remain inert or unused. Therefore, procedural knowledge is more likely to be relevant in the pursuit of personally-valued goals.

Second, knowledge acquired under low environmental support is more likely to have practical value. When knowledge must be acquired on one's own, the probability increases that some individuals will fail to acquire it. When some individuals fail to acquire knowledge, those who succeed may gain a comparative advantage. This advantage is expected to be lower when the knowledge is highly supported by the environment (i.e., explicity and effectively taught) because more people would be expected to acquire and use it. At the same time, knowledge acquired through one's own experiences should have more personal relevance to the types of situations one encounters in everyday life.

Finally, we associate knowledge acquired through experience with knowledge that is procedural in structure. Because procedural knowledge is more difficult to articulate and more poorly conveyed relative to declarative knowledge, its acquisition is more likey to be a function of experiential learning. By the same token, knowledge acquired through experience is more likely to be related to action because originally it was obtained in the context of performing a practical, everyday task.

Each of these features is viewed as a continuous, rather than discrete, dimension of tacit knowledge. That is, knowledge is not categorized as either possessing or not possessing these features, but rather it is a matter of degree. Some knowledge may be more well-supported by the environment than other knowledge. Similarly, some knowledge may have more practical value to the individual than other knowledge. Knowledge that is closer to one end of the continuum is considered more representative of tacit knowledge.

What Tacit Knowledge is Not

We have identified above the features that help describe what type of knowledge we consider tacit knowledge to be. It is helpful also to distinguish tacit knowledge conceptually from other related concepts such as job knowledge, general intelligence, and performance.

Tacit Knowledge is not Synonymous with Job Knowledge

Schmidt and Hunter (1993) suggested that tacit knowledge is merely a type of job knowledge. Tacit knowledge and job knowledge are viewed more appropriately as overlapping concepts. First, some, but not all, tacit knowledge pertains to job-related activities. Tacit knowledge can pertain to any personally-valued activity, including academic and social activities; it is more than job knowledge. Second, some, but not all, job knowledge is tacit. Job knowledge includes declarative and procedural knowledge, with some of the latter characterized as tacit. Job knowledge may be explicit and readily verbalized, as in the rules for operating a lathe or the steps used to compute simple interest, or the knowledge may be tacit, as in knowing what package design will likely sell a product.

Measures of tacit knowledge have the potential to explain individual differences in performance that are not explained by traditional measures of job knowledge, which tend to assess more declarative, explicit forms of knowledge (see e.g., Schmidt & Hunter, 1998). Individual differences in the ability or inclination to acquire and use tacit knowledge make it a potentially useful construct for understanding intelligent behavior in real-world settings, as well as for predicting success in such settings.

Tacit Knowledge is not a Proxy for General Intelligence

The ability or propensity to acquire tacit knowledge is viewed as a dimension of practical intelligence that conventional ability tests do not adequately measure. IQ tests and similar tests, which are intended to measure so-called general intelligence (g), are composed of problems that can be characterized as largely academic or abstract. As discussed earlier, academic problems are well-defined, abstract problems that do not necessarily reflect real-world tasks (Neisser, 1976; Sternberg, 1988, 1997). Therefore, IQ and similar tests measure problem-solving skills that are relatively different from the skills needed to solve everyday, practical problems. For this reason, we do not view measures of tacit knowledge as proxies for measures of academic intelligence. Although general cognitive ability may support the acquisition and use of tacit knowledge in

important ways, tacit knowledge is not reducible to academic intelligence. Of course, it is an empirical question whether measures of tacit knowledge do in fact correlate with measures of crystallized intelligence. This question is addressed in a subsequent chapter of this report.

Tacit Knowledge is not Sufficient for Effective Performance

Although we do not consider tacit knowledge to be a proxy for general intelligence, we do recognize that g and other factors contribute to successful performance in many jobs, based on traditional criteria of success (such as performance ratings). The performance of many everyday tasks requires general intelligence in (at least) the normative range, motivation to succeed, nontacit domain knowledge, and many other resources. We recognize and basically are in concurrence with the results of numerous meta-analyses that show the significant contribution of these variables to understanding performance (see Schmidt & Hunter, 1998). But we attempt to supplement these variables and improve upon conventional approaches to understanding, predicting, and improving performance in real-world settings.

Measures of practical intelligence, like all measures of intelligence, are, at best, indicators of the underlying cognitive functions we seek to understand. As such, we can talk about practical intelligence, and more specifically tacit knowledge, at different levels of abstraction. That is, we can conceptualize tacit knowledge at the level of its cognitive representation, and at the level which it is measured in the behavior and articulated knowledge of the individual. We discuss these different levels of abstraction below.

Describing Tacit Knowledge at Different Levels of Abstraction

Tacit knowledge can be conceptualized at qualitatively different levels of abstraction. At the lowest, least abstract level, tacit knowledge can be described as mentally-represented knowledge structures. We believe that these knowledge structures take the form of complex, condition-action mappings. At this level of description, tacit knowledge takes on its psychological reality and has its consequences for intelligent behavior.

Ideally, we would measure the possession of tacit knowledge directly at the level of its cognitive representation. However, we must infer possession of tacit knowledge from the knowledge that people articulate. When knowledge is articulated, often it is greatly simplified. That is, the complex knowledge structures that map sets of antecedent conditions onto consequent actions are summarized and abbreviated into general rules and procedures. It is at this level, that we measure people's tacit knowledge.

At a higher, more abstract level of description, tacit-knowledge items can be grouped into categories of functionally-related items. Describing tacit knowledge at this level adds value to the identification of tacit knowledge by highlighting the broad, functional areas or competencies that tacit knowledge represents. In other words, in addition to specific items of tacit knowledge, we can identify more generally the types of knowledge that are likely to be tacit.

Before considering how we identify and measure tacit knowledge, we discuss briefly what we view as the underlying cognitive representation of tacit knowledge.

A Cognitive Representation of Tacit Knowledge

We present a model of tacit knowledge in terms of the mental processes of encoding, storing, and retrieving information in and from memory. The proposed model of tacit knowledge draws on the basic distinction between episodic, semantic, and procedural memory, attributable to Tulving (1972, 1995).

Episodic memory is memory for specific, personally experienced events--memory for the "episodes" that make up one's experience. For example, an Army officer's memory of the unpleasant working conditions (e.g., sweltering heat, long hours) surrounding his last assignment can be classified as episodic. The hypothesized contents of episodic memory are often described as cases, situations, or event representations.

Semantic memory is memory for general, impersonal knowledge--memory for information that transcends particular episodes. For example, an officer's memory of which acts of insubordination are subject to what disciplinary action is classified as semantic because it is generalized knowledge and does not depend upon memory for a particular situation (such as an officer's having previously reprimanded a disobedient soldier). Semantic memory also does not address how the behavior is performed, such as how an officer goes about disciplining his soldiers. The latter is the realm of procedural memory, that is, memory for specific behaviors and actions.

Procedural memory is memory for specific condition-action pairings that guide a person's actions in a given situation. It includes learned skills such as driving a car, and acquired knowledge such as how to get your superior to change his directives. An officer's memory of the actions he has used successfully to bring disobedient soldiers into compliance is classified as procedural. The individual does not need to recall specific episodes in which the behavior was performed in order to respond to new situations based on those experiences.

Figure 4.1 shows the three memory stores (episodic, semantic, and procedural) along with arrows indicating relations among them in terms of encoding, storage, and retrieval processes. The top of the figure represents the stimulus environment (the source of inputs to the memory system) and the bottom of the figure represents behavioral consequences of learning (the output of the memory system). We do not intend with this model to introduce a new theory of knowledge acquisition, storage, and retrieval. Instead, we use the model, which is based on existing theory, to illustrate how tacit knowledge is represented cognitively and how it can be identified and measured.

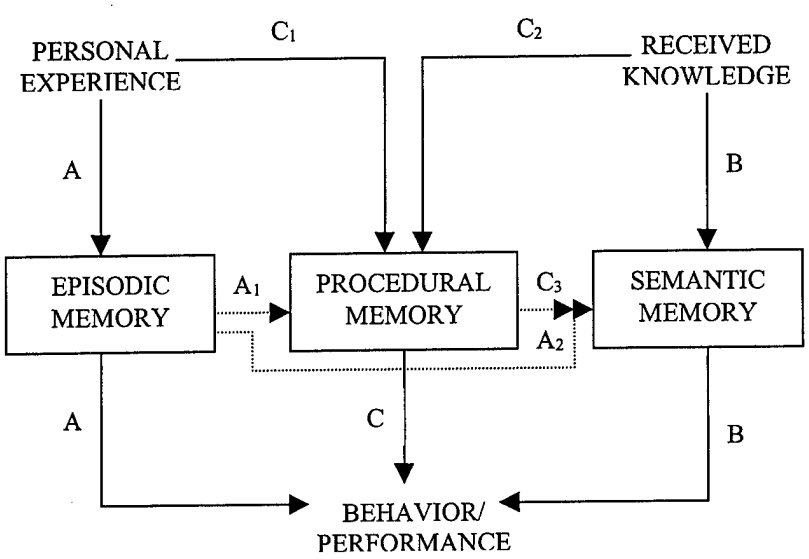

Figure 4.1. Memory structures and knowledge-acquisition pathways in a cognitive model of tacit knowledge.

We identify three major pathways through the memory system. The first pathway, labeled A in the figure, corresponds to the process by which personally experienced events are stored in episodic memory. Over time these memories of specific events may be used to construct more generalized knowledge structures in procedural or semantic memory (indicated by paths A_1 and A_2). According to models of inductive learning (e.g., Holland, Holyoak, Nisbett, & Thagard, 1986), the transition from event knowledge to generalized knowledge involves mental processes that are sensitive to the covariance structure of the environment, to "what goes with what" in the world. These processes (variously referred to as induction, abstraction, or extraction of invariants) isolate shared features and/or structure across episodes and construct abstract or general representations of that shared structure. Thus, Path A can be seen as one pathway by which personal experience comes to influence behavior--either directly, or indirectly through further encoding in procedural and semantic memory.

Path B corresponds to the process by which generalized knowledge of the world is acquired directly--most typically through a process of formal instruction. For example, a civilian researcher might have no personal experience in dealing with soldiers but may still acquire knowledge about which behaviors are subject to disciplinary action by reading Army doctrine. Such knowledge, according to our model, takes the form of "received knowledge" that is input, more or less directly, to semantic memory.

Path C corresponds to the process by which knowledge, acquired either directly or through personal experience, becomes stored in procedural memory. It is knowledge about how to perform certain behaviors or tasks. For example, Army doctrine may

specify step by step procedures for disciplining soldiers who fail to comply with directives. In other words, the steps are made explicit. Over instantiations, these steps are committed to memory and the officer is able to take appropriate disciplinary action without thinking through each step. Alternatively, memory of how to discipline a soldier may be derived from personal experience. For example, an officer may find that disciplinary tactics that are unfamiliar to soldiers have a greater impact on their behaviors than tactics that are familiar to them.

Knowledge in procedural memory may also be derived from episodic memory (path A_1). That is, memory of various experiences may become encoded as a set of complex procedural rules for how to respond to different situations. After several confrontations with insubordinate soldiers, for example, an officer may derive a set of rules for what disciplinary actions to take depending on the situation. Information in procedural memory may also be further encoded into general knowledge (path C_3). An officer's knowledge about disciplinary action may be expressed as a generalized rule that withholding privileges is more effective than requiring additional physical activity.

The model recognizes both direct and indirect influences of knowledge acquisition on behavior. Knowledge from personal experience can exert a direct influence on behavior through its representation in episodic or procedural memory. Experience-based knowledge that is encoded initially in episodic memory can also influence behavior indirectly through its transfer to procedural or semantic memory. Received knowledge can influence behavior through its encoding in either procedural or semantic memory. For example, an officer may discipline soldiers for insubordination because he has been taught that ignoring acts of insubordination threatens one's authority.

In general, individuals are able to articulate the general knowledge represented in semantic memory more readily than knowledge represented in episodic or procedural memory. But the behaviors exhibited by those individuals reflect more than simply generalized knowledge. Researchers have shown that even when memory for individual episodes appears to be lost, information about those episodes continue to influence behavior (e.g., Jacoby, 1983; Schacter, 1987). The most direct support is found in studies of implicit memory. Participants report "knowing" that a word appeared on a list without being able to recall the event of having studied the list (e.g., Gardiner, 1988; Tulving, 1985).

Procedural knowledge, as indicated earlier, guides behavior without necessarily being accessible to conscious awareness. An officer may know at what point he should respond to a soldier's insubordination, but he may not be able to express how he knows when it is the right time to take action. Knowledge received through path C_2 can be linked to its original source in which the information was pre-processed into a set of explicit procedures and taught directly to the individual. Knowledge acquired through personal experience (C_1) is less easily traced because the processing was done by the learner. The individual is the only source for finding out about that knowledge, but he or she may not be able to articulate what he or she knows.

The proposed model helps to illustrate the characteristic features of tacit knowledge. Tacit knowledge is a subset of procedural knowledge that is acquired through personal experience (either through Paths A_1 or C_1), not readily articulated, and directly influences behavior. Based on the model, knowledge acquired via Paths A_1 or C_1 is knowledge acquired through personal experience. Furthermore, knowledge that is acquired via Paths A_1 or C_1 takes the form of "knowing how," and guides behavior without necessarily being available to conscious introspection. Finally, knowledge that is acquired via Paths A_1 or C_1 is likely to be knowledge that supports action directed toward personally valued goals because such knowledge is acquired during the course of goal-directed activity. Paths B and C_2 knowledge, on the other hand, is not acquired through personal experience but through the communication of generalized knowledge based on someone else's experience. Because it has been formulated for communication, knowledge acquired through Paths B and C_2 is in a form that is readily and openly articulated. Paths B and C_2 knowledge also may vary in its relevance to personally valued goals, depending on the similarity of those goals to the goals of instruction.

Knowledge acquired via Paths A_1 or C_1 (i.e., tacit knowledge) is likely to confer a performance advantage to those who posses it. First, because tacit knowledge is not well-supported in its acquisition (i.e., taught directly), it is likely that some individuals will fail to acquire it. Second, knowledge acquired through personal experience is more likely to include conditional information about the types of problems or situations to which the knowledge is relevant. When "behavior/performance" in Figure 4.1 is a response to a realistic, contextualized problem, knowledge that includes contextual information likely will be more useful than knowledge that is decontextualized. Finally, to the extent that one's past experiences, as opposed to someone else's experiences, are more predictive of one's future experiences, knowledge acquired via Paths A_1 or C_1 should be more applicable to the pursuit of one's personal goals than knowledge acquired via Paths B or C_2.

Identifying and Measuring Tacit Knowledge

Measuring tacit knowledge takes into account the realistic, contextualized quality of the knowledge. Responses to realistic problem situations are used as indicators of an individual's possession of tacit knowledge. Wagner and Sternberg (1985) devised a method of presenting scenarios to individuals that depict the types of problems they face in their given pursuits. These scenarios reflect the types of situations in which recognized domain experts have acquired knowledge characterized as "tacit." Because tacit knowledge is not readily articulated, we rely on observable indicators (e.g., responses to the scenarios) to assess whether an individual possesses knowledge characterized as tacit, and can apply that knowledge to the situation at hand. The responses reflect an individual's ability to recognize and take appropriate action in a given situation, and presumably, their procedural knowledge.

Deriving the information for these scenarios poses a challenge in that the tacit knowledge of domain experts must somehow be identified. Domain experts are appropriate sources for identifying tacit knowledge because in order to achieve their expert status, they likely have acquired knowledge that others have not (i.e., knowledge

without direct support). As a subset of procedural knowledge that is not readily articulated, tacit knowledge is not likely to be elicited directly from individuals. However, since tacit knowledge is experience-based, we attempt to identify the knowledge in the recalled experiences of individuals. In other words, when individuals have difficulty expressing their action-oriented knowledge, we attempt to elicit memories for the particular episodes that produced that knowledge.

In the next chapter of this report, we describe methods used to elicit examples of tacit knowledge from domain experts and to develop instruments to measure the acquisition and use of tacit knowledge within a given domain. The methods, which have been applied in domains ranging from education to military leadership, have evolved over the course of our tacit-knowledge research, resulting in a refined and detailed methodology for eliciting and measuring tacit knowledge. We devote the next chapter to describing this methodology as it plays an important role in understanding the findings from tacit-knowledge research and offers a tool for studying tacit knowledge in any domain.

Chapter 5
Measuring Tacit Knowledge

One of the goals of our research is to show that tacit knowledge contributes to successful performance in a variety of domains. That is, we aim to establish a relationship between the possession of tacit knowledge and performance. But how does one proceed to develop a test to measure such knowledge? This chapter addresses the development of tools to measure the amount of tacit knowledge of various kinds that an individual has acquired. We begin by reviewing some approaches that have been used to measure the competencies considered to be relevant to the performance of real-world tasks, and contrast them with our knowledge-based approach. We then discuss what tacit-knowledge tests are intended to measure and offer a general framework for developing and validating such a test.

The Tacit-Knowledge Approach

Before presenting our approach to measuring tacit knowledge, we review two alternative approaches to measuring real-world competencies, the critical-incident technique and the simulation. We then compare the measurement of tacit-knowledge to these approaches.

The critical-incident technique is an approach that focuses on the behaviors associated with effective performance. People are asked to describe several incidents that they handled particularly well, as well as several incidents that they handled poorly (Flanagan, 1954; McClelland, 1976). The critical incidents generated are analyzed qualitatively to determine the nature of the competencies that appear important to success in a given job. The critical-incident technique is probably preferable to observing job incumbents continuously to identify important behaviors. But it assumes that people can and will provide incidents that are critical to success in their particular jobs, and that qualitative analysis is sufficient for identifying the underlying competencies.

The simulation approach is a more direct assessment of job performance. It consists of observing people in situations that have been created to simulate aspects of job performance. The in-basket test is one form of a simulation (Frederiksen, 1966; Frederiksen, Saunders, & Wand, 1957). In an in-basket test, the participant is presented with various materials (e.g., memos, financial reports, letters) and is asked to respond to them. Performance is evaluated based on how the items are handled. For example, does the participant respond to a letter from the Director of Finance requesting 4th quarter financial records with complete and accurate information? Another form of a simulation is the assessment-center approach. The assessment center presents small groups of individuals with a variety of tasks, including in-basket tests, simulated interviews, and simulated group discussions (Bray, 1982; Thornton & Byham, 1982). The simulation approach has the advantage of more closely representing actual job performance. However, it is not always clear what aspects of the job should be chosen to simulate or how to evaluate performance.

The tacit-knowledge approach is based on research on expert-novice differences (see Chi, Glaser, & Farr, 1988) that shows that experts differ from novices primarily in the amount and organization of their domain-relevant knowledge. Our approach differs from the critical-incident technique in that we ask respondents to provide typical work-related situations and possible responses to them rather than relying on the individuals to determine for themselves which incidents are "critical." We use statistical techniques to identify the items that are "critical" to performance. Our approach shares with the simulation approach the view that measuring practically relevant behavior in a test situation depends, in part, on the extent to which the task resembles those found in everyday life. As such, we attempt to include sufficient detail in our measure to provide respondents with a realistic picture of the situation. However, we usually rely on a paper-and-pencil format to present this information rather than simulations for reasons of practicality, with the exception of our tacit-knowledge acquisition task for sales (Sternberg et al., 1993). We have chosen to capture more of the performance domain at the potential costs of less realism in our measure.

The tacit-knowledge tests typically employed in our research consist of a set of work-related situations, each with between five and twenty response items that represent various options for handling the situation. The situations pose a problem for the test-taker to solve, and the participant indicates how he or she would solve the problem by rating the various response items. For example, in a hypothetical situation presented to a business manager, a subordinate whom the manager does not know well has come to him for advice on how to succeed in business. The manager is asked to rate each of several responses (usually on a 1 = low to 9 = high scale) according to its importance for succeeding in the company. Examples of responses might include (a) setting priorities that reflect the importance of each task, (b) trying always to work on what you are in the mood to do, and (c) doing routine tasks early in the day to make sure you get them done. The set of ratings the participant generates for all the work-related situations is the measure of his or her tacit knowledge for that domain. In general, tacit-knowledge tests have been scored in one of three ways: (a) by correlating participants' responses with an index of group membership (i.e., expert, intermediate, novice), (b) by judging the degree to which participants' responses conform to professional "rules of thumb," or (c) by computing the difference between participants' responses and an expert prototype. To understand better what tacit knowledge tests are designed to measure we consider tacit knowledge as a measurement construct.

Tacit Knowledge as a Measurement Construct

Drawing on our description of the key features of tacit knowledge and the cognitive model presented in Chapter 4, we discuss tacit knowledge as a measurement construct. In other words, what are tacit-knowledge tests, and the items contained within them, intended to measure?

This question can be answered by considering a traditional distinction between achievement testing and intelligence testing. In achievement testing, items are presumed to exemplify the measurement construct (e.g., knowledge of world history) but are not commonly viewed as predictors. For example, when an individual correctly answers a

factual, multiple-choice question about world history, we assume that she possessed prior knowledge of either the fact in question or related facts that enabled her to rule out incorrect alternatives. We do not commonly view the history question as predictive of performance on other tests or tasks. In intelligence testing, by contrast, items are presumed to predict performance but are not commonly viewed as exemplars of the measurement construct. For example, when an individual correctly solves a figural analogy problem, we do not assume that he possessed prior knowledge of the analogical relationship in question. However, we do view such analogy problems as predictive of performance on other tests and tasks of general mental ability.

Is a measure of tacit knowledge an intelligence test or an achievement test? Having drawn a distinction between intelligence and achievement testing, we must point out that neither type of test exists in a pure form (Sternberg, 1998). All achievement tests measure underlying abilities--if only the abilities necessary to acquire and display the tested content--and so tend to have predictive value. Likewise, all intelligence tests measure acculturated knowledge--if only the knowledge necessary to make sense of items and testing conventions--and so tell us something about the knowledge content of individuals rated high and low in general intelligence. All of these tests measure a form of developing expertise (Sternberg, 1998). Tacit knowledge tests break down the (artificial) boundaries between achievement and ability testing.

Tacit-knowledge tests are knowledge-based tests built on a theory of human intelligence (Sternberg, 1995). They are intended to measure both practical, experience-based knowledge and the underlying dispositions or abilities that support the acquisition and use of that knowledge. Thus, scores on tacit-knowledge tests are expected to predict performance on tests or tasks that draw on either tacit knowledge or the mental abilities that supported its development and use. These abilities are hypothesized to differ from those implicated in the "general factor" in human intelligence commonly referred to as 'g' and measured, in norm-referenced fashion, as IQ. Research by Sternberg and colleagues has produced support for this hypothesis (Hedlund et al., 1998; Sternberg et al., 1993, 1995).

Because tacit-knowledge items are considered to measure both acquired knowledge and practical ability, we propose that tacit-knowledge tests have the potential to shed light upon (1) the content of tacit knowledge and (2) the events or experiences through which it was acquired. Few would contest that tacit-knowledge items reflect the knowledge of the respondents from whom the items were obtained (in the course of a "story-telling" exercise focusing on personal experiences). The items came from these respondents' memories and so must reflect the content of those memories. What remains to be determined is the degree to which tacit-knowledge items measure the acquisition and use of tacit knowledge by those who did not produce but, rather, endorsed or rated the items. This question is addressed by our numerous research studies in both civilian and military sectors, which we discuss in subsequent chapters.

Developing Tacit-Knowledge Inventories

We have developed tests to assess tacit knowledge for academic psychology, elementary-school teaching, business management, sales, entry-level jobs in organizations, college education, and military leadership. In this section we present a framework for developing tacit-knowledge tests of the format described above, a framework that is based on the techniques we have used to measure tacit knowledge in the various domains we have studied.

The development of tacit-knowledge inventories may be readily understood as a production process, beginning with the "raw materials" of experience-based knowledge elicited from successful practitioners in a given domain and culminating in a revised and validated inventory. At each step in the development process, "value" has been added through the conduct of research and analysis. Figure 5.1 shows, in schematic form, the major phases of the development process, the constituent research activities within each phase, and the information products that were produced at various points in the process.

All of the phases indicated in the figure are designed to support the development of assessment instruments based on (a) the theory and methods of tacit-knowledge research, and (b) the substantive knowledge in the domain of interest. Specifically, the steps are intended to aid in selecting the content that is most promising with respect to the goals of the assessment phase, that is, measuring an individual's possession of tacit knowledge. The term promising is used here to refer to that subset of tacit knowledge with the highest probability of yielding or contributing to tacit-knowledge test questions that, taken together, constitute a valid measure of the underlying, domain-relevant tacit knowledge of respondents. This process was developed over the course of our research with military leaders, but is applicable to the identification and assessment in tacit knowledge in any performance domain. We describe each stage in the process below, from the identification of exemplars of tacit knowledge to the construction of the final inventory.

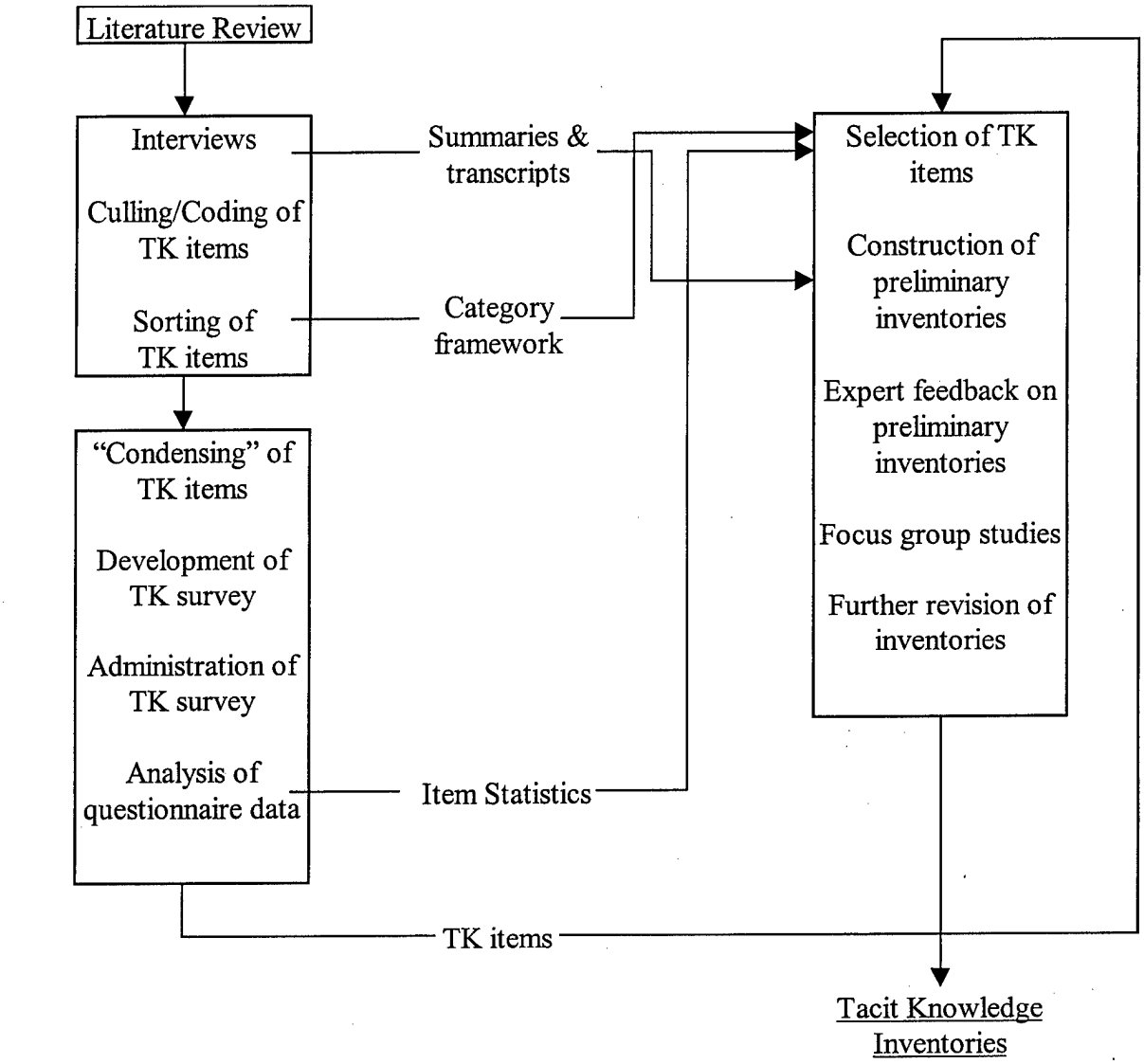

Figure 5.1. Flow chart showing phases, activities, and sources of information in the inventory development process.

Knowledge Identification

As shown in Figure 5.1, we generally begin with a review of job-relevant literature (e.g., sales manuals, Army trade publications) to identify on a preliminary basis the experience-based, tacit knowledge for the relevant profession (e.g., salespersons, Army leaders). This review may suggest some of the content for use in a tacit-knowledge inventory, and may provide a preliminary taxonomy, or category framework, for organizing the knowledge. For example, in research with managers (Wagner & Sternberg, 1986), we proposed a framework of practically-intelligent behavior consisting of tacit knowledge about managing oneself, managing others, and managing one's career.

Typically, a review of the literature does not provide a sufficient number of examples of knowledge that meet our criteria or include enough detail from which to create tacit-knowledge questions of the format described above. In our review, we found that the practical advice presented in the professional literature tended to be decontextualized and already converted to semantic knowledge. We also surmise that the politics of professional print may keep some truly tacit knowledge—knowledge that contradicts doctrine, for example—out of print altogether. Therefore, the next step is to conduct interviews with successful practitioners in the domain to generate a larger body of knowledge from which to draw in developing the tacit-knowledge inventories. We described here a method for conducting these interviews.

A method for eliciting tacit knowledge. In initial research by Sternberg and his colleagues (Sternberg et al., 1993; Wagner, 1987), interviews were conducted with academic psychologists deemed successful based on their tenure and affiliation (e.g., full professors at Yale); business managers who were considered successful on the basis of their position in the company; salespersons who were successful in their sales performance; and successful college students. All of these experts were asked to consider what it takes to succeed in their respective domains and to provide typical performance-related situations and possible responses to those situations that exemplify such knowledge. In subsequent research, we used a more structured interview in which participants were provided with more explicit instructions about the knowledge we sought to identify. We describe the steps involved in conducting interviews with experts at a general level here and provide a specific example of an interview protocol for military officers in Appendix A.

In order to identify the tacit knowledge in a domain, we first need to locate individuals who are likely to possess a substantial level of tacit knowledge. Because tacit knowledge is grounded in personal experience, we seek practitioners who have spent a certain amount of time in their job. And because tacit knowledge is acquired with little environmental support, we seek practitioners who have exhibited success on the job, and not necessarily success in the classroom or other formal training environments. One of the main objectives of understanding tacit knowledge is to understand successful performance. The obvious source for identifying tacit knowledge is the successful practitioner.

Once a relevant pool of "expert" practitioners has been narrowed down, how does one proceed to find out what these experts know? The method we have used to elicit tacit knowledge from practitioners is through semi-structured interviews. The semi-structured interview begins with a set of standard questions/instructions that the interviewer is expected to follow. However, the interviewer is allowed to ask additional questions as deemed necessary to obtain clarification or expansion of a respondent's answer.

The interview generally takes the following format. First, the interviewer introduces him or herself and explains the purpose of the research. The goal of tacit knowledge research can be expressed as an attempt to understand the lessons that practitioners have learned through their on-the-job experiences. In doing so, the researchers will gain insight about how to promote effective performance. It is important to clarify that the research is not an evaluation of the person's performance.

Next, the interviewer explains what he or she is hoping to learn from the interview. The tacit-knowledge construct is defined in a way that can be readily understood by the interviewee. The interviewer may clarify what tacit knowledge is and is not. For example, tacit knowledge may be described as knowledge gained in the process of facing a challenge in one's job. The interviewer may also specify that he or she is not necessarily interested in the "policy" or "theory" regarding what one does, but rather what works.

Because tacit knowledge may not be readily articulated by interviewees, we have found that an effective method of encouraging practitioners to reflect on their knowledge is to ask them to recount stories or incidents in which they learned something important about their job. The interviewer generally follows up on the stories with questions that ask for more details about the situation, additional insights about the thought processes involved in the situation (e.g., objectives, alternative courses of action considered), and what the individual learned from the experience that might be applicable to other situations.

At the end of the interview session, the participant is thanked and given an opportunity to ask questions. Immediately following the interview, the interviewer writes a summary of the interview. The summary may include the following information: a) participant information (e.g., position, time in job, race, gender), b) a summary of each story, c) annotations to each story based on follow-up questions, and d) any comments from the interviewer.

Even with explicit instructions about what the interviewer is looking for, not all of the stories generated from the interviews provide examples of tacit knowledge. Therefore, the elicitation of tacit knowledge does not end with the summarized interviews. The interview summaries are submitted to a panel of experts who are familiar with both the performance domain and the tacit-knowledge construct. These experts are asked to judge whether the interview summary represents knowledge that is intimately related to action, is relevant to the goals that the individual values, is acquired with minimal environmental support, and is relevant to performance in the domain under study (e.g., academic psychology, military leadership).

Products of the interviews. The products of the interviews are transcripts and summaries that contain numerous potential examples of tacit knowledge. These summaries serve two purposes in instrument development. First, tacit-knowledge "items" (essentially pieces of advice) may be extracted from the summaries and used in a number of later analyses. Second, the summaries themselves (consisting of stories that the professionals shared about their experiences) can be used directly in the construction of the inventory.

A useful interim step is to ask a panel of experts (e.g., members of the research team or practitioners familiar with the tacit-knowledge construct) to review the knowledge compiled from the interview summaries to ensure that it meets the criteria for tacitness. These criteria are: (1) the knowledge should have been acquired with little environmental support, (2) it should be related to action, and (3) it should have relevance to the goals that the person values. Often upon further review a knowledge example may be judged by experts to fail to meet one of these criteria. For example, consider the following story told by a military officer.

> I had a lieutenant who was screwing up big-time. He would take sensitive items (e.g., weapons, night-vision devices, etc.) home. He even lost sensitive items. He lost a pistol, and rather than stop the mission and look for it, he continued on with the mission. As we all know, when you lose a sensitive item, you stop everything and look for it until you find it.

The above story was deemed to lack the necessary criteria for tacitness. The interviewee indicated that the knowledge he refers to is generally known by leaders. It even may represent an official procedure. Therefore, we have no evidence that this knowledge is attributable to the officer's experience in dealing with sensitive items that are missing. On the other hand, consider a story from another officer about a similar issue.

> It is important for a commander to know when to report bad news to the boss and when to withhold it. My unit had just completed a night move and had been in position for about two hours. A weapon was identified as missing around mid-night. The section chief told me that the weapon was in the current position because he had seen it during the sensitive item checks. I talked to each member of the section and determined that the weapon was in the position. We looked for the weapon from about midnight until 0300 hours. During this time I chose not to notify the battalion commander because I was confident that the weapon would be found. However, a sensitive item report was due at 0400 hours, so, for ethical reasons, I notified the battalion commander at 0300 hours that the weapon was missing. I told the battalion commander what I had done so far and that I was confident that the weapon would be found at first light. He was not upset. We found the weapon in ten minutes after the sun came up and the battalion commander was pleased we followed the standard operating procedures for dealing with a missing weapon.
>
> In this story, the officer clearly expresses some knowledge he has acquired through

previous experience in dealing with missing sensitive items (e.g., weapons). He has learned that under some circumstances, it is best to hold off reporting a problem until it becomes necessary so long as appropriate steps are taken to resolve the problem in the interim.

Coding the interview summaries. After determining which examples of knowledge meet the established criteria, it is useful to transform the summaries into a more usable form for the purpose of later analyses. We have used a format that is based on the procedural feature of our definition of tacit knowledge. That is, the knowledge is expressed as a mapping between a set of antecedent conditions and a set of consequent actions. An example of a tacit-knowledge story and the item derived from it is shown in Table 5.1.

Table 5.1.
Example Leadership Story with Coded Knowledge Item

Story Summary
The battalion commander noticed that his company commanders were trying so hard to be successful that they would accept missions that their units did not have the capabilities to execute. Thus, the companies and the commanders would expend a great deal of effort and time to accomplish the mission without asking for help from the battalion in order to demonstrate their talents as leaders. The battalion commander gave one of his commanders a mission and the commander worked his unit overtime for two weeks to accomplish it. The battalion commander realized that the same mission could have been accomplished in two days if the commander had requested resources from the battalion. After that incident, the battalion commander made it a point to ask the company commanders to realistically assess their units' resources before taking on a mission. The battalion commander felt that all commanders wanted to succeed and earn the top block rating due to the competitive environment in today's Army.

Coded Item
IF your company commanders have a strong desire to be successful and earn top block ratings
AND
IF they also have a tendency to take on resource-intensive missions that exceed their capabilities
AND
IF they are reluctant to ask higher headquarters for help when they have missions that tax their units' resources
THEN require commanders to conduct resource assessments before they take on missions
BECAUSE an accurate resource assessment should indicate whether or not the unit has the resources to handle the mission. This assessment may prevent commanders from taking on a mission that would overburden their unit.

As the example shows, the item of knowledge is represented by one or more

antecedent condition or "IF" statements, by one or more consequent action or "THEN" statements, and by a brief explanation or "BECAUSE" statement. The logical operators "AND" and "OR" are used in the coding to signal relationships of conjunction and disjunction, respectively. The operator "ELSE" is employed in the coding to connect sets of condition-action mappings into more complex procedures. Each individual piece of tacit knowledge is rewritten into this procedural form. This coding allows the researcher to analyze more readily the content of the tacit knowledge for the purpose of identifying categories of knowledge and selecting examples of knowledge that may be useful as items in a tacit-knowledge inventory. The result of this phase is a set of coded tacit-knowledge items.

The coded tacit-knowledge items then may be subjected to a sorting process to identify major categories of tacit knowledge. This sorting may entail asking a group of experts to organize the items according to categories of their own devising. The results of the independent sortings may be analyzed using cluster analysis, a family of techniques for uncovering the natural groupings in a set of data (for more details of this technique, see Hartigan, 1975). This analysis produces hierarchically organized clusters of items that can be expressed in the form of a tree. The clusters can be interpreted by experts and assigned labels that represent different categories of tacit knowledge. These categories may provide an indication of the major areas of learning that occur in one's respective field. The category framework is also useful in selecting items for test development that are representative of the entire performance domain.

Item Selection

Although one may proceed to develop test questions directly from the tacit-knowledge items generated from the interviews, a further selection process may be necessary for a number of reasons. First, the interview study may yield too many items of tacit knowledge to include in a tacit-knowledge inventory of reasonable length, depending on the context in which the test might be used. Second, we cannot determine on the basis of the interviews alone what tacit knowledge is diagnostic of experience or predictive of effective performance in a given domain, or alternatively, what tacit knowledge is not related to these criteria. A manager, for example, may have learned that subordinates are more likely to come to her with problems if she leaves her door open. But the extent to which this contributes to her success is unclear. By leaving her door open she may become the repository for problems that are the responsibility of other managers, which may create a distraction for her from her job. Third, the results of the preliminary sorting of interview data may not be sufficient for determining the internal structure of the tacit-knowledge construct domain. That is, for the purposes of test construction, we would want further evidence of the structure of the performance domain to ensure the representativeness of our items. For the reasons above, we take an additional step to narrow down the pool of items from which test questions will be constructed.

The next step in the process of selecting items for instrument development is more quantitative than qualitative. It entails surveying job incumbents to assess the "quality" of each tacit-knowledge item. In order to develop a questionnaire that can be

administered to job incumbents, the tacit-knowledge items may need to be condensed. For example, if we want professionals to evaluate 100 examples of tacit knowledge, it would be unreasonable to ask them to read 100 items of the form shown in Table 5.1. Therefore, it may become necessary to condense the items into briefer descriptions. Condensing the items involves extracting only the most important information and deleting unnecessary information. Attempts should be made to increase the comprehensibility of the items for the intended audience and to preserve the intent of the interviewee who provided the knowledge. As shown in the example of a condensed tacit-knowledge item for military leaders (see Figure 5.2), the procedural structure that we consider to be characteristic of tacit knowledge is maintained in the rewriting of items.

If a training event scheduled by your battalion commander conflicts with a training event scheduled by your supported-unit commander and if the event scheduled by the supported-unit commander has potentially greater training value, then take a risk and give priority to the supported-unit commander's training event. By taking a risk to provide your soldiers with the best training, you earn their trust.

1. How good is this advice for company commanders?

1	2	3	4	5	6	7
Extremely bad			Neither bad nor good			Extremely good

2. How commonly known is this advice among company commanders?

1	2	3	4	5	6	7
Known by almost none			Known by some			Known by almost all

3. How often do company commanders face situations like this?

1	2	3	4	5	6	7
Almost never			Sometimes			Almost all the time

4. To what extent does this advice match your concept of leadership?

1	2	3	4	5	6	7
Does not match my concept of leadership at all			Matches my concept of leadership somewhat			Matches my concept of leadership very closely

Figure 5.2. Example question from tacit knowledge survey (company commanders).

The condensed items are compiled into a survey, which we refer to as a Tacit Knowledge Survey (TKS). Job incumbents can be asked to rate each item on a number of dimensions (as shown in Figure 5.2). We have used four seven-point scales that ask for the following judgments: (1) how good does the respondent think the advice is, (2) how commonly known does the respondent think the advice is, (3) how often, in the judgment of the respondent, do incumbents at the specified level face situations such as the one described, and (4) to what extent does the advice match the respondent's personal concept of job performance? Each of the scales is intended to provide a different sort of information about the tacit-knowledge item being rated. The "good" scale is intended to

assess the overall quality of the knowledge being rated. The "known" scale is intended to assess one possible index of tacitness (i.e., on the theory that knowledge whose acquisition is not well supported by the environment may be less commonly known than other knowledge). The "often" scale is intended to assess the generalizability or applicability of knowledge items across job settings within the domain. Finally, the "concept" scale is intended to assess respondents' implicit theories of performance. Together, the four rating scales are intended to provide a comprehensive but non-redundant picture of each tacit-knowledge item for the purpose of evaluating each item's potential for development into tacit-knowledge test questions.

This stage of item selection also entails obtaining data on a relevant criterion so that one can identify items that are predictive of successful performance. In our research with military leaders, we obtained two criterion measures, experience and performance ratings. Experience was expressed in terms of expert-novice differences and performance was assessed using ratings of leadership effectiveness by supervising officers. Responses to the TKS are analyzed along with the criterion measure to identify items that have promise for inclusion in the tacit-knowledge inventory. This analysis generates a number of item statistics that can be used in the selection process.

In our research, we used discriminant analysis to identify items that distinguish individuals with more from those with less experience and those who are more from those who are less effective in their job. Structure coefficients were generated for each item that indicated the item's potential to discriminate between more and less experienced as well as more and less effective individuals. Item statistics such as these can be used, along with the category framework developed in the interview phase, to select items that have the most potential to explain successful performance and provide the best "coverage" of the tacit-knowledge domain.

Instrument Construction

The "knowledge identification" and "item selection" phases generate several outputs that serve as materials for the final phase of "instrument construction." These outputs include: (a) interview transcripts and interview summaries, (b) the category framework derived from expert sort data, (c) a set of item statistics for use in the selection of content for the inventories, and (d) the knowledge items retained on the basis of the category framework and item statistics from the survey study. In the next phase of test development, preliminary inventory questions are constructed, using both selected knowledge items and the interview summaries from which they were drawn. A tacit-knowledge question consists of a situation description followed by several potential responses to that situation. Although the condensed tacit-knowledge item may serve to describe the situation, it is preferable to include the details from the original story to provide a richer, more in-depth problem description. Including more contextual and situation-specific information in the question provides the respondent with a clearer basis on which to evaluate the appropriateness of potential responses to the situation. The original story also provides a source for developing response options to the question.

Once the researchers are satisfied with the form of the preliminary inventory, it

may be beneficial to circulate the inventory among experts in the domain. One method of obtaining feedback is to convene a focus group of experts to review and discuss the inventory. In our research, focus-group participants were given a brief introduction to the goals of the project and an explanation of the tacit-knowledge construct in non-technical language. They were asked to judge the construct-relatedness of inventory questions by considering whether the question addresses knowledge gained through experience and fits the definition of tacit knowledge provided. In addition, focus group participants were asked to help "fill gaps" and "fix problems" in the inventory. In particular, they were asked to (a) provide additional, plausible response options for any question; (b) identify areas of confusion or lack of clarity; (c) identify problems of gender, racial, or ethnic bias; and (d) identify anything that does not "ring true" in the inventory questions.

The researcher can use the feedback from the focus group to revise the inventories. For example, inventory questions for which judgments of construct-relatedness were not unanimous (and positive) may be omitted from the inventory. Similarly, a response option or scenario feature that was objected to by two or more participants may be omitted. The focus group may have suggested additional response options or scenario features, which can be added to the inventory. The final result of this test-development process is a revised tacit-knowledge inventory that can be administered to job incumbents and used to address further research questions, such as those regarding criterion-related validity.

Summary

The phases described above all are designed to support the construction of tacit-knowledge tests. The tacit-knowledge items acquired in the interview study form the raw materials for this construction process. During this process, the tacit-knowledge items are subjected to qualitative analysis (e.g., sorting into categories) and quantitative analysis (e.g., obtaining quality ratings). The various phases serve to address two basic questions about the pool of tacit-knowledge from which an instrument will be developed. First, which items are most promising for use in the construction of tacit-knowledge test questions? Second, what does the underlying structure represented by the tacit-knowledge items tell us about the structure of the construct domain so that we can design our tacit-knowledge tests to capture this domain? The result of this process is an inventory that has greater likelihood of possessing both internal and external validity. We discuss the issue of validity in the last part of this chapter.

Establishing the Validity of Tacit-Knowledge Inventories

Because tacit-knowledge tests are, in a sense, hybrids of conventional achievement tests and ability tests, they differ somewhat from either of these types of tests in the way in which they are constructed and validated. In achievement testing, content validation takes precedence over construct or criterion validation--the content is the construct and mastery of content is the criterion. In tacit-knowledge testing, there are no objectively correct answers and so the measurement of concurrence with an expert response profile is common in test scoring. In intelligence testing, measurement of criterion-related validity has traditionally predominated over the evaluation of content.

An item or class of items that loads heavily on a factor of human intelligence, for example, may be deemed to measure the underlying construct. In tacit-knowledge testing, however, a theory about human-knowledge acquisition specifies what counts and does not count as tacit knowledge. For this reason, a strictly correlational approach to item selection is undesirable.

As Nunnally (1970) and others have argued, such a "criterion-based" approach to test development is problematic and often produces measurement instruments of inferior quality. Specifically, such an approach may be expected to yield tests that suffer from low internal-consistency reliability, poor factor structure, and fragility with respect to criteria other than those on which the selection of items was based. We attempt to select items that best measure the tacit-knowledge construct, based on a total package of construct validity evidence. We discuss the phases of test development outlined above within the context of Messick's (1995) unified validity framework to show how these steps contribute to the validity of our tacit-knowledge tests.

Messick's framework treats the traditionally separate forms of validity (i.e., content, construct, and criterion) as aspects of a more comprehensive construct validity. According to this framework, the essential goal of test validation is to support, through a combination of theoretical rationale and empirical evidence, the interpretation of tests scores and the uses of scores under that interpretation.

The Content Aspect

The content aspect of validity refers to evidence that test content is relevant to and representative of the focal construct. It addresses the concerns that fall under the traditional heading of content validity. In the context of tacit-knowledge test development, the goal of construct relevance calls for tacit-knowledge test questions that are sensitive to knowledge of the type specified by the focal construct and insensitive to knowledge that falls outside the focal construct. A first step towards this goal is taken during the identification phase of test development, in interviews with job incumbents, when we orient participants toward personal experiences and away from formal principles or theory within their performance domains. A second step is taken in the item-selection phase when incumbents are asked to rate the quality of tacit-knowledge items. These ratings (i.e., item means and variances) may provide evidence regarding the relevance of tacit-knowledge items to the underlying construct. For example, tacit-knowledge items with low mean ratings (i.e., when respondents, on average, consider the knowledge represented in the item to be bad advice) may not be relevant to successful performance. And items with low variances (i.e., when respondents agree highly about the quality--good or bad--of the knowledge reflected in the item) may not reflect knowledge gained through personal experience if the knowledge is generally agreed upon as good. In addition to these steps, the goal of establishing construct relevance is also supported by asking domain experts, at various stages in the test development process, to judge the relevance of the items to the tacit-knowledge construct.

The goal of construct representativeness calls for tacit-knowledge items that are typical rather than atypical of knowledge items specified by the focal construct. An

initial step toward this goal is taken in the identification phase by interviewing job incumbents that are representative of the range of specialty areas within the domain. For example, military leaders in the same position (e.g., platoon leader) may serve in one of many branches (e.g., infantry, engineering). Therefore, in our research we sought to interview officers from these various branches to increase the representativeness of the knowledge that was elicited. A second step is taken during the item-selection phase when participants are asked to rate how "often" a situation presented in a tacit-knowledge item occurs. Items that receive both a low mean and small variance, for example, are ones that most incumbents agree occur almost never, and therefore may not be representative of the knowledge domain. The categories derived from cluster analyses of the tacit-knowledge items also provide a source for ensuring construct representativeness. Items can be chosen to represent each of the major categories of tacit knowledge, thus providing better coverage of the construct domain. Finally, at several points during test development, experts' judgements are sought regarding the construct representativeness of the items. After an initial pool of potential tacit-knowledge items is obtained from the interviews, an expert panel is asked to judge the representativeness of each item. The experts are asked to eliminate items that are too narrow or technical in focus (e.g., how to safely store chemical weapons) or knowledge that is relevant to a small proportion of job incumbents (e.g., how to manage stress at work if you are a single mom). Experts again are asked to evaluate the representativeness of the items after preliminary test questions have been developed.

The Substantive Aspect

The substantive aspect of validity refers to the theoretical rationale embodied in our cognitive model of tacit knowledge as it relates to task (test) performance. A major step toward the goal of substantive validity is represented by the model of tacit knowledge presented in Chapter 4. The model is used to suggest that the possession of tacit knowledge will confer an advantage (relative to that conferred by nontacit job knowledge) in people's responding to contextualized problems of realistic complexity. Thus, the cognitive model of tacit knowledge, which is the basis for how we identify and measure tacit knowledge, provides a theoretical rationale for tacit-knowledge test performance and, as such, directly serves the goal of substantive validity. Researchers may also wish to collect empirical evidence to test the propositions of our model more directly. This evidence could involve testing the extent to which participants draw on personally experienced, rather than received, knowledge in performing job-relevant tasks.

The Structural Aspect

The structural aspect of validity refers to the level of fit between the internal structure of the test and the internal structure of the construct domain. It is related to the issue of construct representativeness we discussed earlier. A first step toward the goal of structural validity is taken by interviewing and eliciting knowledge from job incumbents in all areas that represent the performance domain. For example, in our study with military leaders, we interviewed officers in all three of the major branch categories within the Army (i.e., combat arms, combat support, combat service support). The goal of

structural validity also is served by administering measurement instruments (e.g., the Tacit Knowledge Survey) to a wide variety of job incumbents. By using broad samples of job incumbents, we are able to avoid basing our analyses and test development on a restricted subset of the tacit knowledge domain. Of course, the structural aspect of validity is addressed most directly through statistical techniques like cluster analysis and multidimensional scaling that identify the internal structure of the sample of items. By examining the internal structure we cast a wider net in our selection of tacit-knowledge items, and in so doing, we have improved our prospects for developing tacit-knowledge tests that mirror the structure of the construct domain (i.e., the domain of practical, action-oriented knowledge that Army leaders acquire from personal experience).

The Generalizability Aspect

The generalizability aspect of validity refers to the extent to which score properties and interpretations generalize across groups, settings, and tasks. The generalizability aspect includes concerns that traditionally fall under the heading of "reliability." In the context of tacit-knowledge test development, the goal of generalizability calls for tacit-knowledge test scores that generalize across (1) roles within the organization, (2) repeated administrations, and (3) alternate forms of the test. Test development efforts relevant to the content, substantive, and structural aspects of validity are also relevant to the generalizability aspect. In general, by seeking to specify and measure the construct, rather than merely pursuing correlation with an external criterion, we presumably increase the generalizability of score interpretations for our tacit-knowledge tests.

The External Aspect

The external aspect of validity refers to the issue of criterion-related validity. That is, we seek to establish that the test relates to an external criterion. More specifically, the goal is to obtain evidence of convergent and discriminant validity. Establishing criterion-related validity entails showing that tacit-knowledge test scores correlate more highly (i.e., converge) with theoretically related constructs (e.g., performance) and correlate less highly (i.e., diverge) with theoretically distinct constructs (e.g., general intelligence, formal job knowledge).

Test-development efforts to specify and measure the tacit-knowledge construct also support the goal of criterion validity. For example, job incumbents are asked to provide examples of important lessons they learned in the course of performing their job rather than knowledge they gained in school. These instructions increase the likelihood that the tacit-knowledge items obtained will be related to performance criteria and be distinct from formal job knowledge. Research during the item-selection phase involves more directly assessing the relation of these items to external criteria. This step helps to identify tacit-knowledge items that are indicative of successful performance.

Beyond these efforts to support criterion-related validity, an additional step in the test-development process is taken to provide evidence of convergent and discriminant validity. In the context of tacit-knowledge test development, possible discriminant

evidence would be that which discounts the effects of general intelligence, reading comprehension, and general job knowledge on tacit-knowledge test scores. Evidence of convergent validity would include a correlation between tacit-knowledge test scores and variables such as perceived job effectiveness, degree and rate of career advancement, and performance on job-relevant tasks. To obtain such evidence requires conducting a validation study in which measures of these variables are administered to or obtained from job incumbents. For example, in our research with managers and military leaders, we administered the tacit-knowledge inventory along with a measure of general intelligence and obtained performance ratings from supervisors and/or co-workers. Correlational and hierarchical regression analyses can be used to assess convergent and discriminant validity. Convergent validity is supported by a significant relationship between tacit-knowledge test scores and the performance criterion (e.g., supervisor ratings). Discriminant validity is supported by a significant increment in the validity of tacit-knowledge test scores over measures such as general intelligence and general job knowledge.

The Consequential Aspect

The consequential aspect of validity refers to the value implications of the intended use of score interpretation as a basis for action. Because tacit-knowledge tests may be used for employee assessment and development, or even selection, it is important to consider how the knowledge included in those tests fits into the culture and rules of the organization. For example, if an item of tacit knowledge meets all the criteria discussed above (e.g., satisfies the definition of tacit, exhibits a strong positive correlation with effective performance), but it conflicts with the organizational culture (e.g., suggesting that females should be given less responsibility than males) or it involves disobeying a regulation (e.g., suggesting that financial figures should be fudged when information is unavailable), then it may be inappropriate to include in a tacit-knowledge test. Relying on experts to review the tacit-knowledge items throughout the test development process helps to ensure that issues related to the consequential aspect of validity are addressed.

Summary

The goal of the test-development process outlined in this chapter is to support the construction of valid tacit-knowledge tests. Our model of tacit knowledge constitutes, we believe, a step in the direction of this goal. By elaborating the tacit-knowledge construct at the cognitive level, we set the stage for a more detailed consideration of item content during the selection process and, in so doing, increase the substantive validity of our tests. The analysis of item ratings and performance data constitutes a second step towards measuring the construct. By identifying those items with the strongest association with performance criteria, we increase the probability that we will select items and construct test questions that embody the construct--given that the construct model makes clear predictions about the performance benefit of tacit knowledge. The analysis of the underlying structure by sorting items into categories constitutes a third step towards our goal. By examining the structure of the tacit-knowledge space (based on our sample) we are able to make more informed decisions about the distribution of item content in our tacit-knowledge tests and, in so doing, increase the structural validity

and generalizability of score interpretations. Finally, by conducting validation studies we provide support that tacit knowledge is relevant to understanding performance in the domain of interest and that it contributes to that understanding beyond traditional indicators of performance. In the next two chapters we discuss the development and validation of tests to measure tacit-knowledge in the civilian and military domains, respectively.

Chapter 6
The Role of Practical Intelligence in Adaptation: the Civilian Workplace

Our program of research is based on the notion that there is more to successfully predicting job performance than just measuring the general factor from conventional psychometric tests of intelligence (see Sternberg & Wagner, 1993). We propose that tacit knowledge, as an aspect of practical intelligence, is a key ingredient to job success. Of course, there are those who disagree with this position (see Jensen, 1993; Ree & Earles, 1993; Schmidt & Hunter, 1993, 1998), suggesting that individual differences in performance are explained primarily by general cognitive ability. Some proponents of using general cognitive ability tests argue further that the value of these tests are that they are applicable for all jobs, have lowest cost to develop and administer, and have the highest validity (e.g., Schmidt & Hunter, 1998). But even Schmidt and Hunter acknowledge that alternative measures such as work sample tests and job knowledge tests have comparable and perhaps even higher validities than general ability tests, and provide incremental prediction above the latter. We present findings from a number of studies by Sternberg and his colleagues that support the validity of tacit knowledge tests. We organize these findings around several main issues: (a) tacit knowledge as a general construct; (b) the relationship of tacit knowledge to experience; (c) the relationship of tacit knowledge to general intelligence; (d) the relationship of tacit knowledge to performance.

Tacit Knowledge as a General Construct

Tacit knowledge has been studied in domains as diverse as bank management, research psychology, and primary education, and it has proven successful in understanding and accelerating the lessons of experience (Sternberg & Wagner, 1993; Sternberg, et al., 1993; Sternberg et al., 1995; Wagner, 1987; Wagner & Sternberg, 1985). A primary objective of this research on tacit knowledge has been to identify the content of tacit knowledge and develop ways to measure the possession of tacit knowledge. Tacit-knowledge tests present a set of problem situations and respondents are asked to rate the quality or appropriateness of a number of possible responses to those situations. (The format and development of tacit-knowledge tests was discussed in the previous chapter of this report.)

An objective of early tacit-knowledge research was to determine if there was a general factor underlying tacit knowledge, and if this factor was different from the general factor measured by traditional psychometric tests of intelligence. One of the first inventories developed was a measure of tacit knowledge for business managers. This test was administered to a sample of 64 business managers (Wagner, 1987). In order to explore the structure of tacit knowledge, Wagner performed two kinds of factor analyses on the tacit-knowledge scores of these business managers. First, a principal-components analysis yielded a first principal component that accounted for 44 percent of the total variance, and 76 percent of total variance after the correlations among scores were disattenuated for unreliability. The 40 percent variance accounted for by the first principal component is typical of analyses carried out on traditional cognitive-ability

subtests. Second, results of a confirmatory factor analysis suggested that a model consisting of a single general factor provided the best fit to the data. The results of both factor analyses suggest a general factor of tacit knowledge.

Additional support for the generality of tacit knowledge was provided with a different measure of tacit knowledge for the domain of academic psychology. In a study parallel to the managerial one, samples of psychology professors, graduate students, and undergraduates completed a version of a tacit-knowledge test for academic psychologists. Consistent with the manager study, the factor analytic results suggested a single factor of tacit knowledge within the domain of academic psychology. Wagner (1987) also examined the generalizability of tacit knowledge across domains. A group of 60 undergraduates was given tacit-knowledge measures for both domains--business management and academic psychology--in counterbalanced order. The correlations between scores across measures was .58 for total score, $p < .001$ level. This finding suggest that in addition the existence of a general factor of tacit knowledge within a domain, individual differences in tacit knowledge generalize across domains.

The Relationship of Tacit Knowledge to Experience

In several studies, we have shown that individuals with less experience in a given domain exhibit lower scores on tacit-knowledge inventories. In a cross-sectional study, we administered a tacit-knowledge inventory to three groups of participants, totaling 127 individuals, who differed in amounts of experience and formal training in business management (Wagner & Sternberg, 1985). One group consisted of 54 business managers; another group consisted of 51 business school graduate students; and a third group consisted of 22 Yale undergraduates. The means and standard deviations for amount of managerial experience were 16.6 (9.9) years for the business manager group; 2.2 (2.5) for the business graduate student group, and 0.0 (0.0) for the undergraduate group. Group differences were found on 39 of the response-item ratings, with a binomial test of the probability of finding this many significant differences by chance yielding $p < .0001$. We conclude from this study that there were genuine differences in the ratings for the groups. We obtained comparable results comparing Yale undergraduates, psychology graduate students, and psychology faculty on a tacit-knowledge test for academic psychologists (Wagner & Sternberg, 1985).

In a second cross-sectional study, we obtained tacit knowledge scores from three new groups of 64 managers, 25 business graduate students, and 60 Yale undergraduates (Wagner, 1987), and we used a prototype-based scoring system that allowed direct comparisons of the performance of the three groups. In this study, the business-management group, whose average age was 50, outperformed the business graduate students and the undergraduates. The business graduate students in turn outperformed the undergraduates. Again, comparable results were obtained for psychology professors, psychology graduate students, and undergraduates.

In a later study focusing on the development of tacit knowledge over the managerial career, Williams and Sternberg (cited in Sternberg et al., 1995) used extensive interviews and observations to construct both a general and a level-specific tacit-

knowledge measure. We administered this measure to all executives in four high-technology manufacturing companies. We also obtained nominations from managers' superiors for "outstanding" and "underperforming" managers at the lower, middle, and upper levels. This approach enabled us to delineate the specific content of tacit knowledge for each level of management (lower, middle, and upper) by examining what experts at each level knew that their poorly-performing colleagues did not.

Our results showed that there was indeed specialized tacit knowledge for each of the three management levels and that this knowledge was differentially related to success. These results were derived from comparing responses of outstanding and underperforming managers within each management level on level-specific tacit-knowledge inventories. Within the domain of intrapersonal tacit knowledge, knowledge about how to seek out, create, and enjoy challenges is substantially more important to upper-level executives than to middle- or lower-level executives. Knowledge about maintaining appropriate levels of control becomes progressively more significant in higher levels of management. Knowledge about self-motivation, self-direction, self-awareness, and personal organization is roughly comparable in importance at the lower and middle levels, and somewhat more important at the upper level. Finally, knowledge about completing tasks and working effectively within the business environment is substantially more important for upper-level managers than for middle-level managers, and substantially more important for middle-level managers than for lower-level managers. Within the domain of interpersonal tacit knowledge, knowledge about influencing and controlling others is essential for all managers, but especially for those in the upper level. Knowledge about supporting, cooperating with, and understanding others is extremely important for upper-level executives, very important for middle-level executives, and somewhat important for lower-level executives.

The Relationship of Tacit Knowledge to General Intelligence

If individual differences in tacit knowledge appear to have some domain generality, have we accidentally reinvented the concept of "g," or general ability, which can be measured by an intelligence test? Results from several studies of tacit knowledge, in which participants have been given a traditional measure of cognitive ability in addition to a tacit knowledge-inventory, suggest that this is not the case.

Wagner and Sternberg (1985) gave the Verbal Reasoning subtest of the Differential Aptitude Tests (Form T) to a sample of 22 undergraduates. The correlation between tacit knowledge and verbal reasoning was .16 ($p > .05$). In subsequent studies, a deviation-scoring system was used to quantify tacit knowledge, which made lower scores indicate better performance than higher scores. Thus, a positive relation between tacit knowledge and cognitive ability would be represented by a negative correlation. For a sample of 60 undergraduates, the correlation between tacit knowledge and verbal reasoning was -.12 ($p > .05$).

One important limitation of these results is that the participants were Yale undergraduates and thus represented a restricted range of verbal ability. In addition, undergraduates have relatively little tacit knowledge compared to experienced managers.

Rather different correlations between tacit knowledge and IQ might therefore be expected for other groups, such as business managers. We administered the Tacit Knowledge Inventory for Managers to a sample of 45 managers who were participants in a leadership-development program at the Center for Creative Leadership (Wagner & Sternberg, 1990). Participants in the program routinely completed a battery of tests including an intelligence test. For this sample, the correlation between tacit knowledge and IQ was -.14 ($p > .05$).

But even business managers represent a restricted range in IQ and perhaps in tacit knowledge as well. What would be the relation between tacit knowledge and IQ in a more general sample? In a study carried out at the Human Resources Laboratory at Brooks Air Force Base under the supervision of Malcolm Ree, Eddy (1988) examined relations between the Tacit Knowledge Inventory for Managers and the Armed Services Vocational Aptitude Battery (ASVAB) for a sample of 631 Air Force Recruits, 29 percent of whom were females, and 19 percent of whom were members of a minority group. The ASVAB is a multiple-aptitude battery used for selection of candidates into all branches of the United States Armed Forces. Prior studies of the ASVAB suggest that it is a typical measure of cognitive ability, with correlations between ASVAB scores and other cognitive ability measures of about .7. Factor-analytic studies of the ASVAB also suggest that it appears to measure the same verbal, quantitative, and mechanical abilities as the Differential Aptitude Tests, and the same verbal and mathematical knowledge as the California Achievement Tests.

Eddy's (1988) study showed small correlations between tacit knowledge and ASVAB subtests. The median correlation was -.07, with a range from .06 to -.15. Of the 10 correlations, only two were significantly different from 0, despite the large sample size of 631 recruits. A factor analysis of all the test data, followed by oblique rotations, yielded the usual four ASVAB factors (vocational-technical information, clerical/speed, verbal ability, and mathematics) and a distinct tacit-knowledge factor. The factor loading for the Tacit Knowledge Inventory for Managers score on the tacit-knowledge factor was .99, with a maximum loading for the score on the four ASVAB factors of only .06. Upon oblique rotation, the four ASVAB factors were moderately intercorrelated, but the correlations between the tacit knowledge factor and the four ASVAB factors were near 0 (.075, .003, .096, .082).

One final point about these results concerns the possibility that measures of tacit knowledge might identify potential managers from nontraditional and minority backgrounds whose practical knowledge suggests that they would be effective managers, even though their performance on traditional selection measures such as intelligence tests does not. Eddy (1988) did not report scores separately by race and sex, but did report correlations between scores and dummy variables indicating race and sex. Significant correlations in the .2 to .4 range between ASVAB subtest scores and both race and sex indicate that on the ASVAB, minority-group members scored more poorly than majority group members, and women scored more poorly than men. Nonsignificant correlations between tacit knowledge and both race (.03) and sex (.02), however, indicate comparable levels of performance on the tacit-knowledge measures between minority and majority-group members and between females and males.

The Relationship of Tacit Knowledge to Performance

In several early studies, we gave our tacit-knowledge measure to samples of business managers and examined correlations between tacit-knowledge scores and criterion-reference measures of performance in business. For example, in samples of 54 (Wagner & Sternberg, 1985) and 64 (Wagner, 1987) business managers, we found correlations ranging from .2 to .4 between tacit-knowledge score and criteria such as salary, years of management experience, and whether or not the manager worked for a company at the top of the Fortune 500 list.

In the studies just described, the managers were sampled from a wide range of companies and only global criterion measures such as salary and years of management experience were available to be studied. When more precise criterion measures have been available, higher correlations between tacit knowledge and performance have been found. For example, in a study of bank-branch managers (Wagner & Sternberg, 1985), the correlation between tacit knowledge and average percentage of merit-based salary increase was .48 ($p < .05$). The correlation between tacit knowledge and average performance rating for the category of generating new business for the bank was .56 ($p < .05$).

Further support for the predictive validity of tacit-knowledge measures is provided by the previously mentioned study of business managers participating in the Leadership Development Program at the Center for Creative Leadership (Wagner & Sternberg, 1990). In this study we were able to examine correlations among a variety of measures, including the Tacit Knowledge Inventory for Managers. The appropriate statistic to determine what will be gained by adding a test to existing selection procedures, or conversely, what will be lost by deleting a test, is the squared semipartial correlation coefficient or change in R^2 from hierarchical regression analyses. We were able to provide an empirical demonstration of this type of validity assessment in the Center for Creative Leadership study.

Every manager who participates in the Leadership Development Program at the Center for Creative Leadership, Greensboro, North Carolina, completes a battery of tests. By adding the Tacit Knowledge Inventory for Managers to the battery, we were able to determine the unique predictive power of the inventory in the context of other measures commonly used in managerial selection. These measures included the Shipley Institute for Living Scale, an intelligence test; 17 subtest scores from the California Psychological Inventory, a self-report personality inventory; six subtest scores from the Fundamental Interpersonal Relations Orientation-Behavior (FIRO-B), a measure of desired ways of relating to others; the Hidden Figures Test, a measure of field independence; four subtest scores from the Myers-Briggs Type Indicator, a measure of cognitive style; the Kirton Adaptation Innovation Inventory, a measure of preference for innovation; and five subtest scores from the Managerial Job Satisfaction Questionnaire, a measure of job satisfaction.

The criterion measure of managerial performance was behavioral-assessment-data ratings in two small-group managerial simulations called Earth II and Energy International. The managers worked in groups of five to solve realistic business problems. Trained observers rated the performance of the managers in eight categories: activity level, discussion leading, influencing others, problem analysis, task orientation, motivating others, verbal effectiveness, and interpersonal skills. To obtain a criterion measure with sufficient reliability, the ratings were averaged and summed across the two simulations. The Spearman-Brown corrected split-half reliability of this total score was .59.

Beginning with zero-order correlations, the best predictors of the criterion score of managerial performance were tacit knowledge ($\underline{r} = -.61$, $\underline{p} < .001$) and IQ ($\underline{r} = .38$, $\underline{p} < .001$). (The negative correlation for tacit knowledge is expected because of the deviation scoring system used, in which better performance corresponds to less deviation from the expert prototype and thus to lower scores.) The correlation between tacit knowledge and IQ was not significantly different from 0 ($\underline{r} = -.14$ $\underline{p} > .05$). We carried out a series of hierarchical regressions to examine the unique predictive value of tacit knowledge when used in conjunction with existing measures. For each hierarchical regression analysis, the unique prediction of the Tacit Knowledge Inventory for Managers was represented by the change in R^2 from a restricted model to a full model. In each case, the restricted model contained various measures, and the full model was created by adding the Tacit Knowledge Inventory for Managers as another predictor. If adding the tacit knowledge score resulted in a significant and substantial change in R^2, we could conclude that the predictive relation between tacit knowledge and the criterion measure was not subsumed by the set of predictors in the restricted model. The results are presented in Table 6.1.

In Table 6.1, the measures listed in the column titled "Measures in Restricted Model" were the predictors that already had been entered in the regression prior to entering the tacit- knowledge score. In the first example, the sole predictor used in the restricted model was IQ. The values reported in the column titled "R^2 Change When Tacit Knowledge is Added" are the increases in variance accounted for in criterion when tacit knowledge was added to the prediction equation. For the first example, tacit knowledge accounts for an additional 32 percent of criterion variance that is not accounted for by IQ. The values reported in the column titled "R^2 for Full Model" indicate the proportions of variance in the criterion that is accounted for by tacit knowledge and the other measures when used in conjunction.

In every case, tacit knowledge accounted for substantial and significant increases in variance. In addition, when tacit knowledge, IQ, and selected subtests from the personality inventories were combined as predictors, nearly all of the reliable variance in the criterion was accounted for. These results support the strategy of enhancing validity and utility by supplementing existing selection procedures with additional ones. They also suggest that the construct of tacit knowledge cannot readily be subsumed by the existing constructs of cognitive ability and personality represented by the other measures used in the study.

Table 6.1.
Hierarchical regression results from the Center for Creative Leadership Study

Measures in Restricted Model	R^2 Change When Tacit Knowledge is Added	R^2 for Full Model
1. IQ	.32***	.46***
2. 17 CPI subtests, IQ	.22**	.66*
3. 6 FIRO-B subtests, IQ	.32***	.65***
4. Field Independence, IQ	.28***	.47***
5. Kirton innovation, IQ	.33***	.50***
6. 4 Myers-Briggs subtests, IQ	.35***	.56***
7. 5 Job Satisfaction subtests, IQ	.32***	.57***

Williams and Sternberg (cited in Sternberg et al., 1995) also studied the interrelationship of tacit knowledge for management with demographic and experiential variables. (In this research tacit knowledge was defined as the sum of squared deviation of participants' ratings from nominated-experts' score arrays on a tacit-knowledge measure). We found that tacit knowledge was related to the following measures of managerial success: compensation ($r = .39$, $p < .001$), age-controlled compensation ($r = .38$, $p < .001$), and level of position ($r = .36$, $p < .001$). Note that these correlations were computed after controlling for background and educational experience. Tacit knowledge was also weakly associated with enhanced job satisfaction ($r = .23$, $p < .05$). Demographic and education variables unrelated to tacit knowledge included age, years of management experience, years in current position, degrees received, mother's and father's occupations, mother's and father's educational level attained, and mother's and father's degrees received. (The lack of a correlation of tacit knowledge with years of management experience suggests that it is not simply experience that matters, but perhaps what a manager learns from experience.) A manager's years with current company was negatively related to tacit knowledge ($r = -.29$, $p < .01$), perhaps suggesting the possibility that deadwood managers often stayed around a long time. The number of companies that a manager had worked for was positively correlated with tacit-knowledge scores ($r = .35$, $p < .001$). Years of higher education was highly related to tacit knowledge ($r = .37$, $p < .001$), as was self-reported school performance ($r = .26$, $p < .01$). Similarly, college quality was related to tacit knowledge ($r = .34$, $p < .01$). These results in conjunction with the independence of tacit knowledge and IQ suggest that tacit knowledge overlaps with the portion of these measures that are not predicted by IQ.

This pattern of interrelationships between tacit knowledge scores and demographic and background variables prompted us to examine the prediction of our success measures using hierarchical regression. These analyses showed whether tacit knowledge contained independent information related to success--information distinct from that provided by background and experience. The pattern of results was similar across analyses. In the regression analysis predicting maximum compensation, the first variable entered in the regression equation was years of education, accounting for 19% of the variance ($p < .001$). The second variable entered was years of management experience, accounting for an additional 13% of the variance ($p < .001$). The third and final variable entered was tacit knowledge, accounting for an additional 4% of the variance ($p = .04$), and raising the total explained variance to 36%. In the regression predicting maximum compensation controlling for age, years of education was entered into the equation first, accounting for 27% of the variance ($p < .001$). And second, tacit knowledge was entered, explaining an additional 5% of the variance ($p = .03$). This final regression demonstrates the value of tacit knowledge to managers who are relatively successful for their age.

Several general conclusions can be drawn from the above regression analyses. First, it is difficult to predict success measures such as salary and maximum compensation, presumably due to the myriad effects upon such variables that were outside of the focus of this study. Nonetheless, approximately 40% of the variance in the success measures used in this study was explicable. For all four success measures, the educational variable was the most important, followed in the case of salary and maximum compensation by an experiential variable (years of management experience). After education and experience were included in the equations, tacit knowledge still explained a significant proportion of the variance in success. Thus, tacit knowledge contains information relevant to the prediction of success that is independent of that represented by the background and demographic variables.

Although our focus has been on the tacit knowledge of business mangers, there is evidence that the construct also explains performance in other domains. In two studies of the tacit knowledge of academic psychology professors, correlations in the .4 to .5 range were found between tacit knowledge and criterion measures such as number of citations reported in the Social Science Citation Index and the rated scholarly quality of an individual's departmental faculty (Wagner, 1987; Wagner & Sternberg, 1985). More recently, we investigated the role of tacit knowledge in the domain of sales (Wagner, Rashotte, & Sternberg, 1992). We found correlations in the .3 to .4 range between measures of tacit knowledge about sales and criterion measures such as sales volume and sales awards received for a sample of life insurance salespersons. In this work, we also have been able to express the tacit knowledge of salespersons in terms of sets of rules of thumb that serve as rough guides to action in sales situations. Expressing tacit knowledge in terms of rules of thumb may permit explicit training of at least some aspect of tacit knowledge. A preliminary training study in which undergraduates were trained in tacit knowledge relevant to the profession of sales found greater pretest-posttest differences in tacit knowledge for groups whose training identified relevant rules of thumb than for those whose training did not make any such identifications (Sternberg et al., 1993).

Summary

Several conclusions can be drawn from the above studies. First, there appears to be a general factor underlying tacit knowledge within a domain that is different from the general factor measured by traditional psychometric tests of intelligence. In other words, we can say that people possess more or less tacit knowledge in their respective performance domains.

Second, tacit knowledge increases, on average, with experience, but is not simply a proxy for experience. It is not necessarily the amount of time or number of experiences one has, but the knowledge one gains from those experiences that is important.

Third, tacit-knowledge measures exhibit small and often trivial correlations with measures of general intelligence, and they generally predict job performance as well as or better than does g. We do not dispute the relevance of general cognitive ability to performance. Schmidt and Hunter (1998) have shown that g predicts performance in a number of domains. Our aim is to explain additional variance beyond g.

Tacit knowledge also correlates trivially with other conventionally measured abilities such as those measured by the Armed Services Vocational Aptitude Battery (ASVAB). Furthermore, we have found tacit knowledge to be a better predictor of managerial performance than measures of personality, cognitive style, and interpersonal orientation.

Finally, we have shown that tacit-knowledge measures are predictive of performance in a number of domains, correlating between .2 to .5 with measures of rated prestige of business or institution, salary, performance appraisal ratings, and number of publications. These correlations, uncorrected for attenuation or restriction of range, compare favorably with those obtained for IQ within the range of abilities we have tested.

Based on the success of the tacit-knowledge approach in civilian settings, combined with the Army's interest in understanding what it takes to be an effective leader, we applied the tacit-knowledge approach to study military leadership. This research is described in detail in the next chapter as it serves to exemplify our most recent and rigorous method of identifying, measuring, and validating tacit-knowledge.

Chapter 7
The Role of Practical Intelligence in Shaping: the Military Workplace

This chapter presents the results of a six-year project to identify and measure tacit knowledge within the domain of military leadership, and to apply the results to leadership development. In the previous chapter we reviewed tacit-knowledge research in civilian settings, much of which was conducted with managers. The present chapter addresses leadership, which we view as a distinct, albeit related, performance domain. First, we discuss the difference between leadership and management, and relate the distinction to the adaptation and shaping functions of practical intelligence. Next, we briefly review general research on leadership performance and outline the role of tacit knowledge in understanding military leadership in particular. Finally, we present the results of our efforts to elicit tacit knowledge and to develop and validate tacit-knowledge inventories for military leaders.

Leadership versus Management

The relationship between leadership and management has been debated for decades by academics and practitioners. Two alternative positions have emerged concerning the relationship between leadership and management. The view is either that the concepts are distinct or that they are interrelated. According to the first position, management and leadership are qualitatively different concepts. Often the distinction is made between managers and leaders rather than management and leadership. For example, Zaleznik (1977) proposed that managers and leaders are different types of people in terms of their motivation, personal history, thoughts, and behaviors. Managers are problem solvers who create goals in order to maintain the stability of the organization. Leaders are visionaries who inspire workers to take part in their own and the organization's development and change. Bennis and Nanus (1985) also propose that leaders and managers differ qualitatively in their perspectives and willingness to implement change. Managers have a narrow perspective that is concerned with mastering routines to ensure the efficiency of daily operations. Leaders, in contrast, have a broad perspective that allows them to assess the organization's needs, envision the future, and implement change. Kotter (1987) makes a distinction between leadership and management in terms of the processes involved rather than the personalities of individuals. Management tends to be a formal, scientific, and present-oriented process whereas leadership tends to be an informal, flexible, inspirational, and future-oriented process.

There are others, however, who view leadership and management as overlapping processes that fulfill the functions or expectations of an organizational role. Mintzberg (1975), for example, suggests that one of the functions of the manager's role is to be a leader. According to this perspective, the term "manager" is a role label, while "leader" is a role function. Leadership is a process associated with the function of a leader. Yukl (1989) and Lau and Shani (1992) suggest that the functions associated with supervisory positions in organizations requires the incumbent to be both a leader and a manager. Supervisors must practice both leadership and management in order to fill role

requirements. Bass (1990) similarly suggests that leaders must manage and managers must lead. These researchers consider the terms leader and manager to be interchangeable.

Military doctrine on leadership seems to take the latter position that management and leadership are overlapping concepts. The Army uses the term leader to refer to all officers in supervisory positions. Thus, the term leader provides a role label in the military context in the same way that the term manager provides a role label in civilian organizations. It is clear from the definition of leadership in the Army that part of the role of a leader involves performing managerial functions. Leadership is viewed as a process of exerting influence upon others in order to satisfy organizational objectives. Management, on the other hand, refers to a set of expected activities or behaviors "performed by those in senior positions to acquire, direct, integrate, and allocate resources to accomplish goals and tasks" (Field Manual 22-103, p. 44).

We agree with the position that leadership and management are functions that may be part of the same role, whether the individual's title is a manager or leader. But, drawing on our definition of practical intelligence, we view these functions as serving different purposes in relationship to the environment. That is, management deals with functions associated with adapting to the environment, whereas leadership involves shaping the environment. We readily see this difference in the definitions above. The management function addresses daily activities associated with efficiency and effectiveness. Leadership functions to change, or shape, the environment. Clearly, these two functions are interrelated—both are important to success. In this chapter, however, we focus primarily on the tacit knowledge that helps leaders to shape their environment.

Leadership Research

In both military and civilian settings, leaders are faced with increasingly complex and dynamic environments. Advances in technology, increases in the volume of information, shorter time periods for decision making, and a reliance on fewer people are just some of the factors that contribute to this complexity. So, what does it take to be an effective leader in such environments? Numerous researchers have attempted to identify the knowledge, skills, and abilities of effective leaders, but most of these approaches have met with limited success.

A review of the leadership literature, within both military and civilian contexts, suggests that very little research has addressed what leaders know about leading--and even less about how they develop such knowledge while on the job (Horvath, Williams, et al., 1994). Other reviews confirm this impression (e.g., Hollander, 1985; Yukl, 1989). The importance of experience-based knowledge to successful performance has been recognized in other domains such as management (Kotter, 1987; Mintzberg, 1975; Wagner & Sternberg, 1985).

The research that exists regarding the knowledge, skills, and abilities of leaders has produced inconclusive findings. For example, the correlations of both general cognitive ability and experience with leadership performance appear to be modest at best

(e.g., Bass, 1990). But there is evidence that these findings may reflect limitations of the approaches used rather than the absence of a relationship.

Fiedler (1995), for example, found that IQ is positively correlated with leadership success under conditions of low stress, but that it is negatively correlated with success under conditions of high stress. Furthermore, he found that the relationship between experience and leadership performance was greater under conditions of high stress than of low stress. As Fiedler also pointed out, "it is very difficult to believe that intellectual abilities fail to contribute to such critical leadership functions as decision-making and coordinating and organizing work processes, or that leaders cannot learn from past events" (Fiedler, 1995, p. 6).

One possible explanation for the discrepancy between intuitive notions of what it takes to be a successful leader and research findings is that researchers have focused on limited conceptualizations of abilities and experience. Traditional measures of cognitive ability tend to measure academic rather than practical intelligence (Sternberg, 1997). Therefore, these measures may not capture the abilities that are most relevant to performing everyday tasks. Measures of experience have been limited because they rely primarily on time-based definitions such as job tenure or number of leadership positions held. The concept of tacit knowledge is based on the notion that the amount of time is less important than what one gains from his or her experience. Tacit knowledge, by definition, takes into account both ability and experience, but does so in a way that is more directly relevant to performance. Given our prior research and the limitations of leadership research, we considered the tacit-knowledge approach to be a promising avenue for understanding what it takes to be a successful leader.

Tacit Knowledge in Military Leadership

The Army's view of leadership is reflected in several documents: Field Manual 22-100, Military Leadership, Field Manual 22-103, Leadership and Command at Senior Levels, and Army Pamphlet 600-80, Executive Leadership. The definition of leadership varies slightly across these documents because they address leadership at different levels in the organization. For example, Field Manual 22-100, which addresses leadership at junior levels (through battalion command), defines leadership as "the process of influencing others to accomplish the mission by providing purpose, direction, and motivation" (p. 1). At the next level (brigade through corps), leadership is viewed as an influence process in which direct and indirect means are used to create conditions for the sustained success of an organization. At the highest levels, leadership is defined as obtaining the commitment of subordinates to the organization's purposes and goals, beyond that which is possible using position power alone. The Army's latest edition of FM22-100 (in draft), which combines into a single publication the leadership doctrine at all organizational levels, still maintains the distinction originally expressed in separate documents.

Given that the Army has given so much attention to defining leadership, it is not surprising that it has a comprehensive system to develop its leaders. In the Army, leadership development is based on three complementary processes: (a) institutional

training (i.e., formal schooling), (b) self-development, and (c) operational assignments (i.e., on-the-job learning). Implicit in this doctrine is the belief that Army leaders learn from their experience and that the lessons of job experience make a significant and independent contribution to leader development beyond that of formal training. On-the-job experiences provide opportunities for officers to learn how to apply leadership knowledge codified in doctrine and taught in the Army school system. They also provide a context for acquiring new knowledge about leadership--knowledge that may not be well supported by doctrine or formal training.

Although Army doctrine acknowledges the importance of job experience, and leaders spend most of their careers in operational assignments, relatively little is known about the role of operational assignments in leadership development. That is, we have a limited understanding of the process by which Army leaders develop "as leaders" while on the job. The objective of our research is to understand the experience-based, practically-relevant knowledge, in other words, tacit knowledge, that is related to successful military leadership. We organize our findings around three main questions that guided our research. First, can we identify knowledge that meets our criteria as tacit within the domain of military leadership? Second, can we develop instruments to measure the tacit knowledge of military leaders? Third, is the possession of tacit knowledge for leadership related to effective leadership performance? The methods we described in Chapter 5 for identifying, measuring, and validating tacit knowledge were used to address these questions.

Identifying the Tacit Knowledge of Military Leaders

As we described in the method for eliciting tacit knowledge, we relied primarily on interviews with job incumbents to provide examples of knowledge that could be classified as tacit. We began, however, by reviewing domain-relevant literature to identify examples of published tacit knowledge relevant to military leadership (see Horvath, Williams, et al., 1994). This literature consisted of formal doctrine, trade journals, educational publications, and military memoirs. Army doctrine (e.g., field manuals) provides an overview of what leaders are expected to know. Trade journals and memoirs, which reflect the "lessons learned" of military practitioners, are more likely to include knowledge that is practically relevant, procedural, and acquired under conditions of low environmental support. From this literature review we identified some initial examples of tacit knowledge and developed a preliminary framework for classifying items of tacit knowledge.

The preliminary structure of tacit knowledge for military leadership, along with examples from the literature, is shown in Table 7.1. According to this structure, tacit-knowledge exemplars may be distinguished in terms of their relevance to dealing with the self, dealing with others, or dealing with the organization. These categories correspond to knowledge that functions at the intrapersonal, interpersonal, and organizational levels, respectively. Within these functions we identify more descriptive subcategories of knowledge. Tacit knowledge about managing the self (e.g., how to manage one's time) and seeking challenges and control (e.g., how to take initiative) is categorized as intrapersonal knowledge. Tacit knowledge about influencing and controlling others (e.g.,

motivating subordinates), supporting and cooperating with others (e.g., taking care of soldiers), and learning from others (e.g., keeping an open mind) falls under interpersonal knowledge. And the organizational category includes knowledge about solving organizational problems (e.g., understanding the organization's culture).

This structure is preliminary and does not represent any final or conclusive categorization of tacit knowledge for military leadership. It simply provides a foundation for a more thorough exploration of tacit knowledge. As discussed next, we found that face-to-face interviews provided much more substantive and incontrovertible evidence of tacit knowledge than the literature search. They also allowed us to identify knowledge that is specific to different organizational levels.

Table 7.1.
Structure of Tacit Knowledge Based on a Review of Practitioner Literature

INTRAPERSONAL TACIT KNOWLEDGE

Managing the Self

Focus on what is important rather than urgent. A leader who loses sight of his priorities may spend all his time putting out "fires" and neglect progress toward his most important goals. Effective leaders make decisions about what is important and what is not and they allocate their time accordingly. Sometimes this means that deadlines for low-priority tasks are missed, or that extra responsibility is delegated to subordinates.

Seeking Challenges and Control

Be prepared to disobey an order in extraordinary circumstances. When the need to disobey an order is both clear and critical, a leader should be prepared to do so. The decision to disobey should increase rather than decrease personal and professional risk to oneself, and a principle of "minimal divergence" should be followed. According to this principle, one seeks to diverge as little as possible from the commander's intent—even when an order must be disobeyed.

INTERPERSONAL TACIT KNOWLEDGE

Influencing and Controlling Others

Fight rumor-mongering with information. If you keep soldiers in the dark, the orders you issue will seem obscure and arbitrary. Keeping soldiers in the dark encourages rumor-mongering about the mission, and this rumor-mongering can harm morale and decrease readiness. Don't take a vote on what your unit will do, but explain the situation to your soldiers, explain what you expect them to do, and tell them why it is important. Be prepared to respond to questions and even objections but make it clear that the mission is non-negotiable.

Supporting and Cooperating with Others

When you refer a soldier to another source for help, make the call yourself. When you counsel a soldier and decide, for whatever reason, that the soldier should see someone else for further help, make the appointment then and there. This small detail can make the difference between the soldier feeling "handed off" and feeling taken care of.

Learning from Others

Get opinions from your junior leaders in writing. Ask your junior leaders to submit their opinions of the company in writing when you assume command. For example, ask them for their opinion of the three greatest strengths of the company and the three greatest weaknesses of the company, along with suggestions for remediating the weaknesses. Asking your junior leaders to submit opinions in writing gives you early information about the strengths and weaknesses in the company. Asking for opinions in writing also tells you who in your unit can think analytically and write clearly, and who needs remediation in these areas.

Table 7.1 cont.

ORGANIZATIONAL TACIT KNOWLEDGE
Solving Organizational Problems
Don't always choose the best person or team for the job. To remediate weaknesses in your unit, get in the habit of distributing tasks in a manner that meets development as well as efficiency goals. If you always pick the best persons for the job, they are the only ones who will get any experience at the job. For example, pair an able soldier with a less-able soldier and assign the job to them as a team. With any luck, the able soldier will tutor the less-able soldier. This experience can be a beneficial experience for both soldiers.

Interviews with Army leaders. In order to obtain direct evidence of what Army leaders know about how to lead, we conducted interviews with incumbent officers at three organizational levels. Specifically, we were interested in understanding the tacit knowledge of leaders at the platoon, company, and battalion levels. Platoon leaders have very limited experience in Army leadership (typically one to three years) and are responsible for supervising soldiers (approximately 25-45 in number) who have relatively greater time in service. They exercise direct leadership through face-to-face interactions with their subordinates and with relatively little formal position power. Company commanders have more experience than platoon leaders and have considerably more position power. They also decide how missions will be accomplished. They lead larger organizations, typically 120 to 200 soldiers, and as a result have less direct contact with their subordinates. Battalion commanders have considerable experience in the Army, having served between 16 to 20 years as an officer. Their selection for command is the result of a highly competitive process. They have considerable power and discretion in discharging the legal authority of command. They command organizations of typically 500 to 700 soldiers, making it difficult to interact with subordinates face-to-face.

We conducted interviews with a representative sample of 81 Army officers who were selected by their senior commanders to participate in the study (see Horvath, Forsythe, et al., 1994). The sample included 30 platoon leaders, 32 company commanders, and 19 battalion commanders from three categories of military specialties (combat arms, combat support, and combat service support). We followed the interview method described in Chapter 5 and shown in Appendix A.

The interviews were conducted by members of the research team working in pairs, with one member as lead interviewer and the other as notetaker. At the beginning of each interview, the researcher informed the participants of the study's purpose and assured them that our intent was not to evaluate them. We asked participants to relate a

story about a job-related experience from which they learned something about leadership at their current organizational level. We clarified that we were interested in specific examples of informal knowledge that were obtained while they were working in their current job and that we were not interested in leadership doctrine or theory expressed in books or taught in the classroom. Nor did we want purely technical knowledge (e.g., military tactics or supply and maintenance procedures). We also encouraged participants to express, in their own words, the leadership lessons learned in the specific situations they recalled.

During each interview, the interviewer asked follow-up questions based on the set of guidelines included in the interview protocol (see Appendix A). The follow-up questions probed for greater detail in the leadership stories and more elaboration of the lessons the participant derived from the situation. We found that officers often began by articulating general rules (e.g., "A good leader needs to know people"). But when probed, the interviewee revealed more complex, specific procedural rules (e.g., rules about how to judge people accurately for different purposes and in a variety of circumstances). Periodically, the interviewer also paraphrased the participants' comments to ensure interpretive accuracy. After each interview, the notetaker prepared a written summary, attempting to capture the leadership stories and lessons learned in the participant's own words. Then the lead interviewer reviewed these summaries and together the interviewers resolved any disagreement in the summary contents, referring to an audiotape of the interview if necessary.

Once we compiled all the interview summaries, we sought to identify and extract the examples of tacit knowledge contained within those summaries. Knowledge was identified as tacit if it met the following criteria: (a) it was grounded in personal experience; (b) it was intimately related to action; (c) it was not well supported by formal training or doctrine; and (d) it pertained to leadership rather than technical aspects of job performance. We assessed the degree of interrater agreement, that is, the extent to which the raters agreed as to whether or not a story represented tacit knowledge, by asking two raters to independently rate 18 of the 81 interview summaries. We divided the number of stories on which the raters agreed by the total number of stories independently evaluated. After resolving discrepancies over knowledge that was practically useful for leadership (since only one of the raters had military experience), the interrater agreement was determined to be 90%. In other words, the raters agreed in their classification of knowledge as tacit 9 out of 10 times.

The next step involved extracting the tacit knowledge from the interview stories and coding them into a simplified, standard format for the purpose of further analysis. The coding format reflects the procedural feature of tacit knowledge. Each piece of knowledge is expressed in terms of a set of antecedent conditions ("If" statements), a set of consequent actions ("Then" statements), a brief explanation ("Because" statement), and other logical operators ("And," "Or," and "Else"). (A sample coded item is shown in Table 4.1.) These coded items are viewed as "markers" for the complex, predominantly implicit mental representations, which are not directly available to conscious introspection and articulation. The items are not, strictly speaking, the tacit knowledge of the domain, but rather the best available description of that knowledge as it is employed

in solving actual problems. This coding produced 174 items of tacit knowledge across the three organizational levels.

The coded tacit-knowledge items serve two main purposes. First, they serve as input into the instrument development process, which we discuss in the next section. Second, they serve as products that can be analyzed to obtain insight about the nature and structure of tacit knowledge at each organizational level. In regard to the latter purpose, we asked three senior members of the research team (our experts) to identify a framework that represented the major categories of tacit knowledge at the platoon, company, and battalion levels.

Identifying categories of tacit knowledge. The expert members were asked to sort the set of 174 items into categories of their own devising. The sorting was done separately for each organizational level (see Horvath, Forsythe, et al., 1994 for further details). There were no constraints on the size or number of sort categories, so long as no categories overlapped. The results of the independent sortings were then used to form a set of dissimilarity matrixes (one for each level), which we cluster analyzed using a maximum-likelihood method to uncover natural groupings of tacit knowledge in the data (Hartigan, 1975). The cluster analyses produced hierarchically organized clusters, which took the form of tree diagrams. We then asked the expert panel to interpret and label each of the high-level subclusters in the tree diagram based on the content of the included items. These subclusters were taken to represent categories of tacit knowledge and are shown in Table 7.2.

Table 7.2
Categories of Tacit Knowledge with Proportion of Items Obtained by Level

Category	Level		
	Battalion (n=67)	Company (n=64)	Platoon (n=42)
Dealing with poor performers	.06	___	___
Managing organizational change	.04	___	___
Protecting the organization	.13	___	___
Balancing mission and troops	___	.08	___
Cooperating with others	___	.06	___
Directing and supervising subordinates	___	.16	___
Establishing credibility	___	___	.12
Developing subordinates	.18	.06	___
Influencing the boss	___	.08	.14
Communicating	.15	.13	.13
Establishing trust	.07	.08	.07
Managing the self	.07	.09	.19
Motivating subordinates	.09	.14	.28
Taking care of soldiers	.14	.12	.05
Unaffiliated items	.07	.00	.02

The numerical values in the table indicate the proportion of items at each organizational level comprising the category. For example, items from the category "Protecting the organization" made up 9 of the 67 total items obtained from battalion commanders, yielding a proportion of .13. This value means that 13% of the items at the battalion level related to knowledge of how to protect the organization. A blank in the table means that the category did not emerge from the cluster analysis at that level. For example, the category "Protecting the organization" emerged at the battalion but not the company and platoon levels. In all, seven categories were unique to a single level; two were common across two levels but not across all three levels. In the case that a category appeared in two out of the three levels, it was always in adjacent levels. In five cases the category was shared across all three levels. These patterns of results exhibit a gradual change in the composition of tacit knowledge as leaders ascend the organizational hierarchy, further confirming our expectation that tacit knowledge varies across levels.

Relationship of the interview findings to the literature review. So how do these categories relate to those that emerged from our review of the practice literature? We attempted to integrate the results of the cluster analysis with the structure shown in Table 7.1. We found that the categories that emerged from the literature review accommodated fairly well the categories from the interview study. The integrated framework is shown in Table 7.3. We include examples of coded tacit-knowledge items from the interview study for each category. As is apparent from these condensed examples, we obtained more complete and convincing evidence of tacit knowledge from the interviews than from the literature review. In the remaining discussion, we focus on the categories that emerged based on the cluster analysis.

Table 7.3
Tacit Knowledge for Military Leadership: Integrated Framework

INTRAPERSONAL TACIT KNOWLEDGE

Managing the Self

Managing the self [b, c, p]

How to manage yourself when you are upset. IF your subordinate's action causes you to become angry to the point where you are about to lose your composure THEN do something (take a time-out, take deep breaths, sit down) to gain your composure before you act BECAUSE losing your composure in front of your subordinates may hurt your credibility.

Seeking Challenges and Control [x]

INTERPERSONAL TACIT KNOWLEDGE

Influencing and Controlling Others

Motivating subordinates [b, c, p]

How to encourage your soldiers to take initiative. IF you want to encourage your subordinates to exercise initiative THEN provide subordinates with your intent and give them the responsibility to develop their own plan to accomplish the mission. Involve senior NCOs in major decisions. Recognize soldiers' achievements with awards. BECAUSE giving soldiers the responsibility to plan and execute a mission allows and encourages them to exercise initiative. Also, rewarding soldiers for achievements tends to increase their motivation to take the initiative and earn future awards.

Directing and supervising subordinates [c]

How to build a team made up of both military and civilian personnel. IF you are a commander of a unit that has both military and civilian personnel AND IF you are having problems with perceptions of unfairness in allocation of work load and awards between civilian and military personnel THEN use a sign-out sheet to make visible each member's location during the day BECAUSE the sign-out sheet communicates information about each member's whereabouts during the duty day and this may prevent misunderstanding about work allocation.

Influencing the boss [c, p]

How to confront your boss. IF your commander has made a decision that you do not agree with AND IF you feel a need to confront your boss about it THEN frame your input as an approach for guidance instead of a protest. When confronting the boss, do not make evaluative statements about the decision. Instead, communicate how the decision impacted you (e.g., discuss your feelings) or the unit BECAUSE if you approach the commander in a more confrontational manner, you might cause him to become defensive and "close the loop" (e.g., close off communications with the commanding officer).

Table 7.3 cont.

Developing subordinates [c]

How to use participative leadership in solving problems and developing subordinate leaders. IF you find a problem in the unit AND IF the problem pertains to a subordinate leader's area of responsibility THEN direct the subordinate leader to solve it. After you select an alternative, let the subordinate leader execute it. BECAUSE getting subordinates involved gives them ownership or responsibility for the problem. Also, subordinate participation in the decision-making process tends to increase commitment to the solution and promotes development.

Communicating [p]

How to effectively communicate with your soldiers. IF you want to effectively communicate with your soldiers THEN tailor your message to fit their average educational level and look them in the eye when you deliver it. Do not use a lot of profanity or soldier slang in your message BECAUSE tailoring the complexity of the message to fit the general education level of the soldiers increases the likelihood that they will understand it. Also, by not using profanity and slang in your messages, you maintain your leader-subordinate social distance and also reduce the risk of offending your soldiers.

Supporting and Cooperating with Others

Taking care of soldiers [b, c, p]

How to take care of soldiers by handling their problems promptly. IF a subordinate thinks a problem is important enough to see you after hours THEN take immediate action on the problem and do not defer it to the next business day BECAUSE taking immediate action on your soldiers' problems demonstrates that you care about them.

Establishing trust [b, c, p]

How to preserve you subordinate leaders' trust and confidence in you. IF you provide a subordinate leader with a directive AND IF your commander confronts the subordinate leader about the appropriateness of the directive AND IF you are aware of this confrontation THEN let your commander know that you issued the directive to the subordinate leader BECAUSE if you do not take ownership for the directive, your subordinate leader may lose confidence in you.

Cooperating with others [c]

How to choose between conflicting training events. IF a training event scheduled by your battalion commander conflicts with a training event scheduled by your supported unit commander AND IF both training events have equal training value and impact on soldiers' quality of life THEN support the training event scheduled by your battalion commander BECAUSE supporting your battalion commander's training event preserves and demonstrates your loyalty to him or her.

Learning from Others [x]

Table 7.3 cont.

ORGANIZATIONAL TACIT KNOWLEDGE

Solving Organizational Problems

Communicating [c, b]

How to get information from your soldiers. IF you need feedback or input from your soldiers THEN talk to them in informal settings, such as while eating lunch in back of a track, or arrange the furniture in your office to facilitate open communication (e.g., put chairs in a circle) BECAUSE you receive more candid feedback from a discussion with soldiers in an informal setting because they feel relaxed.

How to control distortion of communications and correct misperceptions. IF you want to make sure your guidance is communicated accurately to all levels of the organization THEN conduct periodic sensing sessions with your soldiers to correct misperceptions, clarify your intent, and locate sources of information loss BECAUSE you can get distortion of your intentions and guidance just by passing information through a number of nodes.

Developing subordinates [b]

How to deal with mistakes made by your subordinates. IF a subordinate makes a mistake AND IF you are in a public setting THEN do not embarrass the subordinate in public and do not use coercive means to correct the mistake. Use mistakes as an opportunity to coach and develop your subordinates. Have subordinates recognize their own mistakes and help coach them to think of ways to correct the mistakes. Be sure that you give them positive feedback at the end of this development session in order to restore their confidence BECAUSE coercion destroys initiative and does not foster development in a subordinate. Discussing mistakes, in a non-threatening environment, facilitates learning and development.

Dealing with poor performers [b]

Dealing with weak subordinate commanders. IF you have weak company commanders who have some potential for development THEN give them strong subordinate leaders. Never criticize them in front of the brigade commander. Set them up for success and invite the brigade commander to watch them perform BECAUSE you always want to set your commanders up for success in front of their senior rater if they are trying, but you also have to consider the welfare of your soldiers. BUT IF you have a company commander who is dishonest, immoral, or mistreats soldiers THEN relieve him or her immediately BECAUSE an unethical commander jeopardizes the welfare and morale of your soldiers.

Table 7.3 cont.

Managing organizational change [b]

How to implement change in the battalion. IF you desire to implement change in the battalion you are in charge of THEN focus your efforts on changing/developing company commanders and lieutenants BECAUSE the company commanders and lieutenants are the agents that will implement change in the battalion. The battalion commander commands through his company commanders.

Protecting the organization [b]

Deciding when to jump the chain of command. IF you are having problems with your immediate commander AND IF you decide to seek advice from your boss' commander (jump the chain of command) on how to solve the problem THEN be prepared for the possibility of a disruption of loyalty in your unit BECAUSE you have modeled disloyalty and the effects of this may carry over into your own unit.

ADDITIONAL TACIT KNOWLEDGE

Establishing credibility [p]

How to establish your credibility in new unit. IF you are taking charge of a new unit THEN present an image that you know what you are doing, even if you don't. Sound off—state what you do know with authority. Don't pretend to know things, instead state what you do know with conviction. Also, study to get yourself up to speed BECAUSE a sense of confidence builds trust with superiors and subordinates, which opens the flow of communications.

Balancing mission and troops [c]

When not to pass orders on as your own. IF you receive an order from above that you do not agree with because it does not seem to make sense THEN let your key subordinates know that you do not agree with the order and that it is not your own. Tell them what you think, and tell them that their opinion about the directive should not be communicated to the soldiers. Then focus on how to "make it work" BECAUSE letting key subordinates know that a questionable order is not your own and what you think about it preserves your relationship with them.

[b] Obtained from battalion commanders

[c] Obtained from company commanders

[p] Obtained from platoon leaders

[x] Obtained from literature review only

In general, the results of the interview study provided a more detailed partitioning of the broader categories from the literature review. We also found distinctions by organizational level that could not be readily determined from the practice literature. In terms of the specific categories, we found two categories from the literature review that did not appear in the interviews. We did not obtain tacit knowledge that fit the category "learning from others." Instead, this function may have been distributed across other categories. For example, knowledge about how and when to elicit feedback from

subordinates may fit the category "learning from others," but was grouped with knowledge about communicating. Alternatively, learning from others may not have been considered a part of leadership by our participants.

The other category that did not emerge in the interview data was "seeking challenges and control." The participants may have felt that their positions already offered enough challenge and control, and therefore, did not express knowledge related to this category. Alternatively, knowledge about seeking challenge and control may be expressed by other categories such as knowledge about influencing the boss. Or, knowledge about seeking challenge and control may represent self-oriented goals, which we excluded from the definition of leadership provided to participants.

Although two categories from the literature review did not appear in the interview data, we found two additional categories from the interview study that did not fit into the earlier structure. Tacit knowledge about balancing mission and troops (unique to company commanders) and tacit knowledge about establishing credibility (unique to platoon leaders) did not fit clearly into any of the categories from the literature review. Because these categories were unique to one level, they may not have had the same probability of emerging in the literature as categories that crossed all three levels and thus applied to leaders in general. Clearly, the interview data served to elaborate upon the tacit knowledge we obtained from the literature review.

Developmental challenges at each level. The category framework shown in Table 7.3 not only serves to organize the knowledge we obtained, it is also informative of the developmental challenges at each level, which we summarize here. The tacit knowledge of platoon leaders reflects their limited experience and formal position power, as well as their direct form of leadership (e.g., through face-to-face interaction). Of the knowledge we uncovered at the platoon level, 28% was about motivating subordinates. Motivating relatively more experienced subordinates without much formal authority also raises issues of personal credibility for platoon leaders. Platoon leaders must also establish credibility with the boss if they are to protect their limited autonomy. We found that tacit knowledge about establishing credibility was unique to the platoon level. Tacit knowledge about managing the self was also more frequent at the platoon level than at higher levels (company and battalion), which may reflect the stress of establishing credibility and authority over more experienced soldiers.

The tacit knowledge of company commanders reflects the greater power and discretion associated with their position. At this level, we observed the emergence of tacit knowledge about directing and supervising others. Tacit knowledge about establishing credibility, however, was not as important. The role of a company commander also requires the incumbent to consider the needs of subordinates and simultaneously to coordinate with higher headquarters. This is apparent in the distinct knowledge at the company level about cooperating with others and balancing mission accomplishments with the needs of subordinates.

Finally, the tacit knowledge of battalion commanders reflects their considerable experience and authority. They also are concerned with more system-wide issues. As

such we find that tacit knowledge for protecting the organization and managing organizational change is unique to battalion commanders. We also found that the tacit knowledge about communicating differed from that obtained at lower levels. Specifically, battalion commanders learned to use indirect methods and systems of communication, and these communications were oriented primarily toward conveying the organization's mission and values. Finally, knowledge about dealing with poor performers was unique to battalion commanders, which can be attributable to the greater authority and discretion they possess to deal with personnel issues.

Relationship of the interview findings to military doctrine. The items of tacit knowledge obtained from the interviews were also evaluated in reference to military doctrine. We asked our military experts to judge whether each item served to (a) instantiate doctrine or (b) augment doctrine. Items judged to instantiate Army doctrine were those that elaborated upon or made concrete knowledge that already existed in formal doctrine (e.g., the doctrine says "know yourself" but what does this mean in practice?). Items judged to augment doctrine were those that filled gaps or contradicted formal doctrine (e.g., Army doctrine does not discuss how to influence the boss). Of the 174 tacit-knowledge items obtained from the interviews, almost 75% were viewed as instantiating military doctrine. This finding suggests that a major function of tacit knowledge for military leadership is to make the general guidelines provided in doctrine more concrete. However, 25% of the items were judged to augment the doctrine. Among these items were those that addressed upward influence (e.g., influencing the boss) and when to veer from doctrine (e.g., when to pass or not pass on orders from above as one's own). It appears that leaders learn from their experience not only how to put the principles of leadership into practice but also how to lead in ways that are not formally prescribed.

Developing a Tacit-Knowledge Inventory for Military Leaders

In order to measure the possession of tacit knowledge by military leaders, and test our assertion that tacit knowledge is important to leadership performance, we developed an inventory for each organizational level based on the data obtained from our interviews. In developing the inventory, we followed the process described in Chapter 5. Specifically, we sought to identify, from the body of tacit knowledge elicited in the interview study, items that were most promising for use in developing a measurement instrument. By promising, we mean that the items represent knowledge that is characteristic of more experienced as well as more effective leaders. The 174 tacit-knowledge items generated from the interview phase served as the input into the selection phase.

In order to identify promising tacit-knowledge items, we conducted a study using two separate samples (see Horvath et al., 1996 for details). The first sample consisted of officers who represented different levels of experience (experienced or novice) at each of the three organizational levels. The officers were asked to rate the tacit-knowledge items on several dimensions as described below. For a second sample, we obtained ratings of leadership effectiveness in addition to ratings on the tacit-knowledge items. Our aim was to identify items that best discriminated between experienced and novice leaders in the

first sample and between relatively more and less effective leaders in the second. We discuss the method and results of these two samples separately.

Relationship of tacit knowledge to experience. In the first sample, we sought to identify items that distinguished between experienced and novice leaders at each of the three levels (platoon, company, and battalion). Sample 1 consisted of 791 Army officers enrolled in various military educational programs of the U.S. Army Training and Doctrine Command (TRADOC). During their careers, Army officers cycle between operational assignments and enrollment in TRADOC schools. The TRADOC schools were chosen as a source for participants for two main reasons. First, they provided a ready pool of active-duty officers at all three levels under study. Second, this sample provided the opportunity to stratify officers according to leadership experience. Officers completed the surveys either as novices for the next level of command or as experienced leaders for the one they had just completed. This assignment to one group or the other allowed us to examine which items discriminated between experienced and novice leaders.

We compiled the 174 tacit-knowledge items collected during the interview study into a survey, called the Tacit-Knowledge Survey (TKS), to administer to our samples. The items were condensed to minimize the length of the survey. We abstracted the key components of each item and deleted unnecessary information. Military members of the research team reviewed and edited the condensed items to increase their comprehensibility for a military audience and to preserve the intention of the interviewees who provided the items.

We asked respondents to rate each item on several dimensions. Our aim was to determine which items represented good advice about military leadership that might not be common knowledge. The TKS contained four, seven-point rating scales used to elicit judgments about each item of tacit knowledge. Specifically, we asked officers to make the following judgments about each tacit-knowledge item: (1) how good does the respondent think the advice is, (2) how commonly known does the respondent think the advice is, (3) how often do leaders at the specific level face situations such as the one described, and (4) to what extent does the advice match the respondent's personal concept of leadership? A sample item from the TKS is shown earlier in Figure 7.2.

We mailed the Tacit-Knowledge Survey (TKS) to points of contact at each of thirteen different courses at nine separate locations. Points of contact were officers or non-commissioned officers assigned to the staff at the different schools who helped the research team coordinate data collection at their respective institutions. The points of contact distributed the surveys to officers attending the TRADOC courses who were randomly chosen to participate by members of the research team using class rosters. Completed surveys were returned directly to the research team. The overall response rate was 79%.

In analyzing the data, we first examined relationships among the four rating scales of the TKS using a principal-components analysis of the correlation matrix. That is, we examined the data to determine if the four separate rating scales provided us with

different information. This analysis yielded only one component with an eigenvalue greater than or equal to one, which we interpreted to indicate a general factor of quality. We decided to use the "good" rating in subsequent analyses because it correlated highly with the other ratings and it permitted the most straightforward inference about the respondent's leadership knowledge. That is, we could readily identify items that more experienced officers rated as good. Once we determined which rating to use, we conducted discriminant analyses to identify items that distinguished between experience and novice officers.

Discriminant analysis was used (a) to assess the overall discriminating power of the goodness ratings in the combined set of tacit-knowledge items (i.e., do the item ratings on the whole differ between experts and novices?), and (b) to identify tacit-knowledge items with the highest degree of discrimination (i.e., on which items do the ratings vary most between experts and novices?). We computed a canonical discriminant function (CDF) that distinguished between experienced and novice groups for each of the levels under study. The canonical correlation coefficient based on the discriminant function was significant at each level (battalion: $\underline{R}$=.73, $\underline{p}$=.0006; company: $\underline{R}$=.72, $\underline{p}$=.0001; platoon: $\underline{R}$=.55, $\underline{p}$=.0001) indicating that the overall set of tacit-knowledge items discriminated between novice and experienced leaders. We then examined the structure coefficients for individual tacit-knowledge items. The structure coefficient represented the correlation between the value of the item and the output of the canonical discriminant function; higher absolute values for the structure coefficient indicated greater discrimination. Tacit-knowledge items with the highest structure coefficients were viewed as most promising for further instrument development.

Relationship of tacit knowledge to leadership effectiveness. In the second sample, we sought to identify items that related to perceived leadership effectiveness. Sample 2 consisted of officers assigned to active-duty Army units in U.S. Army Forces Command (FORSCOM). The FORSCOM sample provided a large sample of incumbent leaders at each level under study. By using intact chains of command we were able to identify subordinates, peers, and superiors from which to obtain ratings of each leader's effectiveness. These ratings allowed us to examine the relationship between ratings on the tacit-knowledge items and leadership effectiveness.

We obtained ratings of leadership effectiveness for each of the participants in our FORSCOM sample. The Leadership Effectiveness Survey (LES) consisted of questions that asked respondents to rate the overall leadership effectiveness of officers in their chain of command. We asked participants to rate the effectiveness of all leaders, at the specified level, that they knew in their unit, thus providing us with ratings from at least three perspectives (self, superior, and peer or subordinate). A sample question from the LES is shown in Figure 7.1.

Leadership Effectiveness Ratings

Battalion Commander Ratings

Instructions: Think about the battalion commanders listed below who are under your command. Compared to all other battalion commanders you have known, how good (effective) is the leadership of each battalion commander? Please circle the number under the statement that best corresponds to your rating for each battalion designation.

	The Best	One of the Best	Better than Most	As Good as Most	Not Quite as Good as Most but still gets the job done	Well Below Most	The Worst
Name	1	2	3	4	5	6	7
_____	1	2	3	4	5	6	7
_____	1	2	3	4	5	6	7
_____	1	2	3	4	5	6	7

Figure 7.1. Sample question from the Leadership Effectiveness Survey.

We collected data from all available members of the chain of command in approximately thirty battalions, representing 447 leaders. A battalion is a military organization composed of approximately 600 soldiers commanded by a lieutenant colonel who has an average of 17 years of experience as a commissioned officer. A typical battalion contains five companies, each with approximately 120 soldiers and commanded by a captain, with typically five to eight years of commissioned service. Generally companies have three platoons, each platoon with about 40 soldiers under the leadership of a lieutenant with one to three years of commissioned service.

We mailed the TKS to points of contact at each unit who distributed the survey to all leaders in the chain of command. Members of the research team then visited each unit to collect the TKS and to administer the Leadership Effectiveness Survey (LES) to officers in each battalion as a group. Participants completed the LES for themselves and all other officers in their chain of command, generating ratings from subordinates, peers, superiors, and self. For battalion commanders, ratings were not obtained from peers due to limited opportunities to observe one another on the job. Also, ratings were not

obtained from platoon leaders' subordinates because operational assignments precluded them from participating.

As in the TRADOC sample, we used the "good" ratings from the TKS. For the effectiveness ratings, we formed high and low effectiveness groups from the top and bottom quartiles on each effectiveness measure (e.g., subordinate, peer). Then we computed a point-biserial correlation between the goodness ratings and a categorical variable representing the effectiveness grouping (high or low). From these correlations, we identified tacit-knowledge items that were more likely to be rated as good by officers who were perceived as more effective.

The correlational analysis generated a total of 198 correlations for battalion commanders, 268 correlations for company commanders, and 138 correlations for platoon leaders. The percentage of correlation coefficients that met conventional standards for statistical significance ($p<.05$) in the point-biserial analyses were: 8% for battalion, 9% for company, and 16% for platoon. We recognize that the large number of statistical tests raises concerns about an inflated probability of Type I error; statistical significance could be due to chance. However, at this stage in the research, we evaluated the relative costs of Type I and Type II errors and decided to retain items for further investigation that might subsequently be excluded rather than to exclude items that might prove valuable in further instrument development.

Constructing the tacit-knowledge inventory. From the set of tacit-knowledge items we obtained from the interviews, we developed three versions of the Tacit Knowledge for Military Leaders (TKML) inventory corresponding to the three organizational levels studied: platoon, company, and battalion. We used two primary criteria to guide the selection of items for inclusion in the inventories. First, we selected items that were individually construct-relevant based on item statistics from the TRADOC and FORSCOM data as well as expert judgments. We retained items that the experts judged to fit the definition of tacit knowledge for military leaders and were characteristic of experienced and effective leaders at each level. Second, we selected items that were collectively construct-relevant based on the category framework derived from the interview data. We sought to represent as much of the domain of tacit knowledge as possible by including items that represented the various categories identified.

Each selected tacit-knowledge item was expanded into a scenario that posed a leadership problem and presented a set of five to fifteen response options. We used the original stories collected during our interview study to create these scenarios. We tried to ensure that the scenarios represented situations that likely would be encountered by most officers at the particular level, avoiding stories that were idiosyncratic to a particular individual. A scenario plus response options represented a "question" in the tacit-knowledge inventory with each inventory containing multiple questions.

The preliminary inventories were presented to focus groups representing each organizational level. The focus group members were officers assigned to staff or faculty positions at the U.S. Military Academy (but external to the research team) who had

served in leadership positions at the platoon, company, or battalion levels. The focus groups were asked to evaluate the correspondence between the inventory and the tacit-knowledge construct as we defined it for them. We asked them questions such as "Does this question represent the type of problem that leaders learn to solve through experience?" and "Does this question tap knowledge of the sort that we have defined as 'tacit knowledge'?" We also asked them to provide additional, plausible response options, identify areas of confusion or lack of clarity, and identify problems of gender, racial, ethnic, or "branch" bias. We refined the inventory based on the evaluations and suggestions of the focus groups, resulting in three versions of the Tacit Knowledge Inventory for Military Leadership (TKML), one for each organizational level. Figure 7.2 presents a sample question taken from the inventory for company commanders. Respondents of the inventory are asked to rate the quality or advisability of each response option using a nine-point scale from an "extremely bad" to "extremely good" response. Copies of the platoon, company, and battalion versions of the TKML are included in Appendixes B through D.

1	2	3	4	5	6	7	8	9
Extremely Bad		Somewhat Bad		Neither Bad Nor Good		Somewhat Good		Extremely Good

You are a company commander, and your battalion commander is the type of person who seems always to "shoot the messenger"--he does not like to be surprised by bad news, and he tends to take his anger out on the person who brought him the bad news. You want to build a positive, professional relationship with your battalion commander. What should you do?

_____ Speak to your battalion commander about his behavior and share your perception of it.
_____ Attempt to keep the battalion commander "over-informed" by telling him what is occurring in your unit on a regular basis (e.g., daily or every other day).
_____ Speak to the sergeant major and see if she/he is willing to try to influence the battalion commander.
_____ Keep the battalion commander informed only on important issues, but don't bring up issues you don't have to discuss with him.
_____ When you bring a problem to your battalion commander, bring a solution at the same time.
_____ Disregard the battalion commander's behavior: Continue to bring him news as you normally would.
_____ Tell your battalion commander all of the good news you can, but try to shield him from hearing the bad news.
_____ Tell the battalion commander as little as possible; deal with problems on your own if at all possible.

Figure 7.2. Sample question from the Tacit Knowledge for Military Leaders (TKML) inventory.

Validating the Tacit-Knowledge Inventory

Once we had developed a tacit-knowledge inventory for each organizational level, we sought to obtain preliminary evidence of the validity of these measures in a new sample. Specifically, we sought to establish that tacit knowledge, as measured by the TKML, relates to an external criterion, that of leadership effectiveness. In addition, we sought evidence that tacit knowledge for military leadership predicts leadership effectiveness above and beyond measures that have been traditionally used to understand leadership like general cognitive ability and experience. We also aimed to show that tacit knowledge for military leadership is distinct from tacit knowledge for management. In

other words, we sought further evidence that tacit knowledge is domain specific. We discuss the methods used to conduct our validation study and the results we obtained for leaders at the platoon, company, and battalion levels (see Hedlund et al., 1998 for more details).

We administered the TKML along with our other measures (described below) to officers from 44 battalions stationed at six posts around the United States. The number of battalions sampled at each post ranged from four to ten. By sampling intact battalions, we were able to administer the tacit-knowledge inventory at all three levels of interest (battalion, company, and platoon) and simultaneously to obtain judgments of leadership effectiveness from multiple perspectives. We obtained complete data from 368 platoon leaders, 163 company commanders, and 31 battalion commanders. In addition, we obtained ratings of leadership effectiveness from the superior officers of battalion commanders (i.e., brigade commanders), who themselves did not serve as participants.

Validation measures. In addition to the TKML, we administered measures of verbal ability, experience, and tacit knowledge for managers, and we obtained ratings of leadership effectiveness for all participants. In establishing the construct validity of our measure, we looked for evidence of convergent and discriminant validity. In other words, we expected the TKML to relate more highly to leadership performance than to verbal ability, experience, or tacit knowledge for managers.

The Concept Mastery Test (CMT; Terman, 1950) is a measure of general verbal ability and was administered to provide evidence of discriminant validity. It consists of two sections, synonym/antonym problems and verbal analogy problems. We included a measure of verbal ability because (a) performance on the inventory requires reading comprehension, and we wished to rule out the effects of this ability on test performance; and (b) measures of general cognitive ability are commonly used as predictors of performance, and we wanted to show that tacit knowledge can explain leadership performance beyond cognitive ability. Consistent with previous research, we expected that scores on the CMT would be uncorrelated or marginally correlated with scores on the TKML, and that scores on the TKML would contribute above and beyond scores on the CMT to the prediction of leadership effectiveness.

The Tacit Knowledge Inventory for Managers (TKIM; Wagner & Sternberg, 1991), designed to measure the experience-based knowledge of civilian managers, was also administered to further explore the discriminant validity of the TKML. Like the TKML, the TKIM consists of scenarios and response options that the respondents rate for quality. The TKIM has been validated in earlier research and found to be a significant predictor of managerial success (Sternberg et al., 1993; Wagner, 1987). Responses to the TKIM were scored using an expert profile consisting of the mean responses of 13 business executives from Fortune 500 firms (see Wagner). The total score on the TKIM reflects the squared deviations of each response from the expert mean profile, summed across all response options within questions. We included the TKIM with the expectation that there may be some relationship of tacit knowledge across domains, but that leadership tacit knowledge should be more predictive of performance than tacit knowledge for managers.

We also asked participants to report the number of months they have been in their current position so that we could assess the relationship between job experience and tacit knowledge. We expected to find that tacit knowledge would relate moderately to experience, but that tacit knowledge would be a better predictor of performance than simply the amount of time one has spent in his or her job.

Finally, we adminstered the Leadership Effectiveness Survey (LES) to obtain a criterion against which to validate the TKML. The LES consists of single-item measures that ask respondents to rate the effectiveness of other officers on a seven-point scale. An example question from the LES, which was also used in the FORSCOM sample, is shown above in Figure 7.1. In the construct validation study, the survey called for separate judgements of effectiveness in the interpersonal and task-oriented domains of leadership as well as an overall assessment of leadership effectiveness.

We obtained ratings from multiple sources including peers, superiors, and subordinates. Researchers have found that ratings from multiple sources can represent significant and meaningful sources of variation about perceptions of performance (e.g., Salam, Cox, & Sims, 1997). This approach is referred as a 360-degree approach to performance feedback (Church & Bracken, 1997; Tornow, 1993). Our purpose in using this approach was to explore different perspectives of leadership effectiveness from different sources. We also sought to obtain multiple ratings within sources (e.g., two or more peers) to reduce the potential error variance in the ratings provided by each source.

Where possible, we obtained ratings from an officer's immediate superior, peers in the unit, and subordinate officers. For battalion commanders we were unable to obtain peer ratings due to the limited interaction among battalion commanders, and for platoon leaders we did not obtain subordinate ratings to due the unavailability of non-commissioned officers to participate in the study. When feasible, we obtained multiple ratings of effectiveness from each source, with the exception of supervisors, because each officer only had one immediate supervisor. For those cases in which multiple ratings were obtained (e.g., subordinates, peers), a mean rating was computed for each of the effectiveness dimensions (overall, task, and interpersonal). For the data analysis, ratings on the LES were reverse coded so that higher ratings corresponded to greater perceived effectiveness.

The administration of the instruments proceeded as follows. Battalion units were selected for participation by division, corps, or brigade staff. At an appointed time, the entire available officer chain-of-command for each battalion (approximately 25-30 officers) met at a central location, usually in their battalion conference room. The participants were given instructions and were asked to complete a battery of instruments including the TKML, TKIM, CMT, and the LES, as described above. Participants were assured of the absolute confidentiality of their responses and their informed consent was obtained. Each session ended when all officers in the battalion had completed all the instruments, typically after three to four hours. Completed surveys were inventoried and coded to preserve the participants' anonymity and to facilitate later analysis.

Scoring of the TKML. Tacit-knowledge inventories pose a challenge with respect to scoring. Unlike questions on traditional achievement or intelligence tests, there is less certainty as to the quality or appropriateness of specific responses. A respondent's rating depends on his/her interpretation of the problem, and that interpretation is assumed to rely upon knowledge gained through experience. Therefore, we relied on a group of highly experienced and successful practitioners to provide an appropriate standard for judging the quality of responses.

In order to score the TKML, we gathered responses from a relevant group of experts at each of the levels under study. The expert samples consisted of highly select groups of officers who had recently demonstrated outstanding performance in their position (as defined by the Army's performance evaluation, promotion, and selection system). Fifty-nine experienced battalion commanders, 29 experienced company commanders, and 50 experienced platoon leaders completed the TKML for their respective level. Students at the Army War College (AWC) served as an expert group for the battalion-level inventory. AWC students are lieutenant colonels and colonels who are selected to attend this school based primarily on their demonstrated excellence as battalion commanders. This is a very select group of officers. Majors and lieutenant colonels attending the Pre-Command Course (PCC) served as an expert group for the company-level inventory. This is also a very select group of officers who, based primarily on their success as company commanders, have been chosen to command battalions. Selection for battalion command is an extremely competitive process. Finally, captains selected "below the zone" for major attending the Command and General Staff College (CGSC) served as an expert group for the platoon-level inventory. These three groups of officers were deemed to represent the knowledgeable practitioner by virtue of their experience and accomplishments at their respective levels.

The expert responses to the TKML were used to construct an expert profile at each level. This profile consisted of the mean and standard deviation of the experts' ratings for each response option within a question. We found that the standard deviations among experts generally fell between 1 and 2 on a nine-point scale, which we considered to represent an acceptable level of agreement in their ratings.

In our validation study, the TKML was scored by comparing each officer's ratings to the expert profile. This scoring involved computing the distance (or the squared deviation) of each response from the expert mean. We also took into account the level of agreement among experts in computing the distance scores. That is, response options about which the experts agree less received less weight in the measurement of tacit knowledge. We weighted the distance scores for each response option by the reciprocal of the standard deviation among experts. In this way respondents were penalized less for being further from the expert mean when the experts themselves exhibited disagreement as to the appropriate response. The adjusted distances were then summed across all response options within a question, and all questions within the inventory.

We further adjusted the summary scores to account for different rating styles on the part of respondents (use of scale-range and response bias) that might artificially create

larger distances. We divided the overall score, which reflected the distance scores summed across all questions, by the average standard deviation in the respondent's ratings across response options within questions. In interpreting scores on the TKML, a smaller distance score represents more expert-like responses, and, therefore, greater tacit knowledge.

Assessing the internal consistency of the TKML. Because we had three different versions of the TKML, one for each level under study, we analyzed the data separately by level following the same general procedures. First, we wanted to insure that the TKML was a reliable measure of tacit knowledge. Tacit-knowledge inventories are unique in that they consist of a series of complex questions that tap rather specific knowledge. Individuals may differ in the specific pieces of tacit knowledge they acquire through their experiences, and thus they may fail to score consistently from one question to the next. Add to this the complexity of the domain of military leadership and we might expect that the questions measure very diverse areas of knowledge. In our preliminary research we observed how the content of tacit knowledge varies simply from one organizational level to the next. These complexities reduce the likelihood of obtaining high levels of internal consistency. Therefore, we consider lower levels of reliability to be acceptable, particularly in light of the efforts we have made to develop a measure with high content validity.

To assess the reliability of each version of the TKML, we computed coefficient alpha. In the event that the initial reliability was below .80, we examined individual questions further to determine whether certain questions did not "fit" statistically or conceptually with the inventory as a whole. Specifically, we evaluated questions that exhibited low item-total correlations with the inventory ($r_{it} < .15$) and removed a question only if we determined that it did not fit the conceptual definition of tacit knowledge or was too narrow in focus (e.g., pertaining to a particular specialty like chemical weapons).

Examining the criterion measure. In the next step we examined the effectiveness ratings provided by the LES. We obtained ratings on three dimensions of leadership (task, interpersonal, and overall) from multiple sources (subordinates, peers, superiors) with the expectation that different rater sources would vary in their perceptions of leadership effectiveness. That is, we expected leadership to have different meaning to different people. For example, consider a leader who goes out drinking with his soldiers every Friday night. His subordinates may think he is a good leader, but his superiors may feel he has no authority or credibility with his soldiers. In order to determine whether or not each rating provided a distinct perspective of leadership performance, we examined the intercorrelations among rater sources and rating dimensions. The correlation matrix produced is similar to that used in multitrait-multimethod (MTMM) analysis (Campbell & Fiske, 1959). But the MTMM approach is traditionally intended to rule out the effects of method variance, whereas we looked to confirm it. Because leadership has different meaning depending on one's perspective, we expected to find higher correlations within a single rater source (e.g., a subordinate) across dimensions (e.g., overall and interpersonal leadership) than across different rater sources (e.g., subordinates and peers) on a single dimension (e.g., interpersonal leadership).

Establishing construct validity. After determining which ratings to use as criteria, we proceeded to look for evidence of discriminant and convergent validity by examining the intercorrelations among the predictor variables and the correlations between predictor variables and ratings of leadership effectiveness. Based on the results of the correlational analyses, we performed hierarchical regression analyses, where feasible, to test the incremental validity of the TKML over the CMT and the TKIM. Because the content of the TKML was unique to each level, we discuss the results separately for platoon leaders, company commanders, and battalion commanders, respectively.

The TKML for platoon leaders. We obtained data on the validation measures (the TKML, CMT, TKIM, and LES) from 368 platoon leaders. We scored and examined the TKML data first, and removed one question that correlated poorly with the inventory as a whole. We examined the content of this question and found that it was too narrow in its focus, pertaining to the job of a chemical platoon leader. We believed that the tacit knowledge relevant to this situation would not be familiar to most platoon leaders. The inventory used in our analysis contained 15 questions and had an internal-consistency reliability (α) of .69. Although this reliability is somewhat modest, we consider it to be reasonably promising, given the complexity of the instrument and the preliminary nature of the study. The summed distances on these 15 questions served as the tacit-knowledge score used in subsequent analyses. The means, standard deviations, and intercorrelations among all the variables are presented in Table 7.4.

Next, we examined data from the LES to determine if different rater sources in fact represented distinct measures of perceived leadership effectiveness. On average, platoon leaders were rated by one supervisor and two peers. Subordinates (platoon sergeants and squad leaders) were unavailable to participate due to their status as noncommissioned officers. An examination of the intercorrelations among the effectiveness ratings (see italicized portion of Table 7.4) revealed higher intercorrelations within rater sources across dimensions (e.g., peer ratings of task and interpersonal leadership) than within dimensions across rater sources (e.g., supervisor and peer ratings of interpersonal leadership). These correlations indicate that peers and superiors viewed the effectiveness of platoon leaders differently. The raters also discriminated somewhat between task and interpersonal dimensions of leadership. We concluded that there was enough differentiation in ratings to include all six leadership effectiveness ratings in further analyses.

Table 7.4
Means, Standard Deviations, and Intercorrelations for Platoon Leaders

	n	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Peer-O	385	3.25	.86	--										
2. Peer-I	385	3.44	.89	*.71***	--									
3. Peer-T	385	3.17	.87	*.84***	*.64***									
4. Sup-O	277	3.05	1.20	*.39***	*.33***	*.38***	--							
5. Sup-I	277	3.16	1.17	*.31***	*.26***	*.30***	*.79***	--						
6. Sup-T	277	3.05	1.19	*.33***	*.25***	*.34***	*.85***	*.75***	--					
7. TKML[a]	353	156.44	51.71	-.08	-.03	-.03	-.14*	-.20**	-.14*	--				
8. TKIM[a]	348	148.50	56.64	-.09	.00	-.07	.06	-.03	.02	.36**	--			
9. CMT-A	346	35.11	8.81	-.05	-.06	-.02	.10	.09	.16**	-.18**	-.16**	--		
10. CMT-S	344	43.80	20.07	.04	.12	.05	.04	.03	.05	-.02	-.03	.41**	--	
11. Mos. in job	344	7.20	5.83	.03	.01	.03	.05	.07	.06	.02	-.02	-.06	.00	--

Note. Peer-O = peer ratings of overall leadership effectiveness; Peer-I = peer ratings of interpersonal leadership effectiveness; Peer-T = peer ratings of task-oriented leadership effectiveness; Sup-O = superior ratings of overall leadership effectiveness; Sup-I = superior ratings of interpersonal leadership effectiveness; Sup-T = superior ratings of task-oriented leadership effectiveness; CMT-A = Concept Mastery Test analogies; CMT-S = Concept Mastery Test synonyms/antonyms.
[a] A smaller value on the TKML and TKIM reflects greater tacit knowledge.
* $p < .05$. ** $p < .01$.

The validation of the TKML involved showing that (a) it measured a distinct construct from general verbal ability, experience, and tacit knowledge for managers, and (b) it explained leadership effectiveness beyond these measures. To address the first issue, we examined the intercorrelations among the TKML, the TKIM, the CMT subscale scores (analogies and synonyms/antonyms), and amount of job experience. As shown in Table 7.4, these intercorrelations suggest that tacit knowledge for military leadership at the platoon level is associated with greater tacit knowledge for managers ($\underline{r} = .36$, $\underline{p} < .01$) and greater verbal ability ($\underline{r} = -.18$, $\underline{p} < .01$). (Note: A negative correlation reflects the scoring of the TKML; a smaller score indicates greater tacit knowledge.) The correlation between tacit knowledge for military leadership and tacit knowledge for managers is consistent with Sternberg's (1997) claim that there is an underlying ability to acquire and use tacit knowledge, which he refers to as practical intelligence. The finding that tacit knowledge for military leadership correlated with verbal ability differs from findings in previous tacit-knowledge research. But it is consistent with a body of research that reveals a moderate association between leadership and intelligence as conventionally defined (with correlation coefficients averaging approximately .28; Bass, 1981, p. 50). Although these correlations are significant, they do not suggest that the TKML is measuring the same construct as the CMT or TKIM. Finally, experience, as measured by months in current job, did not correlate significantly with tacit knowledge for military leadership. This finding is consistent with our earlier argument that the amount of experience one has does not guarantee that he or she has effectively learned from that experience.

More important than their relationships with one another, we were interested in the relationship of these predictors to leadership effectiveness. We found that platoon leaders with higher tacit-knowledge scores were rated higher on task effectiveness by their superior officers. Verbal ability only correlated significantly with ratings of task-oriented leadership by superiors. Tacit knowledge for managers and experience did not correlate significantly with any of the effectiveness ratings.

We examined the relationship between the TKML and LES further using hierarchical regression analysis. Specifically, we were interested in the incremental validity of the TKML above the combined CMT and TKIM scores in predicting leadership effectiveness. We entered scores on the two CMT scales and the TKIM in the first step of the regression, followed by scores on the TKML in the second step. For all three effectiveness ratings made by superiors, tacit knowledge for military leadership provided a significant increment in prediction above scores on the CMT and the TKIM, with the overall model $\underline{R}$ ranging from .19 to .21.

Throughout the process of developing the tacit-knowledge inventory, we explored the structure of tacit knowledge as represented by the items we gathered. We also attempted to represent this structure in our selection of items to form tacit-knowledge questions. Therefore, we wished to examine the structure of the TKML inventory based on our validation data. We conducted a principal-components factor analysis of the TKML to identify possible dimensions of tacit knowledge as reflected in the reponses of the 368 platoon leaders. This analysis suggested one factor with an eigenvalue greater than or equal to one, and therefore, we concluded that one general factor of tacit knowledge for military leadership best represented the responses to the TKML for platoon leaders.

The TKML for company commanders. At the company level, we obtained data from 163 commanding officers. Our analysis of the TKML data resulted in the removal of two questions that correlated poorly with the overall inventory. One question had a limited number of response options (4) which we considered to be too few to adequately assess a leader's tacit knowledge about the situation. A second question was judged to represent knowledge that was widely recognized among company commanders and thus did not fit well with the definition of tacit knowledge. The inventory used in our analyses contained 18 questions and had an internal-consistency reliability (α) of .76. The distances of the company commanders' responses from the experts on these 18 questions were summed to generate an overall tacit-knowledge score. The means, standard deviations, and intercorrelations among the variables are presented in Table 7.5.

The LES was administered to the peers, subordinates, and superiors of company commanders. On average, company commanders were rated by two subordinates, three peers, and one superior. As with platoon leaders, the intercorrelations among effectiveness ratings (see italicized portion of Table 7.5) revealed higher intercorrelations within rater sources across dimensions (e.g., peer ratings of task and interpersonal leadership) than within dimensions of leadership across rater sources (e.g., peer and superior ratings of task leadership). These correlations confirmed our expectation that superiors, subordinates, and peers would perceive the leadership effectiveness of company commanders differently. The raters also distinguished between task and interpersonal leadership, leading us to consider all nine ratings in subsequent analyses.

As with the platoon level data, we looked for evidence of discriminant and convergent validity for the TKML for company commanders. We obtained similar patterns of relationships among the TKML, TKIM, CMT, and job experience as we did for platoon leaders. Company commanders with more tacit knowledge for military leadership also had more tacit knowledge for management ($r = .32$, $p < .01$) and higher verbal ability ($r = -.25$, $p < .01$). Experience did not relate significantly to tacit knowledge for military leadership.

Table 7.5
Means, Standard Deviations, and Intercorrelations for Company Commanders

	n	M	SD	1	2	3	4	5	6	7	8	9
1. Sub-O	140	3.19	1.25	--								
2. Sub-I	140	3.32	1.37	*.86***	--							
3. Sub-T	140	3.08	1.22	*.85***	*.77***	--						
4. Peer-O	157	3.17	.73	*.35***	*.30***	*.35***	--					
5. Peer-I	157	3.33	.85	*.32***	*.31***	*.27***	*.79***	--				
6. Peer-T	157	3.09	.73	*.27***	*.19***	*.33***	*.77***	*.64***	--			
7. Sup-O	115	2.94	1.23	*.26***	*.25***	*.27***	*.25***	*.23***	*.29***	--		
8. Sup-I	115	3.12	1.19	*.37***	*.39***	*.31***	*.26***	*.31***	*.22***	*.79***	--	
9. Sup-T	115	2.86	1.32	*.16**	*.09*	*.17**	*.25***	*.24***	*.34***	*.83***	*.67***	--
10. TKML[a]	163	132.19	48.39	-.02	-.04	-.08	-.19*	-.11	-.20*	-.11	-.01	-.03
11. TKIM[a]	159	138.71	52.45	.11	.12	.08	.05	.04	.04	.13	.15	.09
12. CMT-A	157	37.19	9.02	-.18*	-.16	-.12	-.18*	-.20*	-.05	.02	.01	-.04
13. CMT-S	156	47.69	20.67	-.22**	-.21*	-.17*	-.14	-.12	-.07	.07	.06	.00
14. Mos. in job	154	8.80	5.55	-.13	-.07	-.06	-.08	-.07	.03	-.07	.04	-.06

Table 7.5 cont.

	10	11	12	13	14
1. Sub-O					
2. Sub-I					
3. Sub-T					
4. Peer-O					
5. Peer-I					
6. Peer-T					
7. Sup-O					
8. Sup-I					
9. Sup-T					
10. TKML[a]	--				
11. TKIM[a]	.32**	--			
12. CMT-A	-.25**	-.17*	--		
13. CMT-S	-.13	-.14	.61**	--	
14. Mos.in job	.08	-.02	.00	-.03	--

Note. Sub-O = subordinate ratings of overall leadership effectiveness; Sub-I = subordinate ratings of interpersonal leadership effectiveness; Sub-T = subordinate ratings of task-oriented leadership effectiveness; Peer-O = peer ratings of overall leadership effectiveness; Peer-I = peer ratings of interpersonal leadership effectiveness;

Table 7.5 cont.

Peer-T = peer ratings of task-oriented leadership effectiveness; Sup-O = superior ratings of overall leadership effectiveness; Sup-I = superior ratings of interpersonal leadership effectiveness; Sup-T = superior ratings of task-oriented leadership effectiveness; CMT-A = Concept mastery test analogies; CMT-S = Concept mastery test synonyms/antonyms.
[a] A smaller value on the TKML and TKIM reflects greater tacit knowledge.
* $p < .05$. ** $p < .01$.

In terms of explaining leadership effectiveness, we found that their peers rated company commanders who scored higher on the TKML as more effective on overall and task leadership. Scores on the CMT also correlated significantly with subordinate ratings on all three dimensions of leadership effectiveness and with peer ratings of overall and interpersonal effectiveness. However, the direction of these correlations suggested that higher verbal ability was associated with lower effectiveness as a leader.

When we followed up these results with hierarchical regression analyses, we found that for peer ratings of effectiveness, tacit knowledge for military leadership provided a significant increment in prediction over verbal ability and tacit knowledge for managers. This increment was significant even when the CMT and TKIM together contributed a significant prediction in the first step of the regression analysis. The overall model $\underline{R}$ for predicting peer ratings ranged from .25 to .32.

We also conducted a principal-components factor analysis to explore the underlying structure of the TKML for company commanders. The initial solution suggested that the TKML for company commanders consisted of multiple factors, as indicated by factors with eignevalues greater than one. Because we expect that subsets of tacit knoweldge will be interrelated, we used an oblique rotation to allow possible interpretation of these factors. Upon examining the factor pattern matrices, we identified two readily interpretable factors, one of which we labeled "tacit knowledge about dealing with the boss" (7 questions, $\alpha = .61$), and the other "tacit knowledge for motivating and developing subordinates" (5 questions, $\alpha = .60$). The two interpretable factors were consistent with categories identified in earlier phases of the research.

Based on the results of the factor analysis, we decided to construct subscale scores using the questions that loaded on each factor and to examine their individual predictive validities with regards to leadership effectiveness. We found that subscale scores representing tacit knowledge about managing the boss correlated significantly with ratings of overall effectiveness by superiors ($\underline{r} = -.17$, $\underline{p} < .05$) and provided significant incremental prediction beyond verbal ability and tacit knowledge for managers ($\Delta\underline{R}^2 = .06$, $\underline{p} < .05$). Subscale scores representing tacit knowledge for motivating and developing subordinates correlated significantly with ratings of task effectiveness by subordinates ($\underline{r} = -.15$, $\underline{p} < .05$) and provided a significant increment in prediction beyond verbal ability and tacit knowledge for managers ($\Delta\underline{R}^2 = .03$, $\underline{p} < .05$).

The TKML for battalion commanders. Of the leaders we studied, battalion commanders were the highest in the chain of command, and therefore included the fewest number of representatives. We collected data from 31 commanders out of the 44 battalions included in our study. Our analysis of the TKML data revealed several questions (five in all) that exhibited low item-total correlations with the inventory as a whole. We found that two questions represented knowledge that was common among battalion commanders and did not fit the definition of tacit knowledge. One question was judged to be too narrow in focus (referring to military intelligence) and did not assess knowledge that was representative of the majority of battalion commanders. We felt that the final two questions may not have clearly defined the problem and may have been misinterpreted by the respondents. These two questions could be corrected and retained in the inventory. However, for the purposes of our analyses, we used the remaining 11 questions, which together had an internal-consistency reliability (α) of .66. Given the modest

level of reliability and the limited number of battalion commanders sampled, we proceeded with the analyses on an exploratory basis. The means, standard deviations, and intercorrelations among the variables are presented in Table 7.6.

We obtained leadership effectiveness ratings for battalion commanders from an average of three subordinates and one superior. At the battalion level, peers do not interact with one another frequently enough to develop reasonable judgments of leadership effectiveness, and thus we did not seek their ratings. We examined the intercorrelations among ratings (see italicized portion of Table 7.6) and once again found higher correlations within rater sources than within dimensions of leadership across rater sources. We concluded that superiors and subordinates' ratings provided distinct views of the effectiveness of battalion commanders. The raters also clearly distinguished between task and interpersonal dimensions of leadership. Therefore, we considered all six ratings in our analyses.

We found no significant relationships among the TKML, the TKIM, the CMT subscale scores, and job experience. However, we did find significant relationships with the criterion. Battalion commanders with greater tacit knowledge for military leadership were rated as more effective overall by their superiors ($r = -.42$, $p < .05$). In addition, battalion commanders who scored higher on tacit knowledge for managers were rated as more effective on task-related leadership by their subordinates ($r = -.36$, $p < .05$).

We were unable to follow up these results with hierarchical regression analyses because our sample sizes for relationships involving the criteria were less than 31. However, the pattern of correlations suggests that the TKML may be a better predictor of leadership effectiveness than the CMT. Our measure of verbal ability did not correlate significantly with any of the effectiveness ratings. Although the battalion level results are based on a relatively smaller sample, they are consistent with our findings at the company and platoon levels, and suggest that tacit knowledge for military leadership has some relevance to leadership effectiveness. We also found that from the subordinate's perspective, battalion commanders' tacit knowledge for management is related to their perceived effectiveness. This finding is consistent with Army doctrine and our earlier findings, which both indicate that part of the battalion commander's role involves managing a complex system.

Table 7.6
Means, Standard Deviations, and Intercorrelations for Battalion Commanders

	n	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Sub-O	31	2.97	1.09	--										
2. Sub-I	31	2.91	1.26	*.88**	--									
3. Sub-T	31	2.81	.85	*.85**	*.66**									
4. Sup-O	24	2.42	.83	*.03*	*-.09*	*-.09*	--							
5. Sup-I	24	2.43	.84	*-.07*	*.03*	*-.20*	*.59**	--						
6. Sup-T	24	2.29	.81	*-.21*	*-.37*	*-.15*	*.59**	*.16*	--					
7. TKML[a]	31	72.12	20.78	.02	.15	.02	-.42*	-.13	-.19	--				
8. TKIM[a]	31	137.31	42.92	-.24	-.23	-.36*	.07	.03	-.03	-.06	--			
9. CMT-A	30	37.17	9.93	.20	.26	.05	.18	.27	-.04	-.19	-.08	--		
10. CMT-S	30	36.63	21.72	.19	.31	.08	.07	.30	-.22	.02	-.25	.67*	--	
11. Mos.in job	22	15.36	5.77	.23	.18	.13	-.32	-.17	-.07	-.19	-.02	-.13	-.48*	--

Note. Sub-O = subordinate ratings of overall leadership effectiveness; Sub-I = subordinate ratings of interpersonal leadership effectiveness; Sub-T = subordinate ratings of task-oriented leadership effectiveness; Sup-O = superior ratings of overall leadership effectiveness; Sup-I = superior ratings of interpersonal leadership effectiveness; Sup-T = superior ratings of task-oriented leadership effectiveness; CMT-A = Concept mastery test analogies; CMT-S = Concept mastery test synonyms/antonyms.
[a] A smaller value on the TKML and TKIM reflects greater tacit knowledge.
* $p < .05$. ** $p < .01$.

The Role of Tacit Knowledge in Military Leadership

Our research set out to address three main questions: (1) Can we identify tacit knowledge for military leadership?; (2) Can we measure the tacit knowledge of military leaders?; and (3) Does possessing tacit knowledge relate to effective leadership? Over the course of the 6-year project that we have described in this chapter, we have provided affirmative answers to each of these questions. We summarize these results and address the implications of our findings below.

We began our research by reviewing the literature pertaining to leadership, both in general and with specific regard to the military domain. The military literature provided us with some background on the types of things that are formally taught and widely recognized and the knowledge that can be regarded as tacit. We followed up this review by interviewing incumbent Army officers to uncover knowledge that met our a priori criteria as tacit. We found that tacit knowledge appeared to be embedded in the stories that leaders related about their experiences. The stories were quite varied, thus confirming the personal relevance of tacit knowledge. The content of the knowledge also varied by organizational level, suggesting that tacit knowledge reflects differing leadership issues and challenges at each level. The category structure that emerged from a hierarchical cluster analysis provided a tool for ensuring the construct representativeness of our measurement instruments.

Next, we identified items of tacit knowledge that discriminated between experienced and novice leaders at each level of command, providing further support that tacit knowledge is domain-specific knowledge acquired through experience. In the TRADOC sample, we found that among the items that discriminated well between experienced and novice leaders, good ratings on an item were in some cases more characteristic of experienced leaders and in other cases more characteristic of novice leaders. This finding suggested that the advice obtained from officers in the interview study might not necessarily be endorsed by the majority of experienced leaders. This finding also supported our reliance on an larger group of experts as the basis for scoring the TKML.

In the FORSCOM sample, we explored the relationship between how good an item of tacit knowledge was rated and perceived leadership effectiveness. Although we found only a small percentage of significant correlations at each level, these results suggested a number of items that individually exhibited a relationship with leadership effectiveness. Data from both the TRADOC and FORSCOM samples provided us with a subset of items that were more likely to embody the construct of tacit knowledge and have relevance to effective leadership performance.

The results of the interview and content-validation studies provided the foundation for the development and validation of the tacit-knowledge inventory for military leaders. Specifically, these steps ensured the content representativeness and construct relevance of the tacit-knowledge items we chose to include in the inventory. The selected items were used, along with the original interview transcripts, to form three

versions of the TKML inventory, one for each level under study, which were designed to measure the possession of and ability to use tacit knowledge.

In the final stage of our research, we subjected the TKML to a rigorous construct validation. We included measures of verbal ability, experience, and tacit knowledge for managers, along with leadership effectiveness ratings, in order to obtain evidence of discriminant and convergent validity. At all three organizational levels we found evidence that tacit knowledge for military leadership related to perceived leadership effectiveness. At the platoon and company levels, we also were able to test the relative contribution of the TKML in explaining leadership effectiveness by using hierarchical regression analyses. For each case in which the TKML predicted effectiveness ratings, it did so above and beyond measures of verbal ability and tacit knowledge for managers.

The construct validation results also provided insight about the nature of tacit knowledge for military leaders. At all three levels, leaders who possessed greater tacit knowledge were rated as more effective by their superiors. For platoon leaders and battalion commanders, we found that the overall score on the TKML was predictive of effectiveness ratings, while for company commanders it was the subscale score on questions dealing with managing the boss that was predictive of superiors' ratings. The finding that officers who possessed tacit knowledge were viewed by their bosses as more effective leaders makes sense, given the way we scored the TKML. The expert profiles used to score the TKML were based on responses from officers who were designated as highly successful leaders. Their designation as successful was based on performance evaluations made by their superiors. Therefore, we would expect there to be some relationship between those who have greater tacit knowledge, as determined by their resemblance to the experts, and those who are rated as more effective by their superiors.

We found the most complex and revealing data at the company level, where we obtained ratings from peers, superiors, and subordinates. In particular, we found that leadership effectiveness as perceived by all three rater sources was influenced by some aspect of tacit knowledge. Officers who obtained a higher overall score on the TKML were rated as more effective by their peers. Officers who received a higher score on a subset of items dealing with motivating and developing subordinates were rated as more effective by their subordinates. And officers who scored higher on a subset of items dealing with managing the boss were rated as more effective by their superiors. These results are consistent with our earlier characterization of the challenges associated with leadership at the company level. The company commander was described as dealing with multiple demands, including motivating and developing of subordinates, cooperating with peers, and simultaneously performing as part of a larger complex organization (a battalion). Officers who learn the lessons of experience at this level are perceived as more effective on aspects of performance that are most relevant to those with whom they interact.

Although these results should be considered preliminary given the purpose of this study, they yield promising evidence regarding the validity of the TKML and the relevance of tacit knowledge to military leadership. Considering all of the data we gathered, we have shown that military leaders do exhibit knowledge that fits our

definition as tacit, that tacit knowledge can be measured with some degree of reliability, and that possessing tacit knowledge is relevant to understanding leadership effectiveness. In the next chapter we discuss some of the implications of these findings for leadership practice and tacit-knowledge research in general.

Chapter 8
Practical Implications

The ultimate goal of tacit-knowledge research is to improve our understanding of what it takes to be a successful performer in a particular domain. We have addressed a number of performance domains thus far, with our most recent effort involving military leaders. From each of these efforts, we gain increased support for the importance of tacit knowledge as well as new insights about the construct itself. Our work with military leaders represents the most in-depth and rigorous tacit-knowledge research thus far. We first discuss the implications of our research with the domain of military leadership. Then we consider the relevance of this work to the study of tacit knowledge in other domains. Finally, we conclude with a review of training approaches that are applicable to the development of practical intelligence.

Tacit Knowledge in Practice

A number of products were generated from our research with military leaders. These products include leadership stories and advice, coded tacit-knowledge items, tacit-knowledge inventories, and response data from expert and novice groups. The objective is to use these products to help develop more effective leaders; to help leaders gain important job-relevant knowledge and learn more effectively from their own experiences. Although the actual products themselves are intended for use within a military context, understanding the nature of these products and their potential applications is relevant to other performance contexts.

The Products

At various steps in our research, we emerged with a tangible product that embodied some aspect of the tacit knowledge of military leaders. We discuss the leadership stories, the category framework, the tacit-knowledge inventories, the expert response profile, and the leadership effectiveness ratings as they can be applied to support the development of more effective leaders.

Leadership stories. The leadership stories are the products of interviews we conducted with designated experts at three levels of leadership (platoon, company, and battalion). Because tacit knowledge is defined as experience-based, practically-oriented knowledge, we expected that such knowledge would be expressed in the form of stories or narratives about particular experiences. The interview transcripts captured these stories as they were told, and therefore represent potentially rich sources of insight about the everyday lives of Army leaders. In contrast to published knowledge, these stories have the advantage of being drawn from a broad sample of leaders, representing knowledge that is likely to be more current, and having been carefully selected for their "tacit" content. These stories were also sorted into categories, thus providing a way to organize and index them for future reference. The stories can be catalogued to allow links to associated tacit-knowledge items and questions so that interested parties can learn

more about the knowledge they find in the inventories. A sample linkage between an inventory question, a tacit-knowledge item, and leadership story is shown in Figure 8.1.

B3. You are a battalion commander and it is the end of your first battle at a major externally-evaluated training exercise, during which your unit revealed some major shortcomings. During the After Action Review, the Chief Evaluator is highly critical of the battalion and dwells on all the negative things your unit did that day. You carefully record all of the negative observations, but you know full well that the battalion also did some very positive things that day. What should you do?

_____ Leave the After Action Review and return to your units; once there, communicate exactly what the Evaluator said.

_____ If you have a good relationship with your CSM or other similar person, discuss your frustrations and feelings with him or her.

_____ Forget about trying to get any positive feedback: Thank the Evaluator directly for the negative feedback, say you will deal with the problems immediately, and do so without expecting anything more from him.

_____ Be careful not to vent your frustrations with the Evaluator's feedback in front of the soldiers or your junior officers.

_____ Ask the Chief Evaluator if he has anything else he would like to say.

_____ Mention one or two successes the battalion had, and ask the Evaluator if he would like to comment on these positive events.

_____ Leave the After Action Review and return to your units, but when you report to them make sure to note the successes that occurred that day as well as the failures and shortcomings.

_____ Speak to the Evaluator at another time, and state your desire to receive positive as well as negative feedback so that you know what the units are doing right and wrong.

_____ Share your feelings with a friend or confidante at your own level to help you work throug h any negative feelings.

Leadership story: Handling Negative Feedback

After the first day at the NTC, I went to the head of OC to receive my after action review. The head OC was sitting in the rear of his track with his back to me. When I announced myself, he turned around and told me about the negative things my unit did that day. After I recorded all of the negative observations, I asked him if he had anything else for me because the battalion did some very positive things that day. He told me that, "There was not time at the NTC for positive feedback."

I learned that I could not take only the negative news back to the batteries or take my frustrations out on them--I had to suck it up. I think the OC was testing me to see how I reacted to only negative feedback.

I wish I had a CSM during the NTC rotation because he is a battalion commander's professional friend. He is one of the most important persons in the world to the battalion commander. A commander can talk about his frustrations to the CSM so that he does not take them out on the soldiers.

Tacit knowledge item: How to manage your frustrations as a commander.

IF you receive only negative feedback about your unit's performance
and
IF the lack of recognition of positive actions causes feelings of frustration
or
IF you need somebody to share your feelings with
and
IF you have a good relationship with your CSM
THEN discuss your frustrations and feelings with him or her
BECAUSE talking through your feelings with the CSM may prevent you from venting your feelings on your soldiers.

Figure 8.1. Sample linkage between tacit-knowledge question, coded tacit-knowledge item, and leadership story.

Category framework. The category framework that our military experts developed based on the interview data offers a structure for organizing and interpreting the tacit knowledge of military leaders. As a product, the categories serve to inform us about the key developmental challenges faced by Army officers at each level in the chain of command. Unlike the individual leadership stories described above, the category framework provides us with a "meta-story" about leadership. It offers an overview of what leaders need to know to be effective and shows us how the knowledge demands change as one ascends the organizational hierarchy. Table 8.1 summarizes the key developmental challenges faced by military leaders at each organizational level. The categories inform us about the areas of leadership performance in which most of the tacit knowledge is found. These challenges further represent aspects of leadership that are not necessarily covered by military doctrine or learned through formal training.

Table 8.1.
Key Developmental Challenges at Each Organizational Level

Platoon	Company	Battalion
Motivating subordinates	Direct versus institutional leadership	Protecting the organization
Establishing credibility	Directing and supervising others	Managing organizational change
Managing the self	Cooperating with others	Indirect communication and influence
	Balancing mission requirements and subordinate needs	Dealing with poor performers

Tacit-knowledge inventories. The most obvious product of the tacit-knowledge research is a set of inventories designed to assess the ability to acquire and use tacit knowledge. The Tacit Knowledge Inventories for Military Leaders (TKML) exists in three versions, a Platoon Leader Questionnaire, a Company Commander Questionnaire, and a Battalion Commander Questionnaire. These inventories are included as Appendices B, C, and D respectively. Like the leadership stories upon which they are based, the inventory questions themselves represent potential sources of insight into the practical, experienced-based knowledge of military leaders. Because each question includes both a scenario and a series of response options, the inventories present the knowledge in a more structured format that may be conducive to teaching, group discussion, or self-guided learning. Like the leadership stories, the questions can be organized according to content categories to allow individuals to search for related examples of knowledge or to link the question to an original leadership story. The questions, along with supporting data, can be treated as cases to be evaluated. Or the inventory can be used to assess one's level of tacit knowledge relative to the experts or other leaders.

Expert response profile. Along with the inventories, we have response data from an expert sample at each organizational level. The expert response profile summarizes the ratings given by experts to each response option, providing an indication of the level (i.e., how good or bad is the response option considered) and variability of experts' responses (i.e., how much do the experts agree in their ratings). These data can be used to create expert "rules of thumb" as to which response options the experts tend to view as more and less appropriate. Information can be presented in form of the mean rating among experts or the percentage of experts who rated a response option as good, bad, or neither. These data can be used to compare one's ratings to the experts or to stimulate discussions about the rationale or plausibility of certain responses. An example presentation of expert profile data is shown in Figure 8.2. The figure shows the percentage of experts who viewed each response option within the scenario as good (shown in white), bad (shown in

black), or neither (shown in gray). From this chart, one can readily see which options were considered good by most experts and which were considered bad by most.

Leadership effectiveness ratings. Finally, we also view the data from our construct-validation study as a product. For each of the respondents to the TKML we also have leadership effectiveness ratings. These ratings were drawn from officers at different levels in the chain-of-command. We attempted to provide, where feasible, a 360° (or multi-source) approach to assessing leadership effectiveness. In using this approach we found that there are differences in the way that subordinates, peers, and superiors evaluate leadership performance. These differences may reflect variability in the interpretation of situations and the perceived appropriateness of different courses of action.

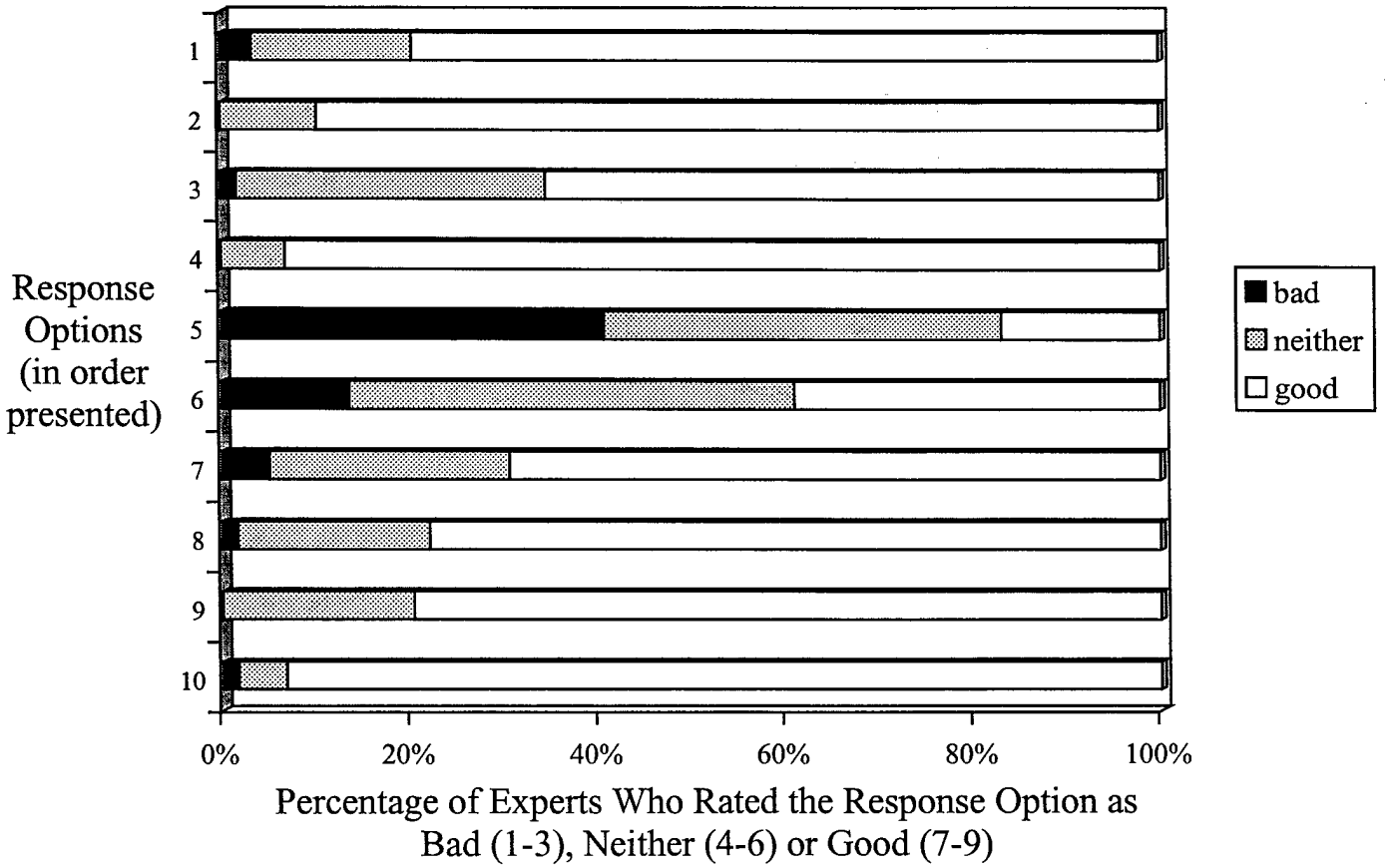

Figure 8.2. Expert responses for scenario B3 of the TKML for battalion commanders.

We found that the relationship between endorsing particular response options and being rated as effective often depended on whether subordinates, peers, or superiors were doing the rating. Obtaining ratings from multiple sources revealed that for many leadership situations there may be no one "right" answer that applies to all situations. Leaders may have to consider the varying effects that their actions may have on those with whom they interact. Through further exploration of these data, we may acquire a better understanding of the differing perspectives of platoon leaders, company commanders, and battalion commanders. For example, we can compare the responses of leaders who were rated low to those rated high on effectiveness according to different rater sources. From these data, leaders might gain insight about the expectations that others have about their performance, and thus what tacit knowledge is relevant to particular situations and dealing with particular individuals.

Applying the Products to Leadership Development

We have shown that tacit knowledge, as reflected in the above products, is related to leadership effectiveness. Therefore, these products should have value in efforts to develop effective leaders. We consider the application of these products in reference to the three pillars of leadership development within the Army. These three pillars are institutional training, self-development, and operational assignments. Although we discuss these pillars separately, we view them as serving interrelated and overlapping functions in leadership development.

Tacit knowledge in institutional training. In any domain, knowledge can be transmitted via "push" or "pull." By push, we mean that knowledge is delivered in a structured format from one source (e.g., instructor, training manual) to another (e.g., student, trainee). Knowledge of this form is typically pre-processed for the learner. It is in a form that can be readily communicated. In contrast, push means that the learner draws the knowledge from the environment as it is needed. The learner has to process the information for him or herself. Traditional classroom instruction relies on the "push" form of transmitting knowledge because it helps ensure a standard set of knowledge is conveyed.

Although tacit knowledge is by definition acquired without the support typically associated with formal training environments, the lessons of experience can be transmitted through formal instruction (e.g., classroom teaching). Tacit knowledge can be conveyed directly in the form of leadership advice or "rules of thumb," or it can be presented in the form of cases to be evaluated. In fact, the structure of tacit knowledge is conducive to case-based instruction. Tacit knowledge is based on real-world examples of the lessons leaders have learned in the process of performing their jobs. Both the leadership stories and the tacit-knowledge questions can be treated as cases to be studied.

Students can be asked, for example, to read and critique a story about a leader who questioned an order from his superior officer. The instructor can ask them to evaluate how appropriately the leader handled the situation. Alternatively, students can review the scenario presented in a tacit-knowledge question along with its associated response options. For example, the situation might describe a leader taking over a

platoon of war veterans and offer several potential responses. Students can consider what they would do in this situation, why they would consider certain options to be better than others, and what might be the potential results of choosing certain options.

The expert response profile can be examined along with the questions to learn what the experts consider to be more and less appropriate responses. Students can be asked to evaluate why the experts viewed certain options as good or bad. Instructors can ask students to indicate their agreement or disagreement with the experts' ratings. They can be asked to develop possible explanations, or rationales, for the expert responses. Similarly, the data on effectiveness ratings can be explored to find out the relationship between endorsing certain response options and perceptions of effectiveness from different rater sources. These activities may encourage students to examine the leadership situations more closely and to consider various contingencies that may influence one's assessment of different responses to those situations.

Self-development. Many of the classroom applications can also be used in self-study. The leadership stories and tacit-knowledge questions can be evaluated on one's own. Ideally, this information would be made accessible in an on-line format, allowing for easy access by all Army personnel. Officers could then search for and examine cases that illuminate the problems they face on the job. And they could reflect on how experts would solve a given problem and on how the "expert" solution might be viewed by various stakeholders.

Using the available data, leaders can also assess their own tacit knowledge compared to the experts. They can complete the TKML themselves by following the instructions included with the inventory. They can score their responses by comparing their ratings to the expert profile for their respective level. Their responses can be scored for particular questions, for certain categories of knowledge, or on the inventory as a whole. The scores, however, should only be used for diagnostic purposes (e.g., gauging one's tacit knowledge relative to the experts); they should not be used to make comparisons among leaders for the basis of personnel decisions. Leaders can use this feedback to suggest areas in need of development. Finally, by simply reviewing the scenarios, leaders may identify potential learning opportunities in their own experiences in which job-relevant knowledge can be acquired.

Operational assignments. The most effective way to acquire tacit knowledge is arguably through one's own experiences. However, this may not be the most efficient or guaranteed method of developing successful leaders. That is, not everyone is exposed to the same opportunities and not everyone learns effectively from their experiences. So, how can the products of our research be applied to helping leaders acquire job-relevant tacit knowledge? We address two potential avenues for improving the tacit knowledge of military leaders.

The first avenue for enhancing tacit-knowledge acquisition is by guiding leaders to key developmental opportunities. Because Army leaders spend a great deal of time in operational assignments, learning from on-the-job experiences seems almost essential for success. However, they may not know which experiences provide the best

developmental opportunities, or they may not acquire the relevant knowledge from the situation. We uncovered a number of "hidden," or tacit, developmental challenges from our interviews with Army leaders. If leaders are made aware of these key areas of development, they can seek out opportunities to learn. Mentors also can serve to foster these experiences. Mentors can identify or create learning opportunities around these key developmental challenges. They can help to orient junior officers to the developmental themes that underlie the challenging situations they face. Mentors can also coach junior leaders through these challenges, drawing on their own experiences as well as the supporting materials we have generated from our research.

The second avenue for enhancing tacit knowledge is to develop the underlying skills that support its acquisition. Three cognitive processes are proposed to underlie the acquisition of tacit knowledge. These are selective encoding, selective combination, and selective comparison (Sternberg, 1985, 1997). We explain each of these processes in more detail and discuss how they relate to other knowledge-acquisition processes identified in the literature.

The first process, selective encoding, is used to filter information from the environment. When new information is presented in a natural context, relevant information is embedded in the midst of irrelevant information. A critical task for the individual is to recognize what information from among that presented is relevant to one's purposes. A good selective encoder knows which information is worth attending to; a bad one does not. For example, an officer needs to use selective encoding to figure out what he or she needs to do beyond what is specified in Army doctrine in order to get promoted.

The second process, selective combination, is used to put together the information that is selectively encoded in a way that forms an integrated and coherent cognitive structure. It is not enough to know the relevant facts; one must see how they interrelate and form a pattern. Once an individual has decided what information is relevant, he or she must make sense of the information. A good selective combiner makes the connections between the facts that typically elude the poor selective combiner. An officer might realize, for example, that promotion is not based on effective performance in one aspect of leadership, but rather a pattern of effective performance across a number of specific areas.

The third process, selective comparison, is used to relate the new information to previously acquired information. It is not enough to encode and combine new information; the information has to be tied to some preexisting knowledge base. A good selective comparer recognizes how existing knowledge can be brought to bear on the present situation. A poor selective comparer does not readily see the relations between existing and new information. For example, an officer may use his or her prior promotional experiences as a basis for searching for cues about the important factors that determine who is promoted in the current position.

The three processes of selective encoding, selective combination, and selective comparison are not viewed as independent processes. Instead, they are used interactively to maximize one's learning on the job. A leader may be confronted with an overwhelming

amount of information in a given situation. He or she must decide not only what information to attend to, but how to make sense of it. In order to determine how to deal with the situation, the leader must also be able to rely, to some extent, on his or her prior knowledge related to the situation in order to respond in a timely and appropriate manner.

The relevance of these three processes in tacit-knowledge acquisition is reflected in the stories elicited from experienced leaders. Consider the following leadership story from a battalion commander about influencing subordinates' behaviors to illustrate these processes.

> I had a brigade commander who routinely stayed at the office until 1900 each evening. The subordinate battalion commanders on down also stayed until after 1900 when they saw the commander's light go out. One day when I was on duty, I stopped in the commander's office and saw him with his feet on the desk, reading a newspaper and watching the news on TV. Since I had a good rapport with the commander, I asked what he was doing. My commander said, "I have six kids at home. This is my chance to unwind from the day and catch up on the news." I took him in my jeep and showed him that all the subordinate commanders were still at work because he was still at work. He explained his behavior at the subsequent staff call and told the commanders to close shop and go home at a reasonable time.

First, the battalion commander notices that everyone stays until after 1900 in the evening. He also notices that the brigade commander's light is turned off at the same time (selective encoding). He associates the two occurrences and arrives at the conclusion that all the subordinates wait until the brigade commander goes home before they leave (selective combination). Next, he observes that his commander has his feet up, is reading a newspaper, and is watching television (selective encoding). He recognizes that these activities together suggest that his boss is no longer working (selective combination) and based on his past interaction with the brigade commander (selective comparison) decides to ask him about his behavior. He has learned through this process that a commanding officer's behavior can have a substantial influence on his or her subordinates.

The relevance of these three cognitive processes is also supported by the literature on expert-novice differences. The literature on expertise suggests that experts take more time to analyze new problems before solving them than do novices; perceive large, meaningful patterns of information more readily than novices; and are able to draw on prior knowledge in their domain better than novices (Chi, Glaser, & Farr, 1988; Sternberg, 1996). Furthermore, when faced with unfamiliar problems, expert problem solvers search for and recognize previously overlooked relevant information (selective encoding), ways of combining information (selective combination), and connections between prior knowledge and the problem situation (selective comparison) (Davidson & Sternberg, 1998).

Of course, many other processes have been used to distinguish between experts and novices. Our focus is on the processes involved in tacit-knowledge acquisition. By understanding why some leaders learn more effectively from their experiences than

others, methods can be developed to help leaders learn to be more sensitive to the lessons of experience. Leaders can be taught strategies to help them to selectively encode, combine, and compare information. They can be given examples in which the relevant information is highlighted, charts or figures may be used to show how the information is combined, and explicit explanations of how the new information is related to prior knowledge can be provided. Leaders can also be given practice using these processes on new and unfamiliar problem situations.

Tacit Knowledge Research

The results of our research not only have relevance within the military context, they also support the application of the tacit-knowledge methodology to new areas of performance. Our research with military leaders represents the most comprehensive and rigorous test of the theory of tacit knowledge to date (see Sternberg et al., 1993, 1995). First, the research with military leaders involved a new performance domain, and unlike the previous work with managers and other professionals that primarily addressed adaptation to environments, the emphasis in leadership is on the shaping of environments. The latter has certainly received less attention in the literature on intelligent performance. Second, we selected a criterion on which to validate the tacit-knowledge inventory that provided an independent and commonly employed measure of leadership performance. That is, we relied on ratings of leadership effectiveness from those who interact with the officers in our study. Finally, each stage of the research was designed to provide evidence in support of the validity of the tacit knowledge construct. We used different independent samples to identify the tacit knowledge, validate the content, build the expert profiles, and validate the TKML instrument. As we discuss below, these steps not only improved the rigor of our methodology, but also the quality of the knowledge that we gained from the research.

A Methodology for Eliciting Tacit Knowledge

An important product of our research is a set of techniques for uncovering, through semi-structured interviews, the practical knowledge that job incumbents acquire from experience--knowledge that tends to go unexpressed under ordinary circumstances. Given the current interest in capturing and "leveraging" the hidden knowledge assets within organizations, such a methodology should prove useful in a variety of settings and for a variety of purposes. The description of our methodology (attached as Appendix A and described in detail in Chapter 5) specifies the composition of interview teams, the introductory briefing of participants, and a set of questions and guidelines for getting at the tacit knowledge embedded in professionals' experience.

A Process for Developing Valid Tacit-Knowledge Tests

In addition to improving upon our method for eliciting tacit knowledge, we also developed a more rigorous test development process. This process relies on information from a review of the literature and interviews with domain experts to provide the foundation for developing a tacit-knowledge test. It begins with clear criteria regarding what is to be classified as tacit knowledge and what is not, with evaluations made

throughout the process to ensure that items continue to meet these criteria. Rather than proceed to develop test questions directly from the interview summaries, we include an interim step to select examples that best capture the construct domain. This interim step involves obtaining judgements from job incumbents as to the quality of the items and selecting items that are most likely to reflect the knowledge of experienced and successful practitioners. In other words, we take a second step to identify tacit-knowledge items that are characteristic of effective performers.

Once we have developed test questions, we subject them to empirical validation. We select a relevant criterion or criteria in order to confirm that tacit knowledge, as measured by our test, is predictive of performance. In other words, is the acquisition and use of tacit knowledge associated with better performance? We also wish to show that tacit knowledge contributes to our understanding of performance above and beyond other potentially relevant predictors. That is, what does tacit knowledge add that existing measures lack? Therefore, we include measures of performance-related constructs, like g, that our test is not intended to measure. We administer these measures to a sample of job incumbents in order to assess the construct validity of our test. We use rigorous statistical tests (e.g., hierarchical regression) to examine relationships among our tacit-knowledge test, the criterion, and other predictors. By following these steps, we increase our confidence that we have measured the construct of interest and that the results we obtain are indicative of the relevance of tacit knowledge to successful performance within the domain of interest.

These research methods as well as the products we discussed above are applicable to other performance domains. The methods for identifying and measuring tacit knowledge can be used to explore the role of tacit knowledge in new areas such as the technical functions of leadership, or new domains like teamwork, patient care, and policing. A number of useful products also emerge from tacit-knowledge research, many of which can be applied directly to employee development. Beyond the identification and measurement of tacit knowledge, our research has implications for training individuals for success. In the final section, we consider the role of training in developing practical intelligence.

Developing the Practical Intelligence of Individuals through Training

Interest in training to improve workplace performance has a long history. Taylor's influential principles of management considered training as well as selection in 1911, as did Munsterberg in 1913 (Goldstein, 1989). Nevertheless, hard evidence about the effectiveness of training remains in short supply for the most part. "At its root, training is an act of faith" (Mangum et al., 1990, p. 82, cited in Hansen, 1994). One problem is that training research is expensive and difficult to carry out. A summary of what we know about training follows (Wagner, 1997).

Evaluating Existing Training Programs

What we would like to know most about training is its value-added impact, that is, the change in relevant outcomes that can be attributed directly to training. An example of

value-added impact is determining how much wages increase as a result of skills acquired in training. The best way to determine the value-added impact of training is by randomly assigning individuals to training and control conditions, and then comparing their rates of growth on relevant variables. Unfortunately, such studies are rare because of the nature of the training enterprise (Hansen, 1994). Most training is done by private companies and organizations. They are not required to release information about the effectiveness of their training, and might be reluctant to do so for competitive reasons. In most cases, solid evaluation of the effectiveness of training is nonexistent. A great deal of the literature on the effectiveness of training consists of claims made on the basis of case studies (Lynch, 1993, Mangum et al., 1990).

Studies of national databases (e.g., Current Population Survey; National Longitudinal Surveys of Labor Market Experience) suggest that company-based training has a positive impact on earnings (see, e.g., Mangum et al. 1990), but it is difficult to attribute the benefits directly to training because of some of the problems noted previously. Other large-scale surveys indicate that students who enter community colleges or proprietary schools often do not successfully acquire any credential or even complete many courses, but those who are successful in obtaining a credential have an advantage in subsequent earnings (Grubb, 1993).

Several analyses of the training literature have been produced as National Reseach Council reports from the Committee on Techniques for the Enhancement of Human Performance (Druckman & Bjork, 1991, 1994). Three key findings were reported. First, most training programs are evaluated by the number of individuals who attain a target level of performance and the amount of training required to do so. The problem is that these criteria do not predict the extent to which training matters in the workplace. Effectiveness of training should be evaluated on the basis of performance on post-training tasks and in real-world settings. Second, if training is to be effective, it must be designed to facilitate long-term retention. Variables that predict degree of long-term retention include amount of original learning, active as opposed to passive participation, relating material to individuals' existing knowledge, and providing opportunities for overlearning and refresher training. Third, transfer of training to the workplace must be an essential component when designing training programs. Variables that affect transfer include degree of original learning, similarity of goals and processing between training and transfer contexts, and shifting the context during training so as to lessen its context specificity.

Developing Individual Practical Intelligence

Can practical job-related competencies of individuals be developed through training? The literature on the effects of training individuals to be better leaders and managers is mixed (Burke & Day, 1986; Latham, 1988; Tannenbaum & Yukl, 1992). A key issue that is related to training success is motivation to participate in training and to apply what one learns in the workplace. Motivation to learn and develop competencies is higher when training is voluntary as opposed to compulsory, and when individuals elect the type of training they will receive (Baldwin, Magjuka, & Loher, 1991). Training appears to have a greater impact when the organization values and rewards continuous

learning and personal development (Rouiller & Goldstein, 1993; Tracey, Tannenbaum, & Kavanagh, 1995). In addition to facilitating personal development as a general organizational value, what is learned through training is more likely to be applied in the workplace when both training and its application are actively supported by an individual's immediate superiors and coworkers (Facteau et al., 1995; Tracey et al., 1995). Finally, opportunities to refresh trained skills and incorporation of training competencies in performance reviews have been suggested as necessary to maintain training effects. However, few actual longitudinal studies that track training effects over time have been reported (Baldwin & Ford, 1988; Tannenbaum & Yukl, 1992).

How to develop practical intelligence is not as obvious a task as how one might develop specific areas of formal knowledge such as an organization's procedures for handling performance reviews. Many approaches to developing practical intelligence are indirect. We consider some of these approaches below.

Behavior role modeling is a method of training in which trainees observe videotaped presentations of individuals demonstrating target practical behavioral competencies. Behavioral competencies to be trained can range from how to respond when a coworker presents you with an interpersonal problem to be solved to how to speak more effectively. Trainees then are given opportunity to practice the target behavioral competencies, with feedback provided by a trainer, other trainees, or by the trainee him- or herself after watching a videotape of the practice application. Finally, trainees are encouraged to develop a written plan for implementing the newly developed competencies in the workplace. Behavioral role modeling appears to be among the most effective methods for developing practical competencies when the criterion is performance at completion of training. However, few studies have assessed long-term maintenance of training application in the workplace (Burke & Day, 1986; Latham, 1988).

Another approach for training practical competencies is learning via *simulation*. Simulations typically begin with a rich description of a complex, hypothetical organization. This may include information about the organization's history, products and services, finances, organizational chart, and market and competing organizations. Two kinds of simulations have been used in workplace-related contexts. Observational simulations involve asking individuals to take on specified roles in the organization. They are observed and rated in a variety of behavioral dimensions. Feedback is provided by trained observers, but also by other participants and individuals are asked to critique themselves as they view videotapes of their performance. Computer-based simulations also begin with a description of a hypothetical organization and assign an individual a role to play. However, the effects of their actions on organizational performance are calculated on the basis of underlying algorithms that are not revealed to participants (Funke, 1991). For example, Reichert and Dorner (1988) constructed a cold-storage depot simulation in which participants could employ up to 100 interventions in an effort to keep the depot operating after an automated control system had purportedly failed. Few studies have evaluated the effectiveness of simulation for developing practical competencies that can be applied in the workplace (Keys & Wolfe, 1990; Thornton & Cleveland, 1990).

Managers report that much of what they really need to know to do their jobs they *learned from experience* (Wagner & Sternberg, 1985). Studies of the origin of important practical knowledge and skills of managers indicate that learning from experience plays a greater role than does formal training (Davies & Easterby-Smith, 1984; McCall, Lombardo, & Morrison, 1988). Learning from experience is facilitated when individuals are placed in challenging situations that force them to come to terms with personal limitations and overcome them. Supervisors can facilitate learning from experience on the part of their subordinates by providing a source of feedback and coaching. Organizations attempt to facilitate from experience by providing (a) special assignments, (b) job rotation programs, (c) formal mentoring, and (d) systematic after-action reviews (Druckman et al., 1997).

Developing the Practical Intelligence of Teams

Once individuals have completed formal schooling and entered the workplace, the emphasis often shifts from individual achievement and performance to performing as a member of a team (Druckman & Bjork, 1994). A team is a "collection of people who must collaborate, to some degree, to achieve common goals" (Dyer, 1987, pp. 24-25). Sports teams are perhaps the most visible example, but increasingly, individuals in organizations are grouped into teams.

Much of what is known about how teams perform comes from laboratory studies in which artificially-constructed teams of individuals are asked to accomplish various tasks. A meta-analysis of the laboratory-based literature found that team performance, as measured by quantity of product, accuracy of performance, and efficiency, was related to (a) the complexity of the assigned tasks, (b) task structure, (c) amount of practice, (d) team communication, and (e) degree of team cooperation and coordination (Freeberg & Rock, 1987).

As yet, the literature on team training is in its infancy (Druckman & Bjork, 1994). What evidence exists suggests that team training is more effective when intact teams who will remain members of the same teams subsequent to training are provided training as opposed to creating teams of convenience from individuals who are sent for training, and when teams are helped to set goals to be achieved through training.

Future of Training

New developments in training may well emerge from outside the bounds of traditional industrial-organizational psychology into other areas, notably cognitive psychology. Two examples of promising applications from cognitive psychology are described briefly.

Cognitive apprenticeship. Cognitive apprenticeship is an approach for training complex cognitive tasks in a manner somewhat analogous to the way traditional apprenticeship has been used to teach trades and physical skills. Cognitive apprenticeship consists of six key elements: modeling (i.e., demonstrating components of

task performance); coaching (i.e., providing hints, feedback, and directing attention); scaffolding (i.e., support in the form of cooperative execution that gives trainees the experience of performing a task they could not perform independently); articulation (i.e., verbalizing aspects of the task or performance); reflection (i.e., evaluating task or problem-solving processes); and exploration (i.e., pursuing new goals and tasks) (Collins et al., 1989; Druckman & Bjork, 1991).

Studies of world-class performers. The development of world-class levels of performance appears to require a more intense and sustained application of the same training and acquisition mechanisms that result in more ordinary levels of attainment for the rest of us (Ericsson, 1996; Ericsson & Charness, 1994). Consequently, understanding the acquisition of expert levels of performance is likely to have implications for training broadly defined, including employment-related training (Wagner & Oliver, 1996; Wagner & Stanovich, 1996).

The tacit-knowledge research we reviewed in the preceding chapters supports the use of these training approaches in that they provide opportunities for people to learn in increasingly less structured environments. The less structure and support, the more likely it is that the knowledge acquired will have relevance to personal goals and be applicable to real situations. Behavioral role modeling and simulations provide opportunities to learn and practice behavior in a controlled setting in which one's action have minimal consequences. Although they are useful for situations that are characterized by high risk and low frequency of occurrence, they are limited in that the feedback provided is based on someone else's experience. The use of job rotation, special assignments, cognitive apprenticeships, and the like place individuals in actual work situations that provide opportunities to learn from their own experience, but they offer additional support to make sure that individuals are exposed to critical learning experiences, and that they learn effectively from those experiences. Of course, these support systems may not be readily available in all situations, and they may be limited in their ability to impart the less well-known, or tacit, knowledge that individuals are more likely to acquire on their own. Therefore, understanding and teaching the skills that support the acquisition of tacit knowledge, which we discussed earlier, may offer the most promising direction for developing practical intelligence.

Chapter 9
Conclusions

Approximately 25 years ago, McClelland (1973) questioned the validity of cognitive-ability testing for predicting real-world criteria such as job performance, arguing in favor of competency tests that more closely reflect job performance itself. Subsequent reviews of the literature on the predictive validity of intelligence tests suggest that McClelland may have been pessimistic about the validity of intelligence tests: Individual differences in intelligence-test performance account for, on average, between 4 and 25 percent of the variance in real-world criteria such as job performance (Barrett & Depinet, 1991; Hunter & Hunter, 1984; Schmidt & Hunter, 1998; Wigdor & Garner,1982). Nevertheless, these findings indicate that between 75 and 96 percent of the variance in real-world criteria such as job performance cannot be accounted for by individual differences in intelligence- test scores. The emerging literature on practical intelligence, or common sense, is a belated response to McClelland's call for new methods to assess practical abilities. The literature and research reviewed in this volume provides several sources of evidence to support a distinction between academic and practical intelligence.

First, the distinction between academic and practical intelligence is entrenched in the conception of intelligence held by laypeople and researchers alike. In addition to evidence provided by studies of implicit theories of intelligence (e.g., Sternberg et al., 1981), analyses of researchers' descriptions of the nature of intelligence suggest a prominent role for practical intelligence. Seventy years ago, the editors of the Journal of Educational Psychology convened a symposium at which prominent psychological theorists of the day were asked to describe what they imagined intelligence to be and what they considered the most crucial "next steps" in research. In a replication, Sternberg and Detterman (1986) posed these same questions to contemporary prominent theorists. An analysis of the responses of both cohorts of intelligence theorists revealed concern about practical aspects of intelligence (Sternberg & Berg, 1986). For example, among the 42 crucial next steps that were mentioned by one or more theorists from either cohort, studying real-life manifestations of intelligence was among the most frequently mentioned "next steps" of both the contemporary researchers and the original respondents. A distinction between academic and practical aspects of intelligence is also supported by older adults' perception of age-related changes in their ability to think and solve problems (Williams, Denney, & Schadler, 1983). Three-fourths of the older adults sampled believed that their ability to solve practical problems increased over the years, despite the fact that performance on academic tasks begins to decline upon completion of formal schooling.

A second source of evidence to support a distinction between academic and practical intelligence is the result of studies in which participants were assessed on both academic and practical tasks. These studies consistently find little or no correlation between performance on the two kinds of tasks. IQ tests and similar measures are unrelated to (a) the order-filling performance of milk-processing plant workers (Scribner, 1986); (b) the degree to which racetrack handicappers employ a complex and effective

algorithm (Ceci & Liker, 1986, 1988); (c) the complexity of strategies used in computer-simulated roles such as city manager (Dörner & Kreuzig, 1983; Dörner et al., 1983); and (d) the accuracy with which grocery shoppers identified quantities that provided the best value (Lave et al., 1984; Murtaugh, 1985). This research shows that the performance of both children and adults is susceptible to the context in which abilities are measured. When problems are presented in a familiar context, whether that context is school or work, individuals appear more intelligent (e.g., Carraher et al., 1985; Roazzi, 1987).

A third source of support for the importance of practical abilities comes from theories of managerial performance. Rational theories that are based on conventional notions of how people solve problems (e.g., Kepner & Tregoe, 1965; Plunkett & Hale, 1982) do not accurately represent the problem solving of experienced and successful managers. These observations led theorists to describe managerial problem solving as non-linear, convoluted, and action-oriented (e.g. McCall & Kaplan, 1985; Mintzberg et al., 1976). Furthermore, knowledge of how to solve problems can be characterized as tacit, and it may only enter into conscious awareness through reflection (Schön, 1983). The recognition that rational models of managerial problem solving do not explain the behavior of successful practitioners suggests that alternative approaches are needed to identify the practical abilities underlying performance.

Finally, the research on tacit knowledge described throughout this volume offers an approach to understanding practical intelligence. Over the course of studies with academic psychologist (Wagner, 1987; Wagner & Sternberg, 1985), business managers (Wagner & Sternberg, 1990), salespersons (Wagner, Rashotte, & Sternberg, 1992), U.S. Air Force recruits (Eddy, 1988), and most recently, military leaders (Hedlund et al., 1998), we have found that tacit knowledge offers insight into the practical abilities associated with success.

Several conclusions can be drawn from this program of research. First, these studies showed that tacit knowledge exists in the stories successful practitioners share about the lessons they learned in the process of performing their jobs. These stories provide rich insights about the practically-oriented knowledge that practitioners are often unaware that they have acquired. Second, we showed that tacit knowledge can be measured through instruments that take into account the procedural and context-specific nature of tacit knowledge. Third, using such instruments, we have found that individuals who exhibit the ability to acquire and use tacit knowledge are more effective in their respective performance domains. Furthermore, tacit knowledge helps to explain some of the additional variance in performance that is not accounted for by measures of general cognitive ability. Fifth, although the acquisition of tacit knowledge may be influenced, to some extent, by g and amount of experience, tacit-knowledge inventories are not simply new measures of these constructs. Finally, tacit knowledge generally appears to be a singular construct within domains, but the content of tacit knowledge varies across domains. In other words, tacit knowledge appears to reflect a single underlying ability, which we label practical intelligence. But, this underlying ability is not sufficient for performing well on domain-specific tacit-knowledge tests. Experience in a particular domain is important in the acquisition of tacit knowledge.

Based on consistent findings that tacit knowledge contributes to our understanding performance in a variety of domains, we discussed a number of potential ways to promote the acquisition and use of tacit knowledge. Numerous insights and products are obtained through the process of studying tacit knowledge. The categories of tacit knowledge within a domain, for example, offer insight into the experiences that provide important developmental opportunities. The products, such as the stories and the inventory questions, can be used to share the tacit knowledge with other practitioners. The tacit-knowledge research also suggests that training approaches should focus on learning environments that more closely match actual on-the-job experiences. Simulations and cognitive apprenticeships are examples of ways to provide the opportunities to gain experience and to increase the likelihood that important lessons are learned. These approaches may encourage the acquisition and use of tacit knowledge, but in rapidly changing, complex environments, it may be more effective in the long run to identify and develop ways to help individuals to learn better from their everyday experiences.

Up to this point, our research efforts have been targeted primarily at understanding and measuring practical intelligence. For the present and foreseeable future, we believe that the most viable approach to increasing the variance accounted for in real-world criteria such as job performance is to supplement existing intelligence and aptitude tests with selection of additional measures based on new constructs such as practical intelligence. Although we are excited by the promise of a new generation of measures of practical intelligence, we are the first to admit that existing evidence for the new measures does not yet match that available for traditional cognitive-academic ability tests. However, a substantial amount of evidence indicates that performance on measures of practical intelligence is related to a wide variety of criterion measures of real-world performance, but relatively unrelated to traditional measures of academic intelligence. Consequently, using both kinds of measures explains more variance in performance than relying on either kind alone.

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APPENDIX A

ELICITING TACIT KNOWLEDGE THROUGH SEMI-STRUCTURED INTERVIEWS

This document describes a set of methods for eliciting experience-based, tacit knowledge from practitioners of professional disciplines through semi-structured interviews. The methods were developed during the conduct of contract research on behalf of the U.S. Army.

1. Sample

We identified subject and demographic variables across which we sought an even distribution. In the Army study these variables included branch category (i.e., armor, infantry, ordinance), level/rank (i.e., platoon leader, company commander, battalion commander), gender, and ethnicity.

2. Interview Team

We formed two, two-person interview teams. Each team consisting of a lead interviewer and a notetaker. The lead interviewer introduced the participant to the study and took primary responsibility for directing the interview. The note taker took written notes, asked questions of clarification for the written record, and joined the lead interviewer in asking follow-up questions (see below). The interview sessions were also audio taped, with the permission of participants. In the Army study, we paired civilian researchers with Army officers who alternated in the roles of lead interviewer and note taker.

3. Introduction

When a participant arrived, members of the interview team introduced themselves. After a brief period of small talk, the lead interviewer gave a standardized introduction to the study and to the interview, along the lines outlined below:

Obtain background information:

What is your current job, and how long have you held it ?

Describe goals of the study:

We are trying to understand the key leadership lessons that Army leaders acquire from their experience on the job. If we can identify these lessons, we'll try to find ways to use them to strengthen leader development efforts within the Army.

Preempt likely misunderstandings:

This is not an evaluation of you as a leader. This is not a study comparing West Point graduates to officers from other commissioning sources.

Orient the Participant:

We want to identify specific examples of informal knowledge about leadership at the _____ [platoon, etc.] level. We want to find examples of things about leadership that aren't written in books or taught in classes. Our hunch is that this knowledge is often not discussed openly, but nevertheless is used by leaders as they meet the demands of their jobs. This knowledge may have been learned because of some challenge or problem you faced. It may have been acquired by watching someone else's successes or failures.

We're not interested in the party line or the doctrine or theory. We're also not interested in the purely technical things you learned from experience--supply procedures, maintenance, gunnery, etc. We have a good idea of the tasks associated with your job. We are really interested in the problems and challenges you faced and what you have learned about leadership at your level from these experiences.

4. Request for Stories

Purpose of the interviews was to elicit stories or cases from the participants leadership experience and to explore the unspoken, practical knowledge gained from or reflected in these cases.

Tell us a story about a leadership experience you have had as a [platoon leader/company commander/battalion commander] from which you learned a lesson.

We sought to keep the focus firmly on the participants' stories (rather than theories or generalizations about leadership). In this way, we sought to ground our interview method in the tacit-knowledge construct (i.e., in knowledge based upon personal, practical experience). Because the value and implications of remembered experiences was sometimes unclear, we sought to enlist each participant as a partner in making sense of the story, and of the leadership lessons associated with it.

5. Follow-up Questions

Follow-up questions focused on key contextual variables in the stories. Representative examples include...

Tell us more about the command climate in the battalion.

So time-in-service was the critical factor here?

Follow-up questions also focused on goals and alternative courses of action reflected in the stories. Representative examples included...

What exactly did you hope to accomplish?

What was your thinking at this point?

What else did you consider doing at the time?

Finally, follow-up questions focused on identifying practical knowledge of wider applicability (i.e., "lessons learned") derived from the experiences described in the stories. Representative examples included...

What do you think you learned from this experience?

How has this experience affected your approach to [X]?

More generally, we also sought to follow up on portions of the remembered events that appeared to be affect-laden for the participant (i.e., about which they appeared to harbor regrets). As each story progressed, we sought to identify a point of diminishing returns in order to make effective use of the interview hour. When the lead interviewer determined that such a point had been reached, he encouraged the participant to recall and share another story from his or her leadership experience.

6. Debriefing

After each interview concluded, the participant was thanked, given an opportunity to ask questions, and given an opportunity to have his or her name added to a mailing list for research reports issuing from the study in progress.

7. Interview Summaries

Directly after each interview, the designated note taker wrote an interview summary (interviews were scheduled to allow for this). The note taker used his written notes and referred to the audio taped record as needed. Each interview summary contained the following: a) subject information (i.e., subject number, branch, time in job, race/gender designation), b) a summary of each story discussed in the interview, c) annotations to each story indicating key contextual variables, and lessons learned, d) an occasional *n.b.* from the note taker.

When the note taker had completed a draft of the interview summary, he routed it to the lead interviewer for revisions. When disagreements over interpretations occurred between the two interviewers, the audio taped record was consulted in order to resolve the dispute.

8. Identification of Tacit Knowledge Content

A series of steps were taken to ensure that knowledge derived from the interviews met our stated, theory-based definition of tacit knowledge before it was selected for further use in the instrument development process. First, in a series of judging sessions, subject-matter experts applied the following four criterion to the selection of content from the interview summaries:

- The knowledge in question is intimately related to action
- The knowledge in question is relevant to goals that are personally valued by the learner
- The knowledge in question was acquired with minimal or no support from the environment
- The knowledge in question addressed military leadership (defined here as "the exercise of influence over others in order to further the legitimate goals of the organization").

9. Further Development/Validation

A series of additional steps were taken to develop and validate the tacit knowledge obtained in the interview study. A complete and detailed account of research methods may be found in the following documents:

Horvath, J. A., Williams, W. M., Forsythe, G. B., Sweeney, P. J., Sternberg, R. J, McNally, J. A., Wattendorf, J. (1994). Tacit knowledge in military leadership: A review of the literature (Tech. Rep. No. 1017). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. ADA291140.

Horvath, J. A., Sternberg, R. J., Forsythe, G. B., Sweeney, P. J., Bullis, R. C., Williams, W. M., & Dennis, M. (1996). Tacit knowledge in military leadership: Supporting instrument development (Tech. Rep. No. 1042). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. ADA310258.

Hedlund, J., Horvath, J. A., Forsythe, G. B., Snook, S., Williams, W. M., Bullis, R. C., Dennis, M., & Sternberg, R. J. (1998). Tacit Knowledge in Military Leadership: Evidence of Construct Validity (Tech. Rep. 1080). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. ADA343446.

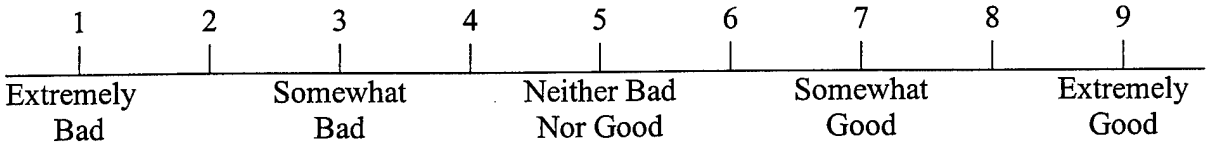
APPENDIX B

TACIT KNOWLEDGE FOR MILITARY LEADERS: PLATOON LEADER QUESTIONNAIRE

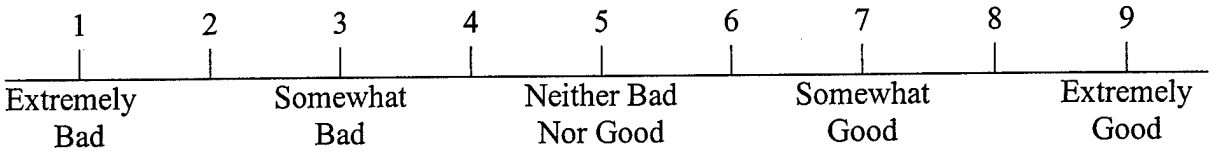
OVERVIEW AND INSTRUCTIONS

This survey was developed as part of the Tacit Knowledge in Military Leadership project to measure the practical, action-oriented knowledge that Army leaders acquire on the job. The project's main objectives were to identify the important lessons of experience that enable officers to be effective leaders and to use that knowledge to enhance leadership development.

This survey consists of descriptions of typical situations encountered by military leaders. After each situation, there are several options for how to handle the situation. For each option listed, you are to rate the quality of the option on the following 1-to-9 scale:



Select the number corresponding to your answer, and write it in the blank preceding the option (or on the answer sheet provided). Remember that some or all of the options listed for a particular question may be good, some or all of the options may be bad, or some or all of the options may be neutral (neither bad nor good). There is no one "right answer," and in fact there may be no "right answers." The options are simply things an officer at this level might do in the situation described. Please rate each individual option for its quality in achieving the goal or solving the problem described in the question. Do not try to "spread out your ratings" just for the sake of doing so. If you think all of the options are good, bad, or whatever, rate them accordingly. DO NOT BE CONCERNED if the numbers are all 9s, all 5s, all 1s, one 9 and the rest 1s, or any other mix. Your answers should reflect your opinions about the quality of the options.



P1. You are a new platoon leader. The battalion you support is preparing to conduct a night move. You assemble your platoon and tell everyone to start packing equipment in preparation for the move that same night. When you come back to inspect their movement preparation, you find that your soldiers have not packed the equipment and are talking to personnel from other platoons, who are hanging around the area. What should you do?

_____ Order the soldiers from other platoons to leave the area.

_____ Take charge of the situation, get your unit moving, then talk to the NCOs to bring the chain of command online.

_____ Tell the soldiers exactly what you want done and when you will return to reinspect.

_____ Assemble your entire platoon and tell them that their work priorities are not on target.

_____ Remind soldiers of the time urgency and the need to get many things done quickly in preparation for the night move.

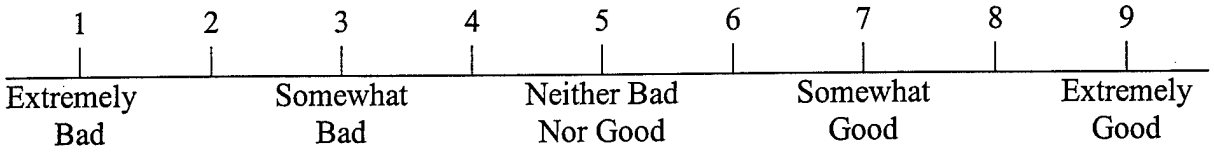
_____ Use verbal leadership and commands to influence your soldiers.

_____ Wait and see if the soldiers do the task later on their own.

_____ Assemble your squad leaders and talk about the situation.

_____ Speak to the soldiers in a friendly manner without emphasizing your authority as their leader.

_____ Warn the platoon sergeant that you will consider using punishment (such as an Article 15) if the platoon does not pull things together immediately.



P2. You are a platoon leader, and your unit is training at the National Training Center. Your battery commander makes your howitzer sections dig individual positions every time you stop, even in the offense. The other batteries do not dig in as much as you do. The Observer Controllers (OCs) tell you that your sections dig good positions, but they question why you do this so much in the offense. The battery commander's order is making a big problem for you because your sections are under-strength, and digging in so much burns everyone out and has a bad effect on morale. What should you do?

_____ Explain your view to the battery commander by talking in terms of Mission-Enemy-Terrain-Troops-and-Time (METT-T) and the effect of the decision on the unit's mission.

_____ Tell the battery commander that his directive adversely impacts the unit's morale.

_____ Go to the battery commander alone and ask him why he issued the directive.

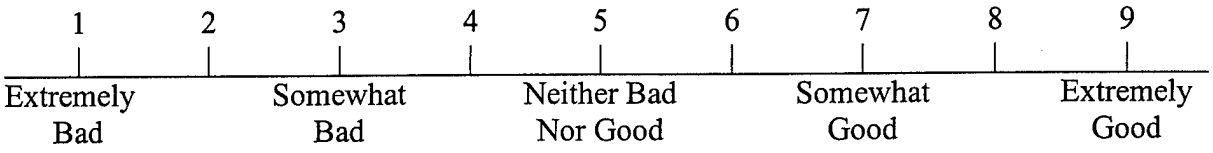
_____ Try to figure out on your own why the battery commander issued the directive and explain it to your soldiers.

_____ Speak to the company first sergeant for advice and assistance.

_____ Enlist the support of one or two other platoon leaders and go together to speak to the battery commander.

_____ Based on the position of your troops, make a decision not to comply with the commander's directive on the basis of "mission first," then explain your actions after the fact.

_____ Get together with the other platoon leaders and agree on a common position, get the support of senior NCOs, and then go as a group and together state your case to the battery commander.



P3. You have spent two months working with your new battery commander. In his last position as the Fire Support Officer for an infantry battalion he supervised a shorthanded team. Consequently, he was required to perform many duties himself. Your commander still tries to stay involved in all of the day-to-day details of running the unit, and he generally delegates tasks less often than you would like. You believe that your commander is overburdened, and you are worried about the consequences of his time-management techniques. What should you do?

_____ If you know that the battery commander intends to give someone a task, speak to that person before the battery commander does, so that he or she has already started the task before the battery commander meets with him or her.

_____ Wait to take action on specific things until after he mentions them to you.

_____ Help your battery commander to better manage his time in any way you can.

_____ Don't wait to be told what to do--anticipate what needs to be done, and if you are capable, do it.

_____ If something needs to be done but you can't do it, find someone else who can and get him/her involved--without being asked by the battery commander.

_____ Offer to take care of specific tasks before he mentions them to you.

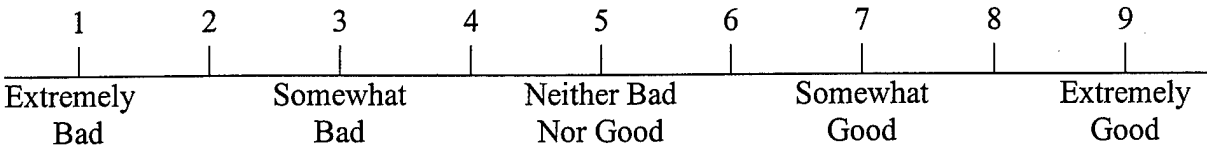
_____ When he returns from command and staff meetings, meet with him right away by yourself and write down everything that has to be done.

_____ Rely on the NCO chain of command; deal with the appropriate NCO and get NCO support.

_____ Go to the first sergeant and/or executive officer and ask for suggestions about what to do about the commander's management style.

_____ Ask the battery commander often what you can do to help and to relieve his task burden.

_____ Assume this is just the way he is and do your best to get along.



P4. During the live fire attack at the National Training Center, your tank platoon is in an overwatch position, as part of the observation post (OP) plan. You are supposed to wait to be called forward into the attack. From your position, you watch the artillery come in on the enemy positions. The smoke from the artillery obscures the enemy's view. At this point, you should move out--you should call your commanding officer and tell him you are moving while the enemy is blinded. Instead, you wait to be told to move out, as the OP plan called for. Consequently, you move after the smoke lifts, and you lose three tanks, including your own. You are angry with yourself and ashamed; you believe you should have known better. How should you deal with this situation?

_____ Think about this negative performance feedback from the NTC as a way to identify and repair your weaknesses.

_____ Try to understand other people's roles in the decision, if any.

_____ During the After Action Review, admit to your soldiers that you made a mistake; take responsibility for what happened.

_____ Reflect on the decision and determine what you should have done, in order to derive the lessons learned.

_____ Remind yourself that you will do better on the next mission.

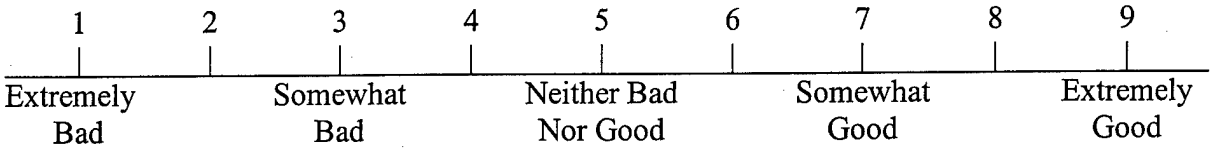
_____ During the After Action Review, describe your mistake to your subordinate leaders in order to develop and train them.

_____ Put the decision behind you; try not to dwell on it.

_____ During the After Action Review, try to explain the reasons for your decision to your soldiers.

_____ Don't let the soldiers get down on themselves because of your decision--build up their confidence and encourage them.

_____ Discuss the issue with your company commander and convince your company commander to allow you the freedom to exercise initiative at certain times, like this one.



P5. You are a platoon leader, and one day your driver has a motivational problem while out in the field. He starts mouthing off to you while standing on top of the turret in front of the rest of the platoon. Everyone in the platoon is listening to what he's saying about you, and it is extremely negative and harsh. What should you do?

_____ In front of the platoon, order your driver to do an unpleasant task as punishment for his insubordination.

_____ Pull him aside and read him his rights: really chew his butt.

_____ Go to the PSG and tell him to take care of this problem.

_____ Order your driver to be quiet and get back to his job.

_____ Pull him aside and tell him to come speak to you in one hour.

_____ Answer your driver back immediately and defend yourself by arguing your position.

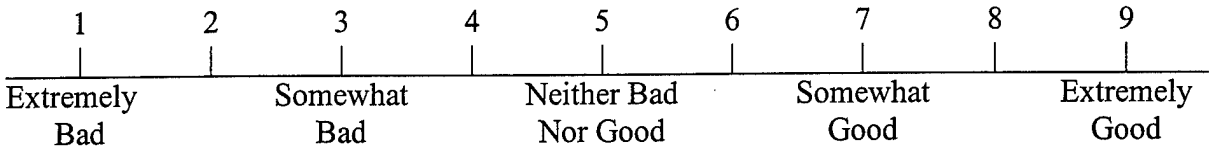
_____ Tell your driver you are recommending him for an Article 15.

_____ Do nothing; walk away and wait for your driver to blow off steam.

_____ Speak to your company commander about the problem and get his/her advice.

_____ Speak to another platoon leader and get his/her advice.

_____ Pull him aside, talk to him in private, and ask what's wrong.



P6. Your battery commander makes a decision you do not agree with. You try speaking with him and stating your position as effectively as you can, but his mind is made up and he is not going to change his position. Other platoon leaders agree with you that the battery commander's decision is wrong. What should you do?

_____ Use the first sergeant or executive officer as a voice-piece for your ideas: Convince one of them to state your opinions to the battery commander.

_____ Speak to the battalion commander and ask for advice.

_____ Tell only your NCOs that you support the battery commander's decision.

_____ Tell your platoon that you support the battery commander's decision, and they must implement it.

_____ Tell only your NCOs that you do not support the battery commander's decision, but ask for their help in implementing the decision anyway.

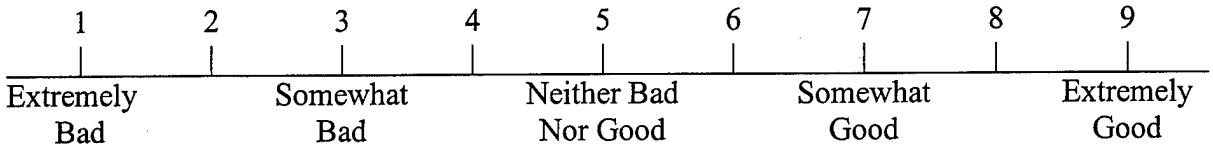
_____ Tell the NCOs that you do not support the battery commander's decision, and ask for their opinions and advice on how to handle the situation with the troops.

_____ Tell your platoon that you do not support the battery commander's decision, but ask for their cooperation in implementing the decision anyway .

_____ Formulate the best possible argument that you can in support of the batter commander's decision, and then explain the decision to the platoon while asking for their support.

_____ Go back to the battery commander and tell him/her that because you do not agree with the decision, it will be very hard for you to gain the support of the NCOs and troops to carry out the battery commander's wishes.

_____ Wait an hour after the meeting, then approach the battery commander with an alternative solution.



P7. You are a new platoon leader who takes charge of your platoon when they return from a lengthy combat deployment. All members of the platoon are war veterans, but you did not serve in the conflict. In addition, you failed to graduate from Ranger School. You are concerned about building credibility with your soldiers. What should you do?

_____ Do not change procedures that work.

_____ Ask the members of the platoon to share their combat experience: Ask what they learned and how it can help the platoon.

_____ Work hard to get into excellent physical shape so that you excel in PT .

_____ Maintain good military bearing by wearing a pressed uniform, shined boots, and having good posture.

_____ Speak to your soldiers with a tone of voice that conveys respect for them.

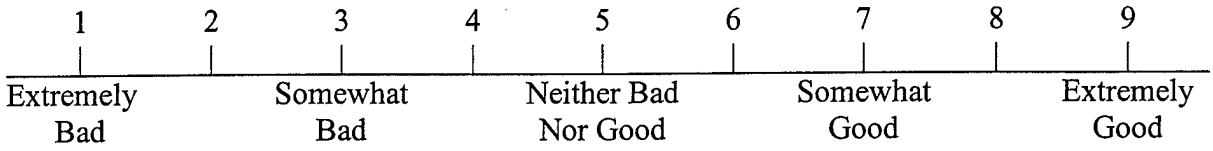
_____ Study field manuals and military history in order to gain technical and tactical competence.

_____ Defer to soldiers on matters related to their combat experience, thus acknowledging that they know more than you do in some areas.

_____ Tell your NCOs about all of the studying you have done to increase your competence.

_____ Listen frequently to your soldiers; hear their views, opinions, comments, and suggestions.

_____ Announce right up front that you are in charge and the soldiers must accept this fact and treat you with appropriate respect.



P8. You are a new platoon leader, and you are under a great deal of stress. Everyone is expecting a lot of you, and there never seem to be enough hours in the day to accomplish everything. There is a lot of competition for key awards and positions in the future, and other officers are working as hard as you are. At home, your family also needs your time and attention. How should you manage your stress?

_____ Find a trustworthy military person or confidant (not your rater) to talk to about your frustrations and problems--someone who will provide you with positive feedback about your performance.

_____ Ask a senior military leader whom you respect for specific advice and suggestions.

_____ Find a trustworthy military person or confidant (not your rater) to talk to about your frustrations and problems--someone who will provide you with honest feedback about your performance.

_____ Try not to take problems home from work.

_____ If tempted to take work home, ask yourself whether it is really critical, or whether I can wait until tomorrow.

_____ Find a trustworthy military person to talk to who will give you positive reinforcement.

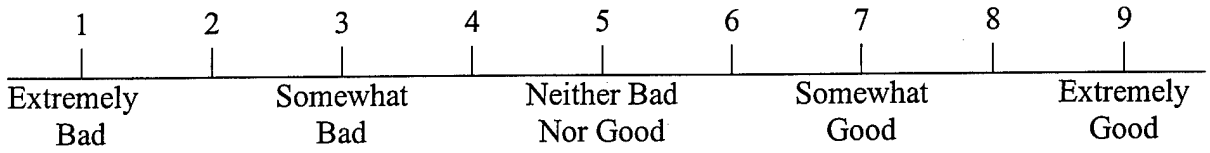
_____ Put your problems in perspective by reflecting on people who are worse off then you are.

_____ Remind yourself of your long-term goals--five or more years out--and look for relationships between the current situations and your long-term goals.

_____ Take up a hobby of interest to you and do it even though you are tired.

_____ Remember to place your career in perspective by focusing on the many aspects of your life that matter in addition to your unit.

_____ Speak to your commander about your stress, frustrations, and problems, and request her/his advice.



P9. You are an engineer platoon leader training with your soldiers. One squad is given the mission to put in a minefield for the Infantry battalion. You pick the second squad because they are good soldiers, have better equipment, and are better trained to do the job. But the squad is exhausted and the soldiers really complain. They note that it is nearing the end of the exercise and they are very tired. You tell them what you want done and you make the standards clear. When you return to check, the minefield is not up to standard and the squad is sitting around eating. You talk to the squad leader, and point out that the minefield is not up to standard. He tells you in front of the squad that the squad is not interested in your standards and that what they have done is the best you are going to get. What should you do?

_____ Relieve the squad leader, put a team leader in charge, and provide him with your guidance to complete the task.

_____ Recognize that the soldiers have reached their limit and tell them you recognize this and will take steps to ensure they are not pushed too far in the future.

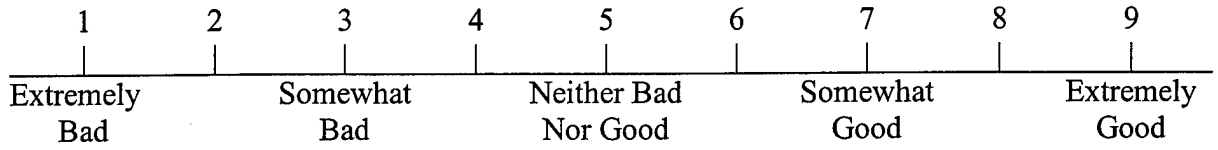
_____ Try to convince the squad leader and soldiers that you will not give them another mission until they have had a chance to rest, but that they must bring the minefield up to standard.

_____ Assume that the soldiers are overworked and let them off the hook this time--do not make them complete the task.

_____ Punish the squad leader by recommending him for an Article 15 for mouthing off to you about the soldiers not caring about your standards.

_____ Order the soldiers to stop eating immediately and complete the task, and threaten punishment if they do not comply.

_____ Say that you recognize they are tired, but tell the soldiers that the task must be completed, and ask what assistance you can arrange for to help them get the task done.



P10. You are a platoon leader, and your battalion requires the company to turn in training schedules six weeks in advance. But the battalion does not give you six weeks notice on requirements. Thus, there are a lot of changes to the training schedule. The battalion tells you six weeks out is too far in the future to assign projects, yet they expect you to plan training six weeks out! The soldiers think that these changes in the schedule jerk them around and sometimes cause morale problems. What should you do?

_____ Tell your soldiers to stop griping and worrying about the changes in the schedule-remind them that they always prepare their classes the night before anyway.

_____ Let the soldiers know the changes to the schedule are not your fault, and that you appreciate their need to be able to plan.

_____ Buffer the platoon from changes that take place higher up by filtering the information you give them about these changes--provide soldiers with as much stability and predictability as possible.

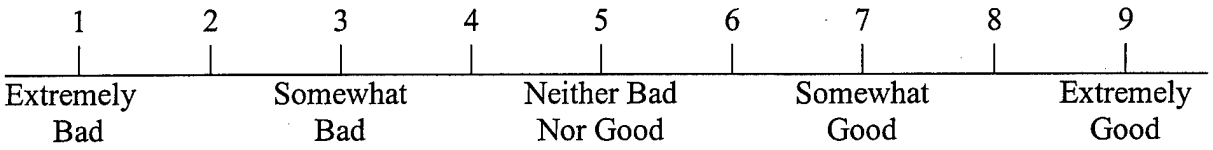
_____ Submit all required paperwork to change the schedule to the battalion, but for your own platoon, publish a special calendar that is more short term but is always accurate.

_____ Tell your platoon to ignore the training schedule, since it changes so much.

_____ Speak to your company commander about the disruptions caused by the changes in the schedule, and solicit his advice and assistance.

_____ Let the soldiers know that you agree with them that sometimes it seems that the battalion and company don't know what they are doing.

_____ Don't publish your own short-term schedule because then soldiers will think with too short-term a focus and won't take the necessary time to prepare for classes, etc.



P11. Your platoon has been working on building a range for 17 months. The assignment has been unpleasant. One reason for this is that the range site is more than an hour's drive away from the Army post. Suddenly, you are told that your platoon has to finish the project in the next three weeks. This will mean that you will have to stay out at the range and work nights, all in the summer heat of Georgia. What should you do to keep your soldiers motivated?

_____ Tell the soldiers what to expect so they can plan ahead, even when you know the work will be unpleasant.

_____ Expose yourself to many of the same hardships as your soldiers by spending time with them in the hot sun, staying with them even when it is unpleasant, etc.

_____ Focus your efforts on providing for their basic needs--get them hot meals, weekends off, and ice in the field, for example.

_____ Do everything you can to get public recognition for your soldiers when the task is complete and they are back at the base--make sure everyone knows how hard they worked.

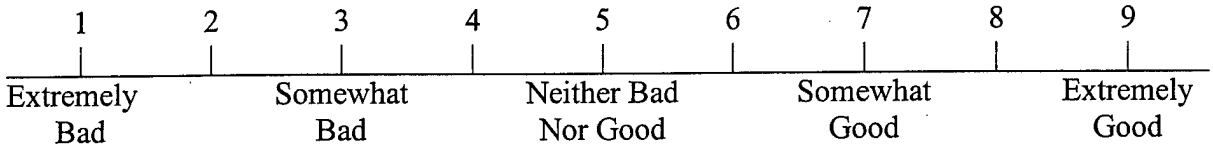
_____ Speak to your company commander and try to arrange for a more pleasant assignment to follow this unpleasant one, and then let your soldiers know what is to come to give them something to look forward to.

_____ Reward the soldiers for good work; let them know they are appreciated.

_____ Find out why the project is important, and then communicate these points to your soldiers to show them why their effort is meaningful.

_____ Give the soldiers a reward to look forward to, such as extra time off when the project is complete.

_____ Empathize with the soldiers' situation and allow them to take steps to make themselves more comfortable, such as modifying their uniform.



P12. You are a platoon leader, and you receive a new private. On his second day in your platoon, he says that he wants to kill himself. You refer the soldier to the Medical Health Center and the Chaplain. Soon after, you learn that the medical center has not assigned a person with relevant professional training to help the soldier. The Chaplain is not having much effect because the soldier is not religious. In general, you have doubts about the qualifications of the people assigned to help him. You are very concerned about this situation. What should you do?

_____ On your own, confer with the mental health officials and ask their opinion.

_____ Every time you speak with the soldier, make sure a witness is present to protect yourself from later misinterpretations or allegations about what was said.

_____ Once the situation de-escalates, take the soldier on an extended training exercise where he can meet and establish friendships with fellow soldiers.

_____ Ask the members of the platoon to help the new soldier by not making fun of him and by working together to keep an eye on him--let them know that they can make a big difference if they help out.

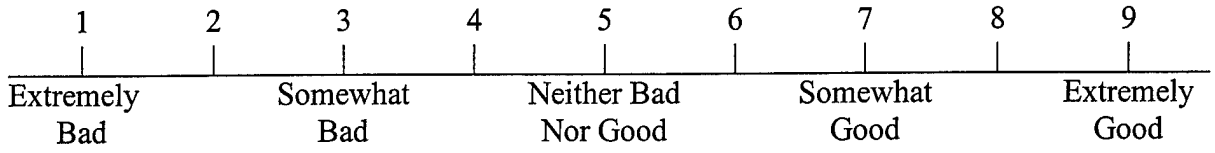
_____ Speak with your commanding officers, inform them of the situation, and ask their opinion.

_____ Call the soldier's parents and ask for their advice and assistance.

_____ Put your concerns and a list of the actions you have taken in writing to your commanding officer in order to protect yourself.

_____ Take immediate action yourself by sitting down and talking with the soldier and giving him 24 hours to decide if he wants to stay in the Army.

_____ Tell the private that he has to pull his weight and do his job.



P13. You are a new second lieutenant. Due to numerous inactivations you have been assigned to the battalion staff until a platoon becomes available. You are somewhat intimidated about working with people who outrank you by such an extent--your direct boss is the battalion executive officer. However, as an officer, you know you have a job to do. Rate the quality of the following strategies for establishing yourself as an effective officer in your new position:

_____ Do not try to act like you know it all.

_____ Be assertive; do not be afraid of using your rank.

_____ Do not worry about upsetting people, even higher ranking officers, when you are doing your duty.

_____ Be careful not to use words or say things that might offend people who outrank you.

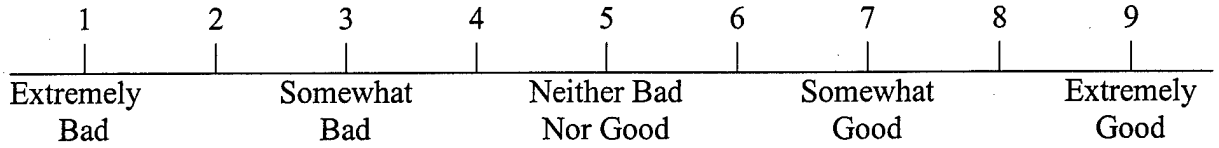
_____ Check with other lieutenants or captains and hear their opinions and get their input on an issue before taking the issue to the boss.

_____ Be respectful when you speak to officers who outrank you.

_____ Approach competent officers directly, and ask frequently for their advice and help.

_____ Find out who the competent officers are by reputation, then seek out these individuals and use them as mentors and sources of advice.

_____ Concentrate on the facts you are trying to communicate when you speak to high-ranking officers--present the facts accurately and do not change what you are saying to avoid upsetting higher-ranking officer.



P14. You and your company commander don't talk about your performance very often. When you do, he usually blows up and chews you out, but never explains what you did wrong. In fact, you rarely know exactly what your company commander thinks of you or what he expects. He generally just tells you what he wants, and that's it: He never communicates with you concerning your overall performance or development. What should you do in a situation with this type of company commander?

_____ Have a friendly competition with the other platoon leaders in order to set goals and judge your progress.

_____ Speak to another company commander about your problem and ask for his advice.

_____ Avoid talking to other officers about your complaints about your company commander--figure things out for yourself as best you can.

_____ Try to learn by talking with others about the boss's likes and dislikes, in order to understand his style and expectations.

_____ Use your fellow lieutenants as a feedback group to determine how your performance compares with that of your peers.

_____ Ask the first sergeant if your subordinates are having problems with the company commander, so that you can counsel them.

_____ Accept the fact that this is just the way your company commander is, and drive on.

_____ Ask the XO or senior lieutenant questions about the boss's opinion of you as a way of getting more information.

_____ Recognize that cooperation among the lieutenants in a company is key to the success of a platoon leader, and make sure that you cooperate with the other platoon leaders.

_____ Use your fellow lieutenants as a social support group to determine if your experiences with the company commander are normal.

_____ Assume that when your boss is not chewing you out, it basically means that he is satisfied.

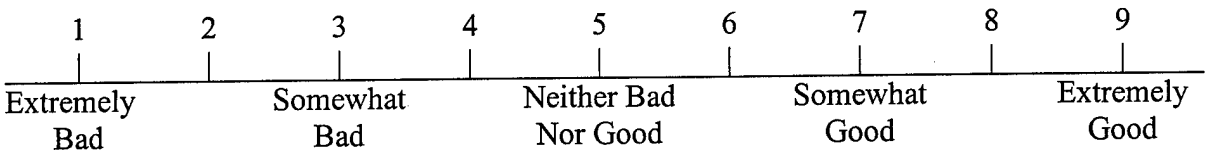
_____ Use your fellow lieutenants as a social support structure to vent your feelings and reduce your stress.

P14, continued

_____ Approach your company commander, explain that your goal is to do and be your best, and tactfully ask him for detailed performance feedback and developmental counseling.

_____ Speak to platoon leaders in other companies about your performance and frustrations.

_____ Ask the first sergeant what the company commander says about you behind your back.



P15. You are a medical service platoon leader, and you have been in the unit for several months. You have frequently seen your peers yelling at soldiers when the soldiers make a mistake. You do the same thing when one of your squads does not follow the platoon's standardized load plan--and you really lose control. You believe you were out of line, and you did not achieve the desired results. You also believe that yelling at people is demeaning and wrong. What should you do now?

_____ Recognize that it is not appropriate to scream at people, and that there are other, more effective ways to handle situations.

_____ Think about how your superior officers' anger has or would affect you--try to put yourself in the shoes of the sergeant and the other soldiers.

_____ Apologize with sincerity to the squad.

_____ Write a note to yourself on your camouflage notebook that says "Control My Temper," in order to remind you to stay in control.

_____ Ask yourself how other effective leaders at your level would have handled the situation, and make plans to modify your behavior accordingly in the future.

_____ Speak to the chaplain or a counselor about how you might better control your temper.

_____ Next time you are about to lose your temper, practice a technique like counting to ten several times to delay and hopefully stifle your outburst.

_____ Sit down with your soldiers and explain why you felt so strongly about the ambulances' standardization; try to make them see why you felt this was worth yelling about.

_____ Take deliberate action to reward soldier initiatives in the future to encourage them to be more forward.

_____ Ask your company commander for ideas about how you should have handled the situation.

_____ Accept that even though you may not like to do it, being in the Army sometimes means yelling at others.

P15, continued

_____ Ask other platoon leaders whom you admire for their advice about handling similar situations in the future.

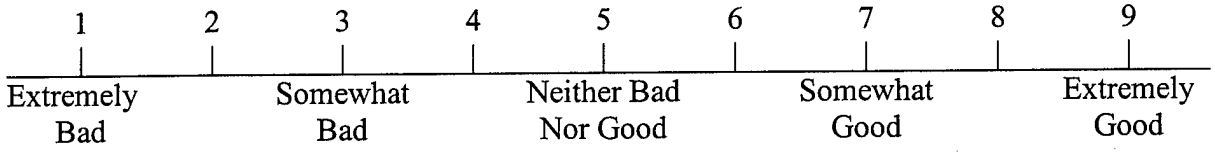
APPENDIX C

TACIT KNOWLEDGE FOR MILITARY LEADERS:
COMPANY COMMANDER QUESTIONNAIRE

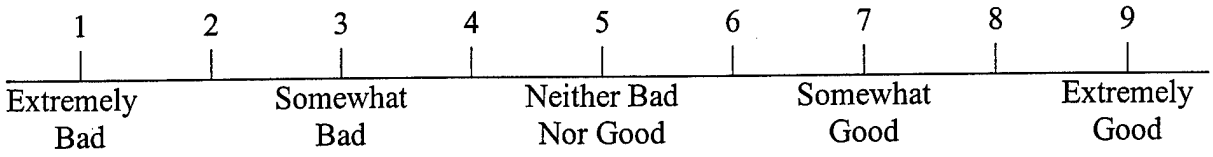
OVERVIEW AND INSTRUCTIONS

This survey was developed as part of the Tacit Knowledge in Military Leadership project to measure the practical, action-oriented knowledge that Army leaders acquire on the job. The project's main objectives were to identify the important lessons of experience that enable officers to be effective leaders and to use that knowledge to enhance leadership development.

This survey consists of descriptions of typical situations encountered by military leaders. After each situation, there are several options for how to handle the situation. For each option listed, you are to rate the quality of the option on the following 1-to-9 scale:



Select the number corresponding to your answer, and write it in the blank preceding the option (or on the answer sheet provided). Remember that some or all of the options listed for a particular question may be good, some or all of the options may be bad, or some or all of the options may be neutral (neither bad nor good). There is no one "right answer," and in fact there may be no "right answers." The options are simply things an officer at this level might do in the situation described. Please rate each individual option for its quality in achieving the goal or solving the problem described in the question. Do not try to "spread out your ratings" just for the sake of doing so. If you think all of the options are good, bad, or whatever, rate them accordingly. DO NOT BE CONCERNED if the numbers are all 9s, all 5s, all 1s, one 9 and the rest 1s, or any other mix. Your answers should reflect your opinions about the quality of the options.



C1. You take over a newly-formed company as a company commander. At the same time, the company also receives a new first sergeant, two new platoon leaders, two platoon sergeants, and a supply sergeant. You quickly begin to perceive that the soldiers in the company have a bad attitude regarding training. A few weeks after taking command, you deploy the unit to the field for a 21-day Field Training Exercise (FTX). There, you again observe (on the second day of the FTX) that the soldiers' performance is poor. For example, their stand-to procedures don't meet your standards. What should you do?

_____ Call your key leaders together and communicate your training standards in terms of the company's METL.

_____ Sit down with your first sergeant, discuss the situation, and ask for his opinion.

_____ Talk to the informal leaders in the company (for example, specialists who have demonstrated knowledge gained by reading field and training manuals) privately to find out why the soldiers have a negative attitude about training.

_____ Call a company meeting and communicate clearly your training standards in terms of the company's mission-essential task list.

_____ Speak to your platoon leaders as a group, but away from the soldiers, tell them your standards and show them how to deal with the stand-to problem.

_____ Speak with each of your platoon leaders individually and privately and tell each one to deal with the problem.

_____ Give the platoon leaders several more days to conduct their own training so that you can more closely observe and interact with the soldiers.

_____ Personally inspect the stand-to procedures--inspect each fighting position and range card yourself.

_____ Call a company meeting, tell the platoon leaders to stand off to the side, ask the soldiers why their performance is poor, and listen to their reasons.

_____ Get the first sergeant and the platoon leaders together to discuss the situation with you.

C1, Continued

_____ Threaten disciplinary action to the entire company if the stand-to procedures are not performed well during your next inspection.

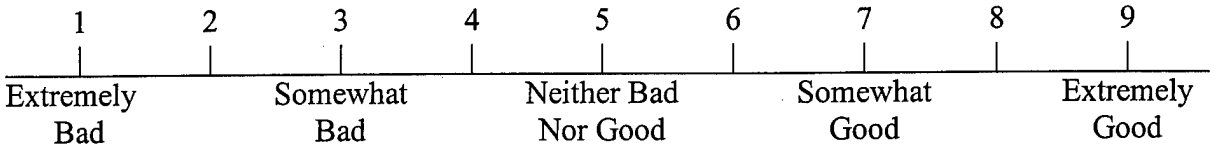
_____ Conduct an After Action Review on stand-to and define your criteria for success.

_____ Speak to the battalion commander and get his advice and direction regarding the best way to handle the problem.

_____ Call a company meeting fully involving the platoon leaders, ask the soldiers why their performance is poor, and listen to their reasons.

_____ Investigate where the soldiers got their prior ideas about what constituted acceptable standards.

_____ Bring in the entire chain of command, all at once, for a group discussion about the situation.



C2. You are a company commander on your final National Training Center (NTC) rotation as a company commander. Your company is cross-attached to a mechanized infantry battalion to form a task force. Before you deployed to the NTC, you were given a new platoon leader (and his platoon) who had been transferred from another company in order to get a second chance. You have reason to believe he is weak tactically. When the task force is organized into company teams, you are required to provide a platoon to an infantry company. You have been advised by your first sergeant to send this new platoon over to the infantry company. What should you do?

_____ Give the weak lieutenant specific step-by-step instructions regarding how to do his job.

_____ Talk to the first sergeant, ask him to explain the reasons for his opinion, and listen to these reasons closely before making a decision.

_____ Send your best tank platoon over to the infantry company.

_____ Keep both your strongest and weakest platoons and send an average-performing platoon over to the infantry company.

_____ Send the new platoon leader and his platoon over to the infantry company.

_____ Speak to the soldiers in the poorly-performing platoon: Tell them you have confidence in their ability to perform well, and that to display your level of confidence you are sending them over to the infantry company where they will represent your company.

_____ Send the platoon you would normally send.

_____ Send the weak platoon leader out with a strong company to observe and learn, without giving him any responsibility.

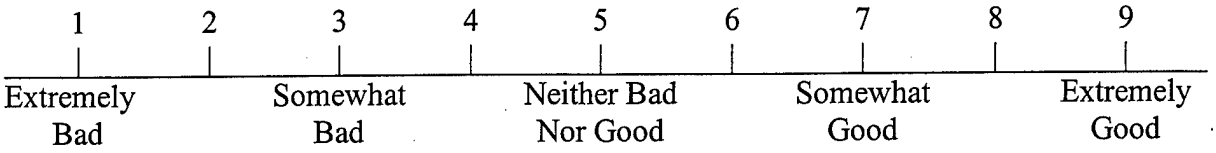
_____ Have a closed-door talk with the weak lieutenant: Tell him he has a free opportunity to learn here, and he should do his best to learn what he can and then call you with any problems.

C2, continued

_____ Speak to your battalion commander and tell him that you were given this new, ill-prepared platoon leader before you deployed to the NTC, and ask for his direction in making your decision.

_____ Speak to the platoon leader; try to uncover the reasons for his weaknesses, and deal with these issues as best you can.

_____ Tell your platoon sergeant to look out for the weak lieutenant.



C3. You are a company commander, and your battalion commander is the type of person who seems always to "shoot the messenger"--he does not like to be surprised by bad news, and he tends to take his anger out on the person who brought him the bad news. You want to build a positive, professional relationship with your battalion commander. What should you do?

_____ Speak to your battalion commander about his behavior and share your perception of it.

_____ Attempt to keep the battalion commander "over-informed" by telling him what is occurring in your unit on a regular basis (e.g., daily or every other day).

_____ Speak to the sergeant major and see if she/he is willing to try to influence the battalion commander.

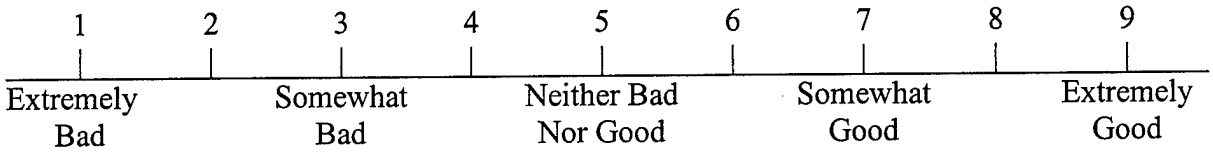
_____ Keep the battalion commander informed only on important issues, but don't bring up issues you don't have to discuss with him.

_____ When you bring a problem to your battalion commander, bring a solution at the same time.

_____ Disregard the battalion commander's behavior: Continue to bring him news as you normally would.

_____ Tell your battalion commander all of the good news you can, but try to shield him from hearing the bad news.

_____ Tell the battalion commander as little as possible; deal with problems on your own if at all possible.



C4. You are a company commander on a battalion-level field training exercise. Your unit has just completed a night move and has been in position for about two hours. At midnight, you learn that a weapon is missing. The platoon sergeant with responsibility for weapons is confident that he knows where the weapon is because he saw it during the sensitive-items check completed after he arrived. A sensitive-item report is due to brigade at 0400 hours. What should you do?

_____ If you are confident the weapon will be found at first light, submit a sensitive item report stating that all weapons are accounted for.

_____ Do not speak to the battalion commander until shortly before the sensitive-item report is due; at this point, completely and honestly report all of your actions since the weapon was discovered missing.

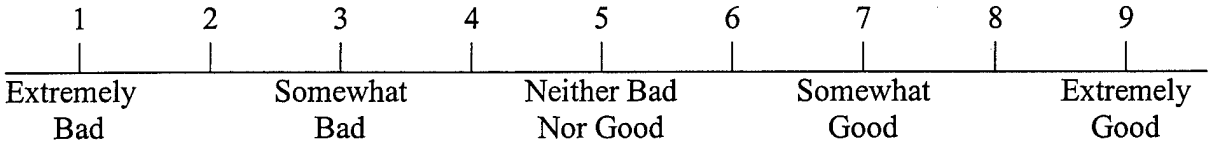
_____ Immediately mobilize everyone in the unit, and conduct a 100% inventory followed by a hands-on search.

_____ Before the sensitive-item report deadline, notify the battalion executive officer of the situation in person.

_____ Consult the standing operating procedures manual to ensure that you follow the rules correctly.

_____ Immediately notify the battalion commander and tell him your plans for finding the weapon and resolving the incident.

_____ If the weapon is not located within one hour, notify the entire chain of command of the lost weapon.



C5. You are a company commander. Your battalion is training for gunnery. Currently, all of the companies are well-prepared to pass gunnery. There is a great deal of competition among the companies and all of the commanders have Officer Evaluation Reports (OERs) due in the next few months. You have an NCO (platoon sergeant) in your unit who just arrived from teaching gunnery at the branch school. He tells you about some advanced training techniques using available equipment that have significantly improved gunnery scores in other units. This information has not been made available to units in the field. After some practice with the techniques, you find that they significantly improve the scores of your sections. What should you do?

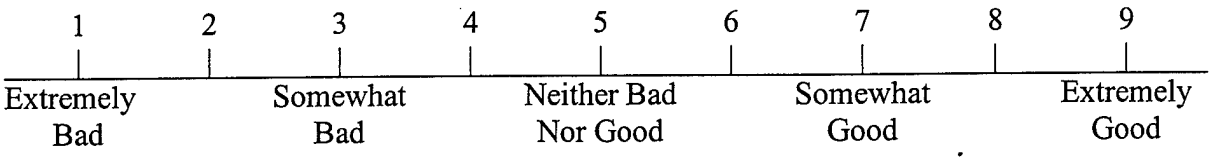
_____ Do nothing--allow the information about the training techniques to be passed through NCO channels if it comes up.

_____ Share the information about the training techniques with the battalion commander, then tell all of the other company commanders.

_____ Train your company using the information, execute gunnery--presumably beating all of your fellow company commanders--then tell everyone how you did it after the fact.

_____ Initiate a meeting with all company commanders, platoon leaders, first sergeants, and platoon sergeants, and have your new platoon sergeant present and describe the techniques.

_____ Tell the platoon sergeant to keep close hold over the information about the training techniques so that only your company possesses this information.



C6. You are a battery commander. Consequently, you work for both your battalion commander and the brigade commander whom you support. During preparation time for the National Training Center (NTC), you are also preparing for a Battle Command Training Program (BCTP). Your battalion commander is interested in the BCTP, but the maneuver brigade commander wants you to focus on the NTC. What should you do?

_____ Find out from the battalion commander what his priority is: Get your battalion commander's guidance and act accordingly.

_____ Focus on BCTP regardless.

_____ Place your priority on the training event that will most benefit your soldiers (NTC), regardless of the wishes of the battalion and brigade commanders.

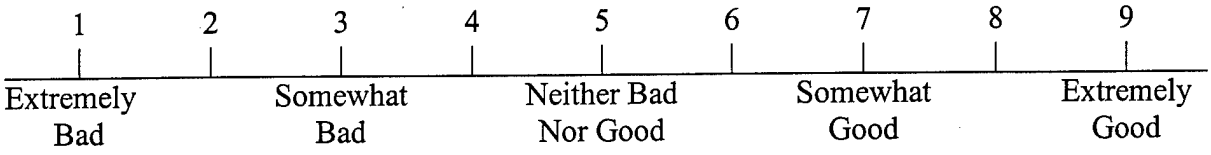
_____ Focus equally on the two training events.

_____ If both training events have equal training value, then support the event scheduled by your battalion commander (BCTP).

_____ Focus on NTC regardless.

_____ Focus on your weakest area.

_____ If both training events have equal training value, then support the brigade commander's wishes (NTC).



C7. You are a new company commander. There are a lot of things you want to fix in the company. You have quickly become overwhelmed by the many pressures you face and the many demands on your time. You realize that you cannot possibly do everything. What should you do to better manage your key leaders and your time so that you are able to accomplish more in the same amount of time? Rate the following strategies:

_____ Have your key leaders execute the alternative after you select it.

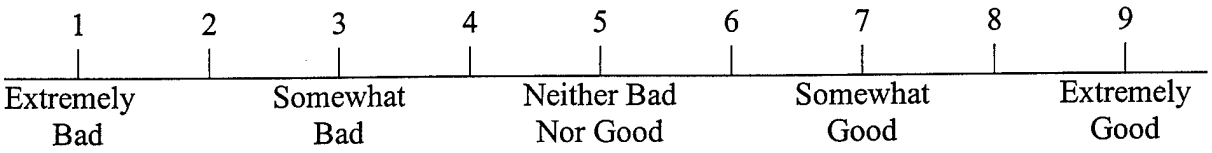
_____ Allow key leaders on their own to select alternatives to solve problems and implement these strategies.

_____ Use key leaders to solve problems by having them research alternatives in their area of responsibility that would solve the problems and report these alternatives to you.

_____ Try to report earlier in the morning and/or stay later at night to get more done.

_____ Give your key leaders more specific directions when it comes to solving problems—tell them what to do to get the job done.

_____ Learn to spot check by walking around the company area and getting a general idea of what's going on--don't feel compelled to check every single thing personally.



C8. You are a new company commander who has just taken over your unit. One of your soldiers is leaving the army. The supply sergeant brings you a Report of Survey and a $250 Statement of Charges for the soldier's missing TA-50 and asks you to sign one or the other. You talk to the soldier and learn that the equipment was lost on re-deployment and that the chain of command had not taken appropriate action. The soldier had notified the old commander three times in writing, saying that his equipment was missing--but the commander took no action because he did not want to submit a late Report of Survey. (The Battalion Commander also did not want any late reports of survey.) The soldier says he will sign the Statement of Charges because he just wants to get out. What should you do?

_____ In spite of his dislike for late reports, notify the battalion commander that you are initiating a late report of survey on the soldier's lost TA-50.

_____ Have the supply sergeant validate the statements made by collecting relevant information from the soldier and other sources, put this information together, and bring it to the battalion commander.

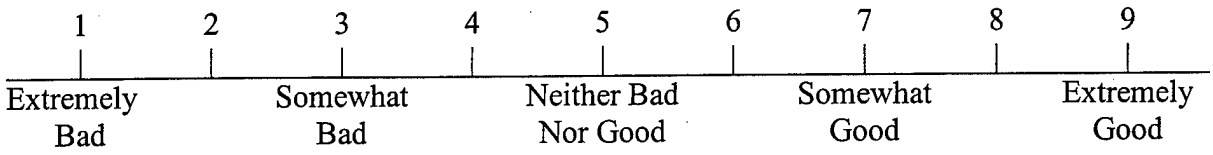
_____ Initiate a late report of survey without first informing the battalion commander.

_____ Point out to the battalion commander that the chain of command failed to properly uphold its responsibility and failed the soldier, and explain that this situation must be rectified now.

_____ Allow the soldier to sign the Statement of Charges so that he can leave.

_____ If the battalion commander is hard on company commanders who initiate late Reports of Survey, do not initiate the report.

_____ Attempt to contact the past company commander to find out why, exactly, he did not take care of the situation.



C9. It is the first week of your command as a new company commander, and you want to establish yourself quickly as an effective leader. You have assessed the current physical training program, and you believe it could use a total overhaul in order to ensure that the company will meet the PT standards. Your company does not have a qualified master fitness trainer. What should you do?

_____ Ask for a volunteer from the entire company to take charge and run the PT program, and supervise this individual very closely.

_____ Talk to your first sergeant and get his/her advice.

_____ Ask for a volunteer from among your platoon sergeants and platoon leaders to take charge and run the PT program, and supervise this individual very closely.

_____ Offer a reward or incentive to any soldier who comes up with the best idea for how to revamp the PT program.

_____ Publicly praise and reward soldiers who demonstrate initiative in revamping the PT program.

_____ Consult a fellow commander who has a solid fitness program for guidance and suggestions.

_____ Ask for a volunteer from among your platoon sergeants and platoon leaders to take charge and run the PT program, and give this person the authority to do it his/her way.

_____ Assess the company's other goals and decide which of the goals is most important before taking action on the PT program overhaul.

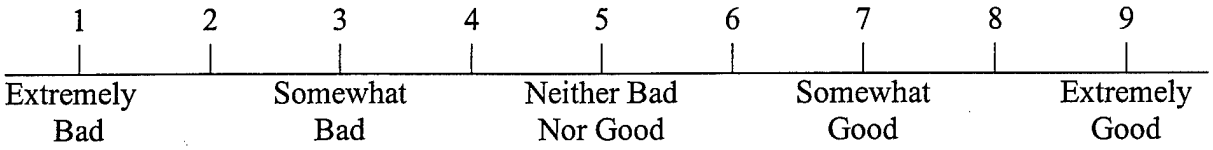
_____ Appoint the most competent person to work with you in revamping the PT program.

_____ Ask the soldiers and key leaders for their ideas and suggestions before deciding on a course of action.

_____ Ask for a volunteer from the entire company to take charge and run the PT program, and give this person the authority to do it his/her way.

C9, Continued.

_____ Speak with your battalion commander to get his/her suggestions regarding the PT overhaul before deciding on a course of action.



C10. You are a new company commander. The previous commander was a micromanager. This individual was extremely detail-oriented, gave very little positive feedback and often tore down the platoon leaders when even the slightest infraction occurred. For example, the old company commander noted one day that one of the platoon leaders was wearing a dirty soft-cap, and he called the entire platoon a disgrace. This behavior on the part of the outgoing company commander was very hard on the platoon leaders. Several developed nervous conditions such as ulcers and sleep problems. Your goal is to create a more positive leadership atmosphere in the unit. What should you do?

_____ Give all unit members more responsibility than they had before, and hold them accountable.

_____ When you must give negative feedback to your platoon leaders, do so constructively, pointing out specific areas that need improvement and explaining how this improvement can be achieved.

_____ Allow the platoon leaders and their soldiers the benefit of the doubt--don't jump to negative conclusions.

_____ Assign work goals with clear milestones to all officers.

_____ Involve senior NCOs in the decision-making process.

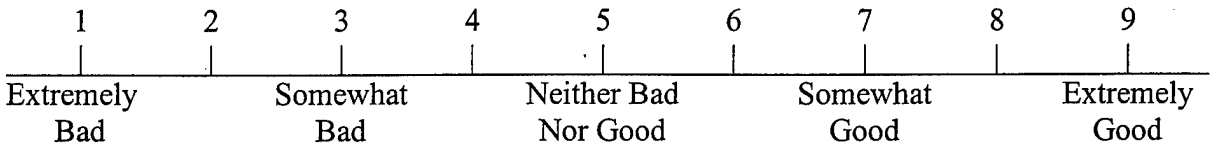
_____ Give the platoon leaders frequent, specific positive feedback.

_____ Continue with the micromanagement style since it is common practice in the company, and relieve and/or replace the lieutenants who cannot handle the stress.

_____ Let your subordinates know your intent and then let them develop their own plans.

_____ Recognize soldiers' achievements with awards.

_____ Have positive expectations: State often that you believe that every member of the unit has the ability to perform well if he or she applies himself or herself and works hard.



C11. You are a company commander with a new brigade commander. Before the new brigade commander took over, the battalion conducted After Action Reviews by critiquing each training task according to the Mission Training Plan. The new brigade commander asks to see how AARs are conducted in the brigade--he wants to find someone who does AARs improperly so he can use this individual as an example to show what needs to be improved. When the brigade commander observes you he says he does not like your AAR format and he feels you are critiquing instead of letting the soldiers talk. Thus, you must now develop a system for listening more to your soldiers while still maintaining an effective command. Rate the quality of the following strategies.

_____ Ask yourself why you talk when you do and evaluate whether you need to speak at these times to optimally benefit your unit.

_____ Listen most to soldiers who have the best interest of the unit at heart and have no hidden agendas.

_____ Ask around among the soldiers to discover the informal leaders in the group, then seek out and listen to these soldiers.

_____ Try listening at moments when you would customarily talk.

_____ When soldiers' safety is at risk, use directive leadership instead of listening.

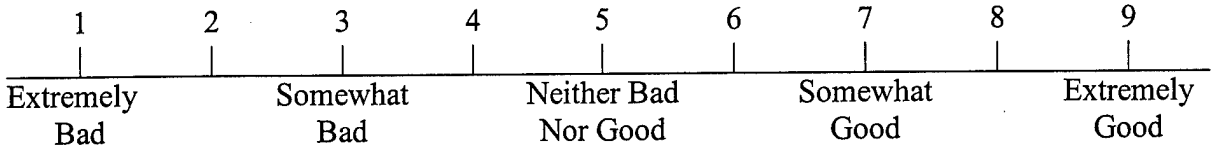
_____ Whenever you have time, seek out your soldiers, ask them questions, and listen to their opinions and views.

_____ Do not listen to soldiers when they lack the knowledge necessary to make a decision.

_____ Schedule regular meetings with your NCOs when you just sit and talk about the unit—and make these meetings times when you do less talking and more listening.

_____ Listen most to soldiers who are squared away and who command the respect of other soldiers.

_____ Listen to soldiers who are willing to express their opinions before a group.



C12. You are a company commander, and there has been an ongoing problem in your unit with alcoholism and especially with soldiers driving under the influence of alcohol. Two soldiers in the unit who previously had bad problems have since joined Alcoholics Anonymous groups and are now recovered. One other soldier is now in jail because of a car accident he caused while intoxicated which resulted in the death of a civilian. You are extremely concerned about this ongoing problem, and you would like to do something to get through to the soldiers about its seriousness and impact upon your unit. What should you do?

_____ Regularly pull a soldier out of formation, at random, and ask him/her to speak to the unit about why driving under the influence is a bad idea.

_____ Encourage soldiers to form their own informal peer support group to combat alcoholism.

_____ Provide incentives to soldiers for going three consecutive weeks without drinking and for other milestones of good behavior.

_____ Present in detail the story of the soldier who is now in jail to the whole unit.

_____ Have the reformed alcoholics give presentations stating how they beat their problem to drum up peer support.

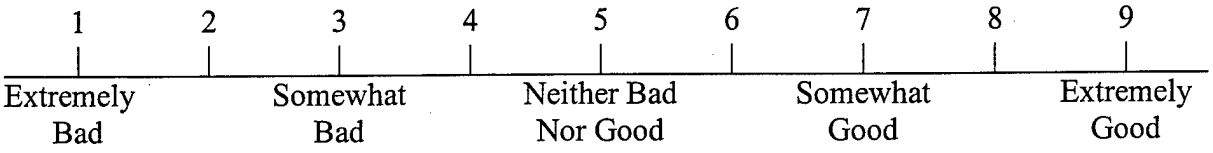
_____ Use different approaches from day to day when you talk to the troops about the problem--for example, one day mention the soldier who is in jail; the next day mention the success of the Alcoholics Anonymous groups.

_____ Prepare an analysis of what driving under the influence costs a soldier in lost pay and fines, and make this information readily available to all soldiers.

_____ Conduct frequent health and welfare inspections to search for alcohol.

_____ Call in Alcoholics Anonymous sponsors to give a talk about the dangers of alcoholism.

_____ Be tough on the soldiers: Threaten the most extreme punishment possible for even the slightest infraction of the rules.



C13. You are a company commander with some relatively junior lieutenants. Your goal is to develop these lieutenants. Rate the quality of the following strategies for achieving your goal.

_____ Involve the lieutenants in every administrative action in the company.

_____ Beginning early on, encourage the lieutenants to determine their own goals, and use this information during counseling sessions.

_____ Involve the lieutenants only in those decisions that affect their platoons.

_____ Explain the big picture to the lieutenants regarding upcoming missions.

_____ When going on a mission, explain only their portion to the lieutenants.

_____ Tell the lieutenants when things in the battalion are bothering you.

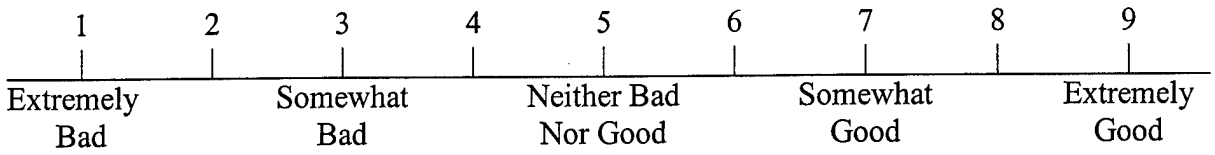
_____ Involve the lieutenants in administrative activities only with soldiers from their own platoon.

_____ Don't share ideas with the lieutenants; make your own decisions and implement them.

_____ Have the lieutenants present for administrative punishments (Article 15s, etc.) only if their schedules allow it.

_____ Start a professional development program to assist the lieutenants in their growth.

_____ Involve the lieutenants in all decisions.



C14. You are a company commander. You have a platoon leader who is causing you problems. Once he was cleaning his weapon on the mail loading dock and he pointed it at a civilian. Another time he was late to a range. He frequently argues with you and does not do what you ask him to do. This is a new problem for your first sergeant--he has never experienced this situation before. The behaviors are continuing and growing in severity to a point where the lieutenant is insubordinate. What should you do?

_____ If a relatively severe instance of insubordinate behavior occurs in public, shift the focus and avoid humiliating the platoon leader in public, but have him see you one-on-one later on.

_____ Use all assets available to you--but do not involve your boss (the battalion commander).

_____ Deal with the situation immediately--do not let it fester.

_____ Counsel the platoon leader only when his/her performance warrants it.

_____ Ask the battalion commander to give him a letter of reprimand.

_____ If a severe instance of insubordinate behavior occurs in public, dismiss the platoon leader from the room and deal with him later.

_____ Before taking action, find out if the platoon leader has been counseled before for his bad behavior.

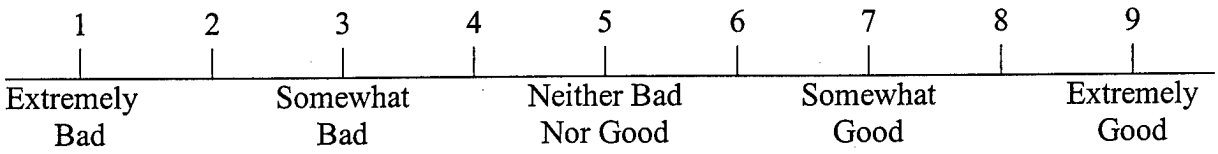
_____ Talk with the platoon leader and work out the problem.

_____ Establish regular sessions during which you counsel the platoon leader about his performance.

_____ To prepare for counseling sessions, get together with your first sergeant and role play various scenarios for dealing with the platoon leader including his potential reactions to your actions.

_____ Wait awhile to see if the situation improves on its own.

_____ If an instance of insubordinate behavior occurs between the two of you in private, immediately reprimand the platoon leader.



C15. You are a company commander, and your battalion commander often gives directives that you believe are unreasonable. You have tried to give your commander input regarding these directives, but he has not listened to your input. The NCOs and soldiers also feel these orders are unreasonable, and the situation is causing you considerable stress. You have generally lost respect for the battalion commander. He gives you another order you believe is unreasonable. What should you do?

_____ Speak to the sergeant major and see if she/he will use her/his influence with the battalion commander to improve the situation.

_____ Let your key subordinates know this is not your directive but rather the commander's.

_____ Do your best to gain the NCOs' and soldiers' compliance by explaining the rationale for the commander's orders, being as convincing as you can be.

_____ Go alone to the battalion commander and tell him/her you believe the order is unreasonable.

_____ Keep trying to give your battalion commander input regarding his unreasonable directives.

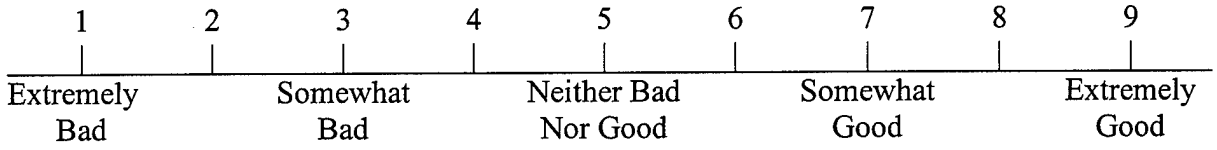
_____ Represent the orders as your own to your key subordinates.

_____ Say that the system is to blame for the unreasonable order.

_____ Let your soldiers know that this is not your directive but rather the commander's.

_____ Assign the unreasonable order a lower priority and accomplish it in the manner you choose.

_____ Get your key leaders together and go as a group to the battalion commander and say that the order is unreasonable.



C16. You are a company commander with both military and civilian personnel in your unit. You have no E5 sergeants--instead, you have civilians doing supervisory jobs with soldiers working under them. You are experiencing problems in maintaining group cohesion: For example, civilians see soldiers taking off for training and wonder why they have to keep working; soldiers see civilians getting cash awards for good performance and wonder why they can't have similar awards; and so on. You must deal with these problems to keep your unit running smoothly. What should you do?

_____ Try to develop cohesion separately in the civilians and military members by having separate social functions.

_____ Educate the soldiers and the civilians about the differing requirements of their jobs: Tell your soldiers that they have contractual obligations and they must accept their situation; tell the civilians that their situation is different from the soldiers' situation.

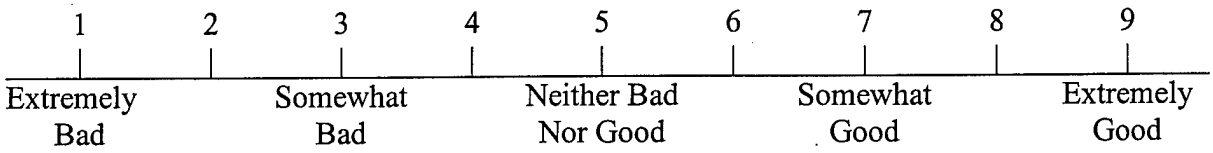
_____ Have both civilian and military members of the unit draw up a poster of your organization (an organization chart) and post it where everyone can see it.

_____ Form a morale committee composed of both civilian and military personnel to plan company social functions.

_____ Create a sign-out roster, and have people sign out when they leave their place of duty, stating where exactly they are going and why.

_____ Study your own procedures to ensure that you are being fair and equitable to both the civilian and the military personnel.

_____ Schedule outings, pot luck dinners, parties, and dining outs that include all members of the unit and their families.



C17. You are a company commander, and your unit is dispersed and is assigned to various garrison commands. Thus, you cannot possibly exercise direct control over your troops. The garrison commanders have non-judicial authority over your soldiers. You want to develop a good relationship with the garrison commanders. What should you do to take care of your soldiers under these conditions?

_____ Talk to the garrison commanders whenever there is a problem with one of your subordinate leaders.

_____ Visit the local garrison commanders on a regular basis.

_____ Request extra resources (and do what you can to expedite the request) to help garrison commanders provide for your soldiers, if necessary.

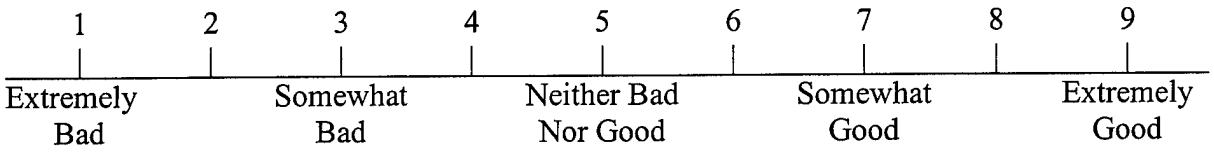
_____ Have your boss contact the garrison commanders to inquire about soldier support issues.

_____ Do not talk to the garrison commanders unless one of your subordinate leaders comes to you and tells you that there is a problem.

_____ Coordinate with the garrison commanders whenever possible to ensure that your soldiers' needs are being met.

_____ Speak to your soldiers individually as often as you can to check up on how they are being treated.

_____ Check with the garrison commanders about the quality of support being provided to your soldiers.



C18. You are a company commander, and you believe that you have an incompetent battalion commander. This incompetence is both technical and tactical. Often this person issues directives that are not going to achieve the mission. What should you do?

_____ Infer the underlying intent of the directive, go to your commander, and inform him of your interpretation of the underlying intent and the steps being taken to achieve this intent.

_____ When provided with the next unworkable directive, go back to the commander immediately and try to help direct the commander's thinking onto more appropriate and workable solutions.

_____ Use your first sergeant to help you develop ways to make the directive work well and look good to the troops.

_____ Speak to the sergeant major and the executive officer, ask for any relevant information, and listen to their opinions.

_____ Confront the commander and provide specific examples of why his directives are incompetent.

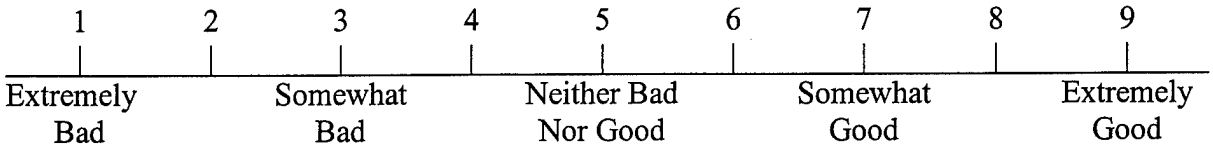
_____ Speak to the brigade commander about the problem, arming yourself with specific examples of incompetent directives.

_____ Continue to follow directives and let the chips fall where they may.

_____ Explain to your subordinates that the battalion commander does not understand the area in question because it is not his primary specialty.

_____ Infer the underlying intent of the directive and develop your own strategy to solve the problem and achieve the mission.

_____ Communicate the battalion commander's intent (rather than his specific directive) and ensure that it is met.



C19. You are a company commander on deployment. Your unit is sustaining continuous operations. You are feeling the stress of the many demands upon your time, but you want to maintain your mental effectiveness and readiness. What should you do?

_____ Sleep.

_____ Take time alone each day to read inspirational books or materials.

_____ Use your peers as a sounding board and support group.

_____ Maintain contact with family and friends back home to keep you centered and remind you there's more to life than your job.

_____ Take time alone each day to think, regroup, and work through what's on your mind.

_____ Keep perspective by remembering that you have other talents and skills that are not related to your current job.

_____ Work as hard and as fast as you can: Have as your goal getting to tomorrow's work as soon as possible.

_____ Mentor or counsel troubled soldiers regularly to keep your own problems in perspective.

_____ Each day, reflect on your successes and on what you can do better in the future maintain a positive focus.

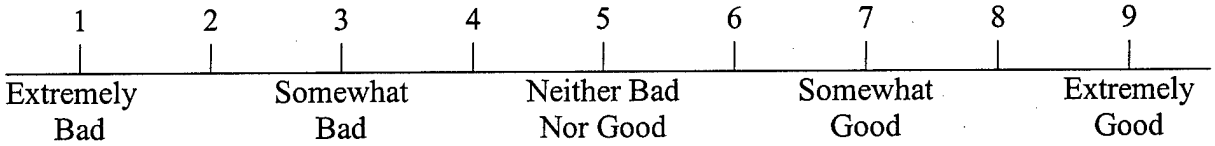
APPENDIX D

TACIT KNOWLEDGE FOR MILITARY LEADERS: BATTALION COMMANDER QUESTIONNAIRE

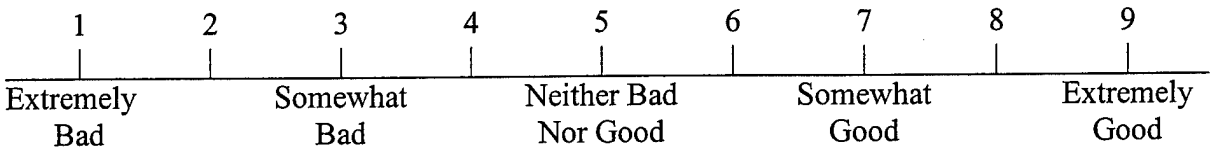
OVERVIEW AND INSTRUCTIONS

This survey was developed as part of the Tacit Knowledge in Military Leadership project to measure the practical, action-oriented knowledge that Army leaders acquire on the job. The project's main objectives were to identify the important lessons of experience that enable officers to be effective leaders and to use that knowledge to enhance leadership development.

This survey consists of descriptions of typical situations encountered by military leaders. After each situation, there are several options for how to handle the situation. For each option listed, you are to rate the quality of the option on the following 1-to-9 scale:



Select the number corresponding to your answer, and write it in the blank preceding the option (or on the answer sheet provided). Remember that some or all of the options listed for a particular question may be good, some or all of the options may be bad, or some or all of the options may be neutral (neither bad nor good). There is no one "right answer," and in fact there may be no "right answers." The options are simply things an officer at this level might do in the situation described. Please rate each individual option for its quality in achieving the goal or solving the problem described in the question. Do not try to "spread out your ratings" just for the sake of doing so. If you think all of the options are good, bad, or whatever, rate them accordingly. DO NOT BE CONCERNED if the numbers are all 9s, all 5s, all 1s, one 9 and the rest 1s, or any other mix. Your answers should reflect your opinions about the quality of the options.



B1. You are a new battalion commander, and you want to develop detailed knowledge of the strengths and weaknesses of each of your company commanders. Rate the following strategies for their effectiveness in helping you gain this information:

_____ If you plan to talk to the soldiers, discuss beforehand with each company commander your intention to talk directly to the soldiers and explain your reasons for doing so.

_____ For each company, direct a sensing session of the entire company with the company commander present in order to get a sense of the unit.

_____ Ask the command sergeant major, battalion XO, and operations officer for their assessment.

_____ If you choose to talk to the soldiers, express your desire to each company commander to use the information you will learn to help with their development as leaders.

_____ Ask your company commanders to talk to their own soldiers and ask a specific list of questions, and then report back to you with the information they have learned.

_____ Talk directly (in private) with the soldiers and ask them to comment on the commanders' strengths and weaknesses.

_____ Talk directly (in private) with the soldiers and ask them their opinions about the quality of their training, what they are learning, and other impressions they have.

_____ Ask your company commanders to speak to other commanders' soldiers (not their own soldiers) and report back to you with the information they have learned.

_____ Assign a battalion staff member who does not rate the company commanders to speak with the soldiers and report to you on what he/she learns.

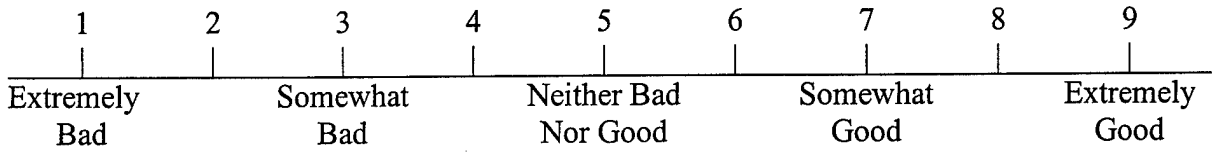
_____ Rely on historical statistical indicators of performance.

B1, Continued

_____ Talk directly (in private) with the soldiers and ask them specific questions about their work hours, their job descriptions and responsibilities, and other factual items.

_____ Speak to the company commanders individually and ask each of them to comment on the strengths and weaknesses of the other company commanders and units.

_____ Ask the brigade commander for his/her assessment.



B2. You are a battalion commander and it is the end of your first battle at a major externally-evaluated training exercise, during which your unit revealed some major shortcomings. During the After Action Review, the Chief Evaluator is highly critical of the battalion and dwells on all the negative things your unit did that day. You carefully record all of the negative observations, but you know full well that the battalion also did some very positive things that day. What should you do?

_____ Leave the After Action Review and return to your units; once there, communicate exactly what the Evaluator said.

_____ If you have a good relationship with your CSM or other similar person, discuss your frustrations and feelings with him or her.

_____ Forget about trying to get any positive feedback: Thank the Evaluator directly for the negative feedback, say you will deal with the problems immediately, and do so without expecting anything more from him.

_____ Be careful not to vent your frustrations with the Evaluator's feedback in front of the soldiers or your junior officers.

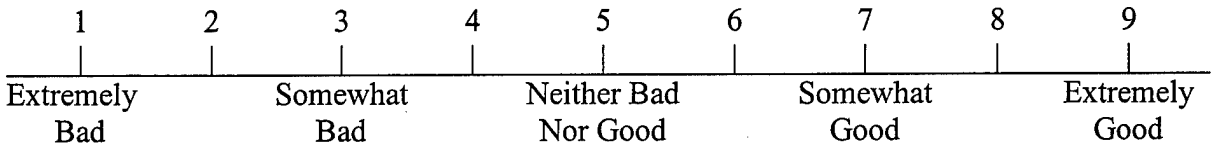
_____ Ask the Chief Evaluator if he has anything else he would like to say.

_____ Mention one or two successes the battalion had, and ask the Evaluator if he would like to comment on these positive events.

_____ Leave the After Action Review and return to your units, but when you report to them make sure to note the successes that occurred that day as well as the failures and shortcomings.

_____ Speak to the Evaluator at another time, and state your desire to receive positive as well as negative feedback so that you know what the units are doing right and wrong.

_____ Share your feelings with a friend or confidante at your own level to help you work through any negative feelings.



B3. You are a new battalion commander and one of your most important and challenging tasks is to establish the training priorities for your unit. While everything looks important and you would like to meet every possible contingency, you also realize that you do not have the time or resources to "do it all." Rate the following strategies for how effective they would be in helping you establish your priorities.

_____ Study the brigade's training schedule.

_____ Talk to the brigade S-2, S-3, and CSM to verify your understanding of the brigade commander's training focus.

_____ Schedule meetings to discuss training with each of your staff members during your first week of command.

_____ Explain your goals and your plans for the battalion very clearly to your officers and staff.

_____ Assess the tactical and technical competence of your soldiers individually by giving them formal and informal tests.

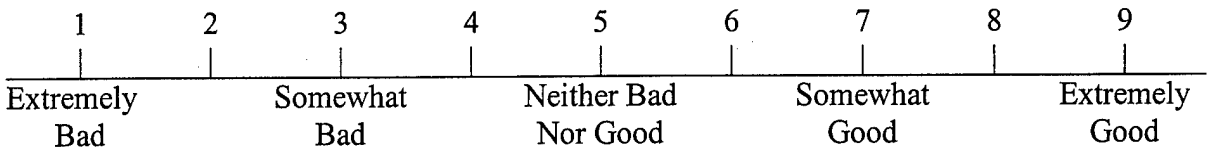
_____ Rely on the assessments made by the previous battalion commander.

_____ Select three to five upcoming missions (based on the brigade training plan) to focus your soldiers' energy on.

_____ Before doing anything, make sure you understand the commander's intent two levels up.

_____ Soon after taking command, visit each staff section's shop and get a full briefing on their operations.

_____ Talk to the brigade commander to determine his training priorities.



B4. You are a battalion commander. Your brigade commander has made it clear that he does not wish to speak with you about pressing issues that arise in your battalion. Also, he expects perfection from your battalion at all times, and he seems to view your battalion's poor performance at the JRTC as unforgivable--he keeps harping on past failures. The brigade commander does not provide you with feedback on your strengths and how to improve your weaknesses. His communication style is formal, abrupt, and in your opinion, ineffective. He begins every conversation by reminding you that you are only an 0-5. You are frustrated because you never know where you stand, performance wise, in your brigade commander's eyes and you lack a person from whom to receive performance feedback. In general, you find your situation with the brigade commander to be intolerable, and morale in your unit seems dangerously low. What should you do?

_____ Speak to the Assistant Division Commander, explain your need for extra feedback, and request feedback on your performance.

_____ Deal with the brigade commander as best you can, but hold regular sessions with the members of your unit to air concerns and voice problems in the hope of improving morale.

_____ Remain loyal to the brigade commander so you do not model disloyalty in front of the members of your unit.

_____ Seek a formal appointment with the brigade commander, state that you and he seem to have a problem, and ask him why.

_____ If you choose to speak with the Assistant Division Commander and your officers are critical of your decision, then explain your reasons for your actions to them and let them know they are welcome to voice concerns about how you are leading the unit.

_____ Speak to your family members, the chaplain, or other friends from outside the military in order to deal with your personal frustrations.

_____ Jump the chain of command and speak to the Assistant Division Commander about the problem with the brigade commander.

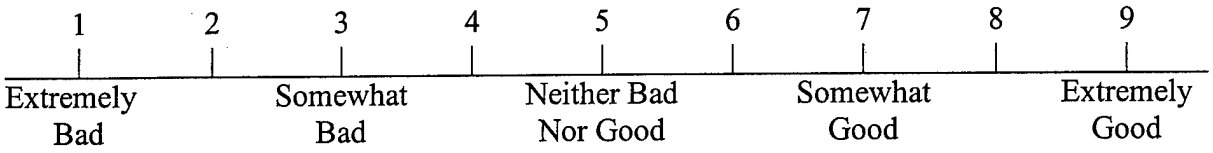
_____ If you speak to the Assistant Division Commander, prepare yourself for the possibility of a disruption of loyalty in your own unit.

B4, Continued

_____ Talk to your fellow battalion commanders about the problem and try to develop a joint solution.

_____ Request advice from one of your brigade commander's superiors whom you already know and trust.

_____Talk to the brigade XO and the brigade S3 and try to get some information.



B5. You are a battalion commander and your goal is to implement effective training. Rate the following strategies in terms of how good they would be at achieving your goal.

_____ Provide soldiers and their families with a copy of an extended training schedule (for example, six months out).

_____ Develop specific rules and procedures that your battalion uses regularly in order to manage training.

_____ Go to the brigade S-3 and demand that the training schedule not be changed.

_____ Give soldiers three or four-day holiday weekends whenever possible.

_____ Take into consideration school vacations and events when planning training.

_____ Brief families collectively on the extended training schedule once it has been developed--have a family dinner in the mess hall, for example, and then go over the extended training schedule.

_____ Be willing to change the training schedule in order to capitalize on unplanned training opportunities.

_____ Have regular meetings with your brigade commander to keep him/her focused on what your battalion is doing.

_____ If someone violates the training schedule without authority, and without good cause, recommend the person for appropriate punishment.

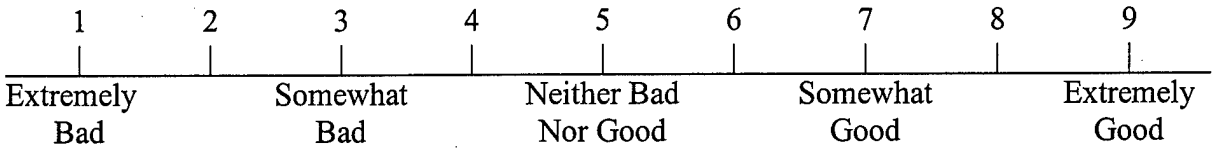
_____ Once inside the specified time limit, do not make changes to the schedule once the schedule has been distributed.

_____ If you take away a soldier's weekend for a training exercise, make sure he or she gets it back during another training cycle.

_____ Try to dissuade your superiors from making sudden changes to the training schedule.

B5, Continued

_____ Communicate your training goals and your vision to your subordinates and your superiors.



B6. You are a battalion commander, and there are many unmarried soldiers in your unit. You are concerned about the special needs and problems unmarried soldiers may have, since they do not have a regular family life. Your goal is to ensure high morale for your unmarried soldiers. Rate the quality of the following strategies for achieving your goal.

_____ Take special pains to ensure that single soldiers have some place to be on holidays—by arranging meals or outings for single soldiers, for example.

_____ Discourage single soldiers from taking holiday leaves and encourage them to take on holiday duties so that married soldiers can spend holidays with their families.

_____ Maintain procedures and facilities single soldiers need in order to communicate with family members back home--provide access to telephones, writing supplies, and so on--and encourage the soldiers to keep in touch with their families.

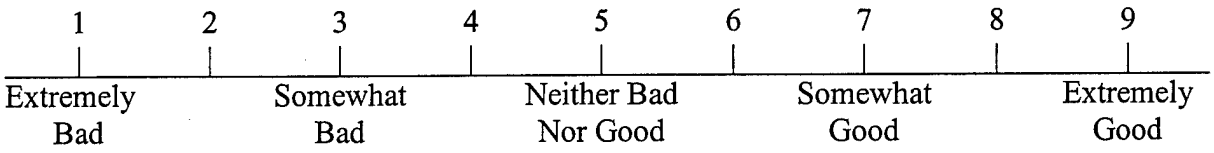
_____ Encourage married soldiers to invite single soldiers to their homes for holidays or other special occasions.

_____ Take measures (for example, obtaining furniture, making game rooms, and allowing soldiers to decorate the way they like) that will make the billets where the single soldiers live feel more like home to them.

_____ Allow soldiers from other units to share in the improvements you make to your soldiers' living quarters.

_____ Keep single soldiers busy with training and company sports so they won't get bored.

_____ Spend time with the single soldiers in their dining facility and gym.



B7. You are a battalion commander, and you want to make sure that your soldiers and junior officers share your vision for the battalion. Rate the effectiveness of the following strategies for communicating your vision to your unit.

_____ Distribute your command philosophy in writing to all soldiers in your battalion.

_____ Reinforce your vision in all daily activities and interactions, and do so for the entire term of your command.

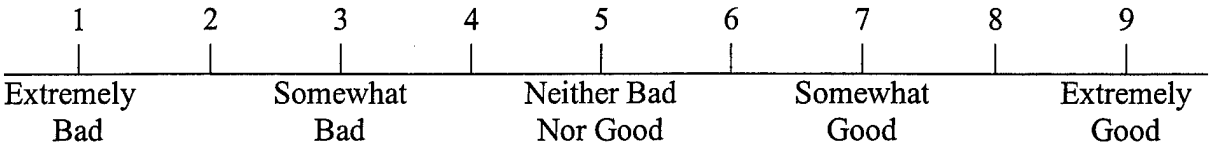
_____ Do not adhere to a single perspective--be willing to change your vision as necessary to reflect changing needs of the unit.

_____ On a daily basis, visit company areas in the garrison and in the field, and highlight shortcomings and the progress that has been made toward achieving your vision.

_____ Communicate your vision starting on the first day of your command.

_____ Reward those who support your vision, and punish those who don't.

_____ Solicit feedback and ideas from your junior officers regarding your vision—be alert for ways to improve it.



B8. You are an artillery battalion commander. You are in direct support of a brigade whose commander is a light infantryman, while your background is mechanized artillery. On several occasions, the differing perspectives of you and your brigade commander result in communication difficulties. For example, you are used to moving on the battlefield at a very fast pace, whereas your commander is used to moving at a slow pace. In fact, communication problems arise often between the two of you. Your goal is to improve your communication with your brigade commander. What should you do?

_____ Ask a peer of your brigade commander, such as a divarty commander, for help with the problem.

_____ Invite the brigade commander over to your house to watch a sporting event or movie and try to establish a friendship with him.

_____ Speak to the brigade commander, express your feelings about why the two of you sometimes have trouble communicating, and ask for his help with the problem.

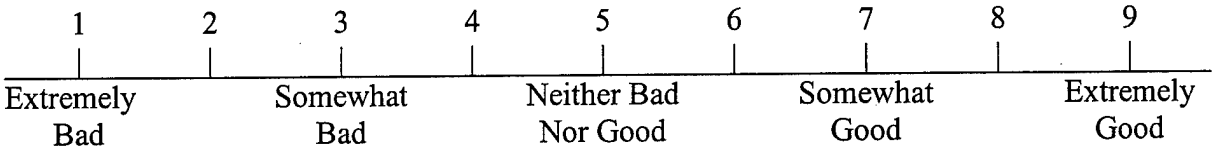
_____ Make an effort to think from the brigade commander's point of view about your unit's activities and performance.

_____ Speak to the brigade commander, ask him why he believes the two of you sometimes have trouble communicating, and ask for his help with the problem.

_____ Find an interest or hobby you and your brigade commander share, then use this shared interest to develop analogies to help you communicate with him more effectively: In other words, talk in terms of topics you both understand.

_____ Make an attempt to interact with the brigade commander as a person outside of the work environment, in a wide variety of settings.

_____ Speak to your brigade commander's superior about the problem and ask for his advice.



B9. You are a new battalion commander and you are feeling somewhat lonely and frustrated with your job. Your goal is to manage your stress effectively so that it does not interfere with your ability and motivation to perform at your best. Rate the quality of the following strategies for achieving your goal.

_____ Budget time for inspirational reading.

_____ Develop a mutual support group with other battalion commanders--talk to them frequently.

_____ Realize that dealing with stress is important to your promotion, and soldier on.

_____ Spend more time at the office and work harder--recognize that more satisfaction will come from pushing yourself harder and getting more done.

_____ Combat stress by engaging in physical exercise or an activity you enjoy.

_____ Use your spouse or other close friend from outside of the military as a sounding board.

_____ Use your junior officers to bounce ideas off of.

_____ Talk over your feelings with the brigade commander.

_____ Take up a hobby that is unrelated to your job demands.

_____ Budget time for personal reflection and relaxation.

_____ Keep a journal or notebook of ideas in order to organize your thoughts and work through things on paper.

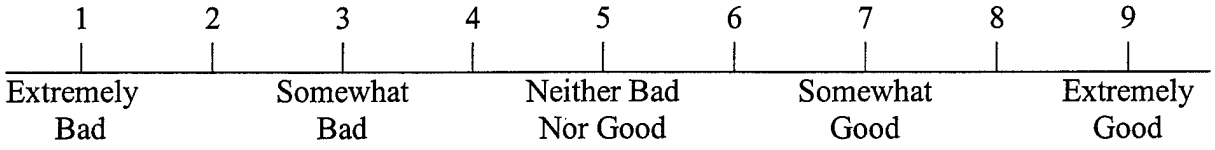
_____ Remind yourself often that all battalion commanders experience such feelings and that your feelings are normal and will resolve themselves in time.

_____ Take as much leave as you are entitled to, and while on leave, do not think about work or have contact with work personnel.

_____ Realize that it is your job to tough things out for 24 months.

B9, Continued

_____ Renew your vision and remind yourself of why you wanted to be a battalion commander.



B10. You are a battalion commander, and one of your primary goals is to ensure that your soldiers have predictability in their lives. Thus, you are concerned about planning training way in advance, and you make it a point to do so. For some time, your unit has been scheduled for a pre-planned battalion-level training exercise. At the last minute, there is a brigade command and staff meeting. At the meeting, the brigade staff announces that they are making major changes in your battalion training plan. What should you do?

_____ Ask to have a minute alone with your commander and express your concerns to him privately, allowing him to voice these concerns openly at the meeting if he chooses to do so.

_____ After the meeting, attempt to get a consensus among all the battalion commanders regarding this issue, and communicate this shared viewpoint to the brigade commander.

_____ Be silent, but try to recruit your commander to your position after the meeting is over.

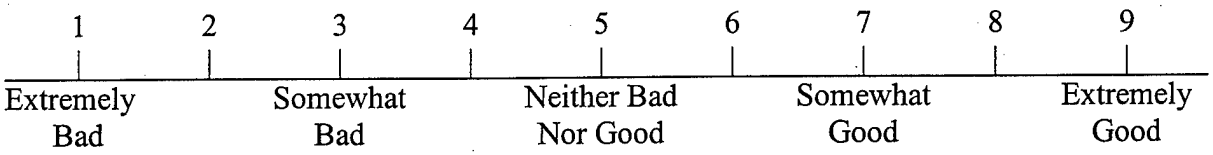
_____ State that soldiers need predictability in their lives, and note that the senior leaders should be setting the correct example.

_____ State that good training exercises require predictability so that leaders of all levels can learn.

_____ Stand up and remind the brigade staff, the brigade commander, and your peers about the brigade's specific doctrinal responsibilities for training.

_____ State that the brigade staff's proposal to change the short-term training schedules is a violation of training doctrine.

_____ Be silent: Do not try to second-guess the brigade staff's decision.



B11. You are a battalion commander. You have one company commander who is particularly intense. He sets extremely high--even unrealistic--standards for himself. While his company has yet to pay the price for this problem, his expectations are so high that he never can meet them, and this situation is hindering his personal health as well as his professional development as an officer. His company is scheduled for a major training exercise next month. Your goal is to help him better understand how he is hurting himself by maintaining unreasonable standards. Rate the quality of the following strategies for achieving your goal.

_____ Talk to all of your company commanders as a group about potential roadblocks to their development, mentioning too-high standards as one potential problem and describing examples to illustrate your point.

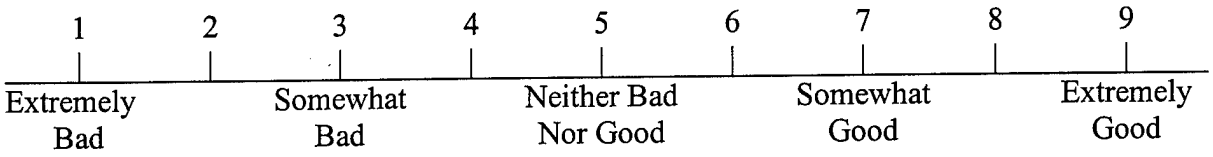
_____ Wait to speak to the company commander until after he goes to the training exercise, using examples based on his experiences there to illustrate your points.

_____ Do nothing: Allow him to learn from his own mistakes that no one can successfully maintain unrealistic standards forever.

_____ Ask another company commander to have a friendly chat with the obsessive company commander about the need to set realistic goals.

_____ Have a discussion with the company commander about his potential problem before he leaves for the training exercise, using examples you are aware of from your daily interactions with him in your unit.

_____ Warn the company commander before he goes to the training exercise that you believe he has a serious problem that requires his immediate attention and that may ultimately derail his career.



B12. You are a battalion commander, and you notice early in your command that your guidance often becomes distorted when it reaches the lower ranks. For example, one day you comment that you want the line companies at 100% personnel strength for aircraft mechanics before you will start to assign them to headquarters. A few days later, the headquarters maintenance tech asks you why you are going to fill the line units at 150% of authorized mechanics before assigning them to headquarters! Your goal is to ensure that your guidance is communicated accurately to all levels of the organization. Rate the quality of the following strategies for achieving your goal.

_____ Hold meetings with your platoon leaders to verify what they know.

_____ When you must communicate important information verbally, try to speak directly to as many officers and soldiers as you can.

_____ Hold the chain of command responsible for accurately passing information down to lower ranks.

_____ Work on your relationship with your senior NCOs.

_____ Conduct periodic discussions with your soldiers to correct misperceptions, clarify your intent, and locate sources of information loss.

_____ Ask your company commanders to conduct periodic discussions with the soldiers so that the company commanders can verify that the lower levels are receiving accurate information.

_____ Whenever possible, post and distribute written statements outlining your objectives.

_____ Encourage your junior officers to be on the lookout for soldiers' statements about your orders that are not completely accurate--and ask the junior officers to correct these misperceptions immediately.

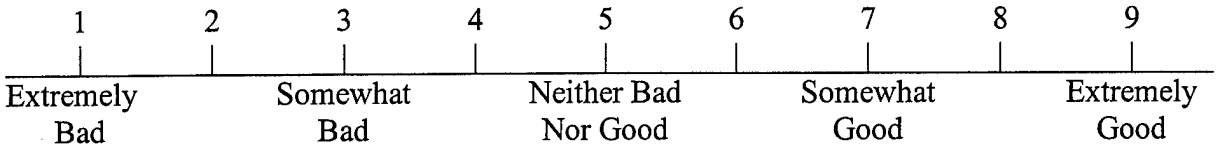
_____ Develop an NCO professional development program that stresses how to pass down information properly.

_____ Spend more time leading by walking around the unit and talking to people.

_____ Look for breaks in the chain of command.

B12, Continued

_____ Use multiple means of communicating the same message.



B13. You are a battalion commander. Reluctantly, you gave your S-1 a company command for his professional development, even though you had questions about his abilities. He was a loyal S-1, but not a very good one: He had problems with organization, and his workstyle was a bit "helter-skelter." In conversations with lieutenants you have learned that they are having a hard time with this individual. Also, as you walk around the battalion, you see other indications that confirm your doubts about this person's abilities. In general, you are concerned and you have doubts about this officer's ability to command effectively. What should you do?

_____ Ask your sergeant major to spend more time coaching the former S-1.

_____ Ask a competent company commander to mentor the problematic officer.

_____ Provide the former S-1 specific help with organization such as hints and strategies you and others have found useful.

_____ Set the former S-1 up with a strong 1SG and company XO.

_____ Explain to the former S-1 specifically why it is important for him to change his behavior for the soldiers' benefit.

_____ Help the lieutenants you spoke with to work through their direct superiors to solve problems.

_____ Communicate regularly with the officer and encourage him to use you as a resource whenever he has problems.

_____ Come down hard on the former S-1 about his shortcomings and threaten to take disciplinary action if he does not improve.

_____ Conduct sessions with the former S-1 during which you talk to him about aspects of his behavior you want changed.

_____ Talk to the S-1's first sergeant to get a better feel for what's going on.