30 Practical Intelligence

Jennifer Hedlund

Richard Wagner concluded his chapter on practical intelligence in the previous edition of the *Cambridge Handbook of Intelligence* with the prophetic question as to whether there would be a separate chapter on the topic in the next edition. He suggested that many of the key ideas associated with practical intelligence were converging with other theoretical perspectives, such as life-span development, expertise, and embodied cognition (Wagner, 2011). Although efforts to understand practical intelligence have occasionally intersected with other bodies of knowledge, and the growth of practical intelligence research has somewhat slowed in the period since the last edition, practical intelligence continues to have a distinct presence in the literature. Perhaps the most prolific area of research related to practical intelligence has been the study of tacit knowledge. Although researchers continue to seek further understanding of the content of tacit knowledge and its relation to successful performance, there has been a growing emphasis on identifying ways to facilitate tacit knowledge acquisition.

This chapter will provide an overview of research on practical intelligence, with particular attention to the work of Sternberg and his colleagues, who have been most associated with the concept, and illustrate how research on practical intelligence has evolved over time. A substantial portion of this chapter will focus on the role of tacit knowledge in understanding practical intelligence. The chapter concludes with a discussion of potential ways to facilitate tacit knowledge acquisition and develop practical intelligence.

Defining Practical Intelligence

The concept of practical intelligence appeared in the literature as early as the 1940s in relation to the use of situational judgment tests (SJTs) to assess managerial potential (McDaniel & Whetzel, 2005). In-basket tests, used to assess managerial potential since the 1950s, have also been associated with the concept of practical intelligence (Frederiksen, 1966, 1986). Specific attention to the concept of practical intelligence, however, emerged in the 1980s in relation to broader conceptualizations of intelligence and the competencies needed to perform everyday tasks. Robert Sternberg brought the concept of practical intelligence to the forefront with his triarchic theory of intelligence (Sternberg, 1985, 1988) and subsequent theory of successful intelligence (Sternberg, 1997).

Practical intelligence is defined as the ability that individuals use to find a more optimal fit between themselves and the demands of the environment through adapting, shaping, or selecting a new environment in the pursuit of personally valued goals (Sternberg, 1985, 1997). It has been characterized as "street smarts" or "common sense" and can be contrasted with analytical intelligence or "book smarts." Baum, Bird, and Singh (2011) described practical intelligence as an ability complex that "overlaps concepts related to expertise, decision making, and judgment" (p. 398). Yalon-Chamovitz and Greenspan (2005) referred to practical intelligence as the "cognitive underpinning of everyday function" (p. 220). Practical intelligence is best understood in relation to the types of problems individuals encounter in everyday life.

Understanding Practical Problems

Everyone encounters problems for which solutions are neither readily available nor readily derivable from acquired knowledge. These problems occur in the workplace, in school, at home, or really anywhere. Sternberg and his colleagues (Sternberg, 1985, 1997; Wagner & Sternberg, 1986), building on a distinction made by Neisser (1976), differentiated practical problems from academic problems. Academic problems tend to be well-defined, formulated by others, complete in the information they provide, removed from ordinary experience, of little or no intrinsic interest, and have only one correct answer and one method of obtaining the correct answer.

Practical problems, in contrast, tend to be poorly defined, unformulated or in need of reformulation, lacking in information necessary for solution, of personal interest, related to everyday experience, and to present multiple "correct" solutions, each with liabilities as well as assets, along with multiple methods for picking a problem solution. People who are adept at solving one kind of problem may not be adept at solving problems of the other kind (Sternberg, 1985, 1997; Wagner & Sternberg, 1986). Initially, the examination of practical intelligence issued from a concern that the intelligence of adults functioning largely outside the academic environment was evaluated primarily by traditional tests of intelligence originally developed to predict academic success (for a review, see Berg, 2000).

Research on Practical Problem-Solving

Research conducted in a wide range of settings and with diverse populations has demonstrated the distinction between academic and practical problem-solving (for more extensive reviews, see Ceci & Roazzi, 1994; Rogoff & Lave, 1984; Sternberg & Wagner, 1986).

In research with schoolchildren, several investigators have found that performance on academic tasks does not necessarily correspond to performance on real-world tasks, even when the same processes are involved (e.g., mathematical reasoning). Researchers studying children in Brazil who worked as street vendors found that they performed significantly better on mathematical problems presented in the context of vending than on those problems presented in an academic context,

and were able to complete monetary transactions without the aid of pencil and paper or calculators (Carraher, Carraher, & Schliemann, 1985; Nunes, Schliemann, & Carraher, 1993). In contrast, Perret-Clermont (1980) found that schoolchildren who showed no difficulty in solving arithmetic problems on a paper-and-pencil test could not solve the same problems in an everyday context (e.g., counting bunches of flowers).

Grigorenko and colleagues (2004) developed and administered a measure of practical intelligence, called the Yup'ik Scale of Practical Intelligence (YSPI), to 261 adolescents from a rural and a semi-urban Yup'ik Alaskan community. Children from the semi-urban community scored better on a measure of crystallized intelligence while those from the rural setting scored better on the measure of practical intelligence. Additionally, in the rural community sample, the YSPI was the best predictor of peer and adult ratings on several traits, including thinking skills, respect for elders, hunting skills, and household skills.

Practical abilities also are relevant to effective performance in school. Mandelman, Barbot, and Grigorenko (2016) administered the Aurora Battery, designed to assess analytical, practical, and creative intelligence, to a sample of 145 middle school students. Measures of practical intelligence, which included tasks such as tracing the best carpool route between friends' houses and dividing monetary amounts among friends, were the best predictors of grade point average (GPA).

Research with adults has produced similar results. In a series of studies by Ceci and his colleagues (Ceci & Liker, 1986, 1988; Ceci & Ruiz, 1992; Ceci & Roazzi, 1994), racetrack handicappers were observed to use complex algorithms to predict post time odds. The successful use of these algorithms was found to be unrelated to IQ scores or use of the same algorithms in a different context (e.g., stock market prediction). In research with assemblers at a milk processing plant, Scribner (1984, 1986) found that the use of complex strategies to fill orders in a manner that minimized the number of moves required to complete the order was unrelated to the assemblers' IQ scores, arithmetic test scores, or grades in school. Similarly, grocery shoppers' accuracy at identifying the best values, by performing calculations of the cost per unit, was unrelated to their scores on a mathematics test (Lave, Murtaugh, & de la Roche, 1984; Murtaugh, 1985).

Research also demonstrates the potential benefit of practical intelligence to daily life activities. Grigorenko and Sternberg (2001) examined the relative influence of analytical, creative, and practical intelligence on adaptive functioning in a sample of 293 men and 452 women from a large industrial city in Central Russia. Practical intelligence was the most consistent and strongest predictor of both physical and mental health. Specifically, individuals with higher practical intelligence scores reported better physical health, lower anxiety and depression, and higher self-efficacy than individuals with lower practical intelligence scores.

Yalon-Chamovitz and Greenspan (2005) studied the relevance of practical intelligence in individuals with intellectual disabilities. They developed a video-based measure of practical intelligence that involved scenes of instrumental activities of daily living such as cooking and doing laundry. They embedded three practical problems or errors in the scenarios that might occur while completing the task in

each video. Participants were scored based on when they noticed a problem, their explanation of the problem, and their recommend solution. In addition, a guardian or case manager rated each participant on their ability to perform activities of daily living . The authors suggested that the video measure of practical intelligence provided a more direct assessment of cognition than caregiver ratings, which are based solely on outward behavior. They found that scores on the video assessment correlated significantly with ratings of activities of daily living. Further, practical intelligence scores were highly correlated with experience, suggesting that practical abilities can be developed by increasing opportunities to participate in everyday activities.

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). Few of these researchers would dispute the claim that intelligence as conventionally defined and measured predicts performance both in and outside of school. However, there is wide recognition that other aspects of intelligence may be equally, if not more important, than *g* to the performance of tasks both within and outside academic settings. The greatest support for the relevance of practical intelligence to everyday performance comes from the extensive body of research on tacit knowledge.

Practical Intelligence and Tacit Knowledge

In solving practical problems, individuals draw on a broad base of knowledge, some of which is acquired through formal training and some of which is derived from personal experience. Much of the knowledge associated with successful problem-solving can be characterized as tacit because it may not be openly expressed or stated. Although people's actions may reflect their knowledge, they may find it difficult to articulate what they know. Research on expert knowledge indicates that experts draw on a well-developed repertoire of knowledge in responding to problems in their respective domains (Scribner, 1986), that the knowledge tends to be procedural in nature and to operate outside of focal awareness (Chi, Glaser, & Farr, 1988), and that it reflects the structure of the situation more closely than it does the structure of formal, disciplinary knowledge (Groen & Patel, 1988).

The term "tacit knowledge" has roots in works on the philosophy of science (Polanyi, 1966), ecological psychology (Neisser, 1976), and organizational behavior (Schön, 1983) and has been used to characterize the knowledge gained from everyday experience that has an implicit, unarticulated quality. Such notions about the tacit quality of the knowledge associated with everyday problem-solving also are reflected in the common language of the workplace as people attribute successful performance to "learning by doing" and to "professional intuition" or "instinct."

Sternberg and his colleagues (Sternberg, 1997; Sternberg et al., 2000) view tacit knowledge as an aspect of practical intelligence that enables individuals to adapt to, select, and shape real-world environments. It is knowledge that reflects the practical ability to learn from experience and to apply that knowledge in pursuit of personally valued goals. Baum, Bird, and Singh (2011) suggest that tacit knowledge represents

"knowing" while practical intelligence represents both "knowing and doing." Prior to discussing research on tacit knowledge, it is important to understand how it has been conceptualized and operationalized in the literature.

Conceptualizing Tacit Knowledge

Tacit knowledge has been defined by Sternberg and his colleagues (Sternberg, 1997; Sternberg et al., 1995, 2000) according to three main features that correspond to the conditions under which tacit knowledge is acquired, its structural representation, and the conditions of its use. First, tacit knowledge generally is acquired on one's own with little support from other people or resources. According to Sternberg (1988), the acquisition of tacit knowledge is facilitated by the cognitive processes of selective encoding (sorting relevant from irrelevant information in the environment), selective combination (integrating information into a meaningful interpretation of the situation), and selective comparison (relating new information to existing knowledge). When these processes are not well supported, as often is the case in learning from everyday experiences, the likelihood increases that some individuals will fail to acquire the knowledge.

Second, tacit knowledge is procedural in nature. It is knowledge about how to act in particular situations or classes of situations. Drawing on Anderson's (1983) distinction between procedural and declarative knowledge, tacit knowledge can be viewed as a subset of procedural knowledge that is drawn from personal experience and that guides action without being easily articulated. The third characteristic feature of tacit knowledge is that it has practical value to the individual. Knowledge that is experience-based and action-oriented will likely be more instrumental to achieving one's goals than will be knowledge that is based on someone else's experience or that does not specify action.

Measuring Tacit Knowledge

Because people often find it difficult to articulate their tacit knowledge, researchers rely on observable indicators of its existence. Tacit knowledge typically is measured in the responses individuals provide to practical situations or problems. The format of most tacit knowledge inventories (TKIs) closely resembles SJTs (Chan & Schmitt, 1998; Legree, 1995; Motowidlo, Dunnette, & Carter, 1990). These types of tests generally are used to measure interpersonal and problem-solving skills (Hanson & Ramos, 1996; Motowidlo et al., 1990) or behavioral intentions (Weekley & Jones, 1997). In a SJT or TKI, each question presents a problem relevant to the domain of interest (e.g., a manager intervening in a dispute between two subordinates) followed by a set of options (i.e., strategies) for solving the problem (e.g., meet with the two subordinates individually to find out their perspective on the problem; hold a meeting with both subordinates and have them air their grievances). Respondents are asked either to choose the best and worst alternatives from among a few options or to rate on a Likert scale the quality or appropriateness of several potential responses to the situation. Their responses are then scored relative to an expert or consensus mean.

There has been some debate about whether TKIs are measures of practical intelligence. McDaniel and Whetzel (2005) criticized the use of TKIs as measures of practical intelligence since SJTs generally have been found to be multidimensional in nature. Specifically, they argue that "no factor analysis of any situational judgment test has provided evidence of a general factor of practical intelligence, whether correlated with *g* or not" (McDaniel & Whetzel, 2005, p. 519). SJTs tend to exhibit strong correlations with measures of *g* and personality, indicating that they may assess multiple factors related to successful performance. They further argue that the incremental validity of TKIs and other SJTs over *g* in predicting job performance is to be expected given that they measure "non-cognitive job-related constructs" (p. 523).

Stemler and Sternberg (2006) suggest that practical intelligence offers a potential explanation for the consistent incremental validity of SJTs in predicting performance and may address the lack of a shared theoretical framework surrounding the development and use of SJTs. They argue that practical intelligence is best assessed by measuring both the cognitive (i.e., the knowledge, both explicit and tacit, that underlie actions) and the behavioral (i.e., the actions themselves) elements. However, behavioral assessments are more challenging in terms of time and resources while cognitive assessments (e.g., TKIs) can be administered more efficiently.

To address some of the criticism of TKIs, Cianciolo and colleagues (2006) tested the underlying factor structure of three different TKIs. The College Life Questionnaire presented everyday scenarios that undergraduate students might encounter such as dealing with roommates or paying tuition bills. The Common Sense Questionnaire consisted of common situations that entry- to mid-level employees might deal with on the job. Lastly, the Everyday Situational Judgment Inventory consisted of live-action situations that a typical young American might face. In two studies with college students, they established that each TKI was represented by a single underlying factor structure. Additionally, the covariance among the latent tacit knowledge and practical problem-solving factors was accounted for by a single factor, which was consistent with practical intelligence. They did observe some overlap in measures of practical and general intelligence, with practical intelligence exhibiting a factor loading of 0.48 on *g*, but argue that the evidence suggests that practical intelligence is not the same as general intelligence.

Research on Tacit Knowledge

Tacit knowledge has been studied in domains as diverse as sales, primary education, college admissions, military leadership, information technology, and policing and has been related to a variety of performance indicators, including supervisor ratings, grades in school, economic success, and innovation. Researchers also have examined the relationship between tacit knowledge and other relevant constructs such as experience, general intelligence, personality, and learning styles. These relationships are reviewed in more detail below.

Tacit Knowledge and Performance

Tacit knowledge tests typically correlate in the range of 0.2 to 0.5 with various performance criteria. Research with managers has found tacit knowledge to correlate significantly with salary, whether or not the manager worked for a company at the top of the Fortune 500 list, and ratings on the ability to generate new business (Wagner, 1987; Wagner & Sternberg, 1985). In a study with business executives attending a leadership development program, Wagner and Sternberg (1990) found that tacit knowledge scores explained 32 percent of the variance in performance beyond scores on a traditional IQ test and explained variance beyond measures of personality and cognitive style.

Colonia-Willner (1998, 1999) administered the Tacit Knowledge Inventory for Managers (TKIM; Wagner & Sternberg, 1991) to 200 bank managers and found that tacit knowledge scores significantly predicted managerial skill, whereas psychometric and verbal reasoning did not. Baczyńska (2015) administered the TKIM along with measures of analytical and emotional intelligence to ninety-eight line managers in Poland who were participating in a one-day assessment center. Tacit knowledge was the only significant predictor of each of five ratings of managerial competency, accounting for 21 percent to 38 percent of the total variance in those ratings.

In research with military leaders, Hedlund and colleagues (2003) developed TKIs for three levels of military leadership: platoon leaders, company commanders, and battalion commanders. The Tacit Knowledge for Military Leadership (TKML) inventories were administered to 368 platoon leaders, 163 company commanders, and 31 battalion commanders along with the TKIM and a measure of verbal ability. Scores on the TKML correlated with either peer or supervisor ratings of leadership effectiveness at all three levels. TKML scores also accounted for small but significant incremental validity in leadership effectiveness beyond verbal ability and managerial tacit knowledge.

In research with salespeople, Wagner and colleagues (1999) found that tacit knowledge correlated with sales volume and sales awards received. Additionally, Sujan, Sujan, and Bettman (1991) found that more effective salespeople used more domain-specific and problem-oriented strategies while less effective salespeople used more global and relationship-oriented strategies. Jisr and Maamari (2017) found that tacit knowledge correlated significantly with innovation performance in a sample of 331 service industry professionals from twenty different companies in Lebanon.

Taylor and colleagues (2013) created the Police Officer Tacit Knowledge Inventory (POTKI) to measure the practical abilities of police officers. They administered the POTKI along with the Common Sense Questionnaire to twenty-two novice and forty-eight experienced police officers. Respondents were scored based on their distance from the mean expert ratings across response options, as well as their ratings on items designated as "better" or "worse" choices from among the options. They found that tacit knowledge scores correlated significantly with common sense scores and greater agreement with the "better" options were associated with higher supervisor ratings.

In a subsequent study, Taylor, Van Der Heijden, and Genuchi (2017) collected additional data from police applicants. In general, they found more agreement among experts on tacit knowledge items designated as "better" options than items considered "worse." The response patterns also exhibited significant differences between expert and novice police officers with questions addressing intrapersonal knowledge differentiating among experts and novices more effectively than questions about interpersonal tacit knowledge.

Cianciolo and colleagues (2006) administered the Common Sense Questionnaire to samples in the United States and Spain. Scores on the Common Sense Questionnaire correlated significantly with supervisor ratings in the United States but not in Spain, suggesting some cultural differences in the relevance of tacit knowledge to performance. However, there were high correlations between Spanish and US ratings of the individual items, suggesting similar preferences for response options across samples.

Tacit knowledge has been shown to relate to performance in several studies with educators, ranging from elementary school to college. In research with academic psychologists, tacit knowledge scores correlated with citation rate, number of publications, and quality of department (Wagner, 1987; Wagner & Sternberg, 1985). At the elementary school level, Grigorenko, Sternberg, and Strauss (2006) found that higher tacit knowledge scores were associated with higher principal ratings. In a US sample, teachers with higher tacit knowledge scores rated themselves as less effective, while teachers in Israeli with higher tacit knowledge scores rated themselves as more effective. These differences may reflect differences in self-efficacy between the US and Israeli samples. Grigorenko and colleagues (2006), however, found that ratings on the tacit knowledge items were highly correlated between the US and Israeli samples ($r = 0.59$), suggesting that the knowledge assessed by the TKI is generalizable across cultures.

Although tacit knowledge research typically has focused on problems outside the classroom, there is also evidence that tacit knowledge has relevance to academic performance. Scores on a TKI for college students correlate with indices of academic performance and adjustment to college (Sternberg, Wagner, & Okagaki, 1993). Sternberg and The Rainbow Project Collaborators (2006) found moderate correlations between several measures of tacit knowledge and both high school and college GPA. However, the measures of practical intelligence did not account for additional variance in grades once measures of analytical and creative were included. Insch, McIntyre, and Dawley (2008) found that scores on all six dimensions of an Academic Tacit Knowledge Scale exhibited significant relationships with GPA in a sample of undergraduate business students. Fox and Spector (2000) found that practical intelligence significantly predicted evaluations of undergraduate students' performance on a simulated interview. Razali and Trevelyan (2012) found that the practical intelligence of engineering students correlated significantly with their performance on a fault diagnosis test. Together these studies consistently show that individuals with higher tacit knowledge perform significantly better in their respective performance domains.

Tacit Knowledge and Experience

The common phrase "experience is the best teacher" reflects the view that experience provides opportunities to develop important knowledge and skills related to performance. Research comparing novices and experts has consistently found differences in the amount and pattern of tacit knowledge as a function of expertise. Findings regarding the relationship between the amount of time on the job and tacit knowledge have been less consistent.

Wagner and Sternberg (1985) found a significant correlation between tacit knowledge and a manager's level within the company. Similarly, Wagner (1987) found differences in tacit knowledge scores among business managers, business graduate students, and general undergraduates, with the managers exhibiting the highest scores. These differences in tacit knowledge also were observed when comparing psychology professors, psychology graduate students, and undergraduates. In research with salespeople, Wagner and colleagues (1999) found that scores on a TKI for salespeople correlated significantly with number of years of sales experience.

A study by Baum, Bird, and Singh (2011) found that both venture and industry experience were significantly related to practical intelligence in a sample of 283 entrepreneurs in the printing industry. Joseph and colleagues (2010) compared sixty-eight IT professionals and fifty-four IT undergraduates on the SoftSkills for IT (SSIT). Experienced IT professionals generated significantly more responses, took significantly less time to respond, and provided significantly higher quality responses than the novices. Additionally, Taylor, Van Der Heijden, and Genuchi (2017) found significant differences between expert and novice police officers in their response patterns on a TKI.

Several studies have found that the relationship between tacit knowledge and performance varies based on employee rank. Hedlund and colleagues (2003) found no significant relationships between months in the current position and tacit knowledge scores in a sample of military leaders. However, the relationship between tacit knowledge and performance was strongest at the highest level of leadership. Similarly, Taylor, Psotka, and Legree (2015) found the strongest relationships between leadership style and tacit knowledge scores at the highest level of military command, suggesting that leaders at the highest level have developed the broadest range of responses to a variety of situations. Additionally, Tan and Libby (1997) found that the level of tacit knowledge for auditing distinguished top and bottom performers at the higher rank but not at the lower ranks of auditors employed by a major accounting firm in Singapore.

Some studies have focused specifically on better understanding the relationship between experience and tacit knowledge. Armstrong and Mahmud (2008) studied 356 Malaysian public sector managers and found that novices had significantly lower tacit knowledge scores than successful managers but there were no significant differences between novices and typical managers. Individuals primarily exposed to managerial functions had significantly higher tacit knowledge than those who were primarily responsible for other tasks (e.g., engineering, accounting). No

significant relationship, however, was found between length of experience and tacit knowledge scores.

Finally, Elliott and colleagues (2011) studied 501 student teachers in England and compared their responses on the Tacit Knowledge Inventory – High School to a sample of 163 experienced teachers. They found no significant differences between experienced and novice teachers on ratings of "good" tacit knowledge items but experienced teachers were significantly more likely to recognize "bad" responses. Additionally, student teachers improved significantly in their ability to identify "bad" responses but there was no similar improvement in the identification of "good" responses.

Tacit Knowledge and General Cognitive Ability

Although there is some debate as to whether TKIs measure a factor that is distinct from general intelligence (Gottfredson, 2003), most of the research indicates that the correlations between tacit knowledge and conventional intelligence tests are trivial to moderate at best. Scores on TKIs exhibit nonsignificant correlations with a test of verbal reasoning in undergraduate samples (Wagner, 1987; Wagner & Sternberg, 1985), an IQ test for a sample of business executives (Wagner & Sternberg, 1990), and a test of general intelligence in a sample of salespeople (Wagner et al., 1999). In research with military leaders, tacit knowledge scores exhibited nonsignificant correlations with a measure of verbal ability in samples of platoon leaders and battalion commanders but a small, significant correlation in a sample of company commanders (Hedlund et al., 2003). In a study of Air Force recruits, Eddy (1988) found that scores on a TKI for managers were unrelated to scores on the Armed Services Vocational Aptitude Battery (ASVAB).

Some researchers have found moderate correlations in the 0.2 to 0.3 range between tacit knowledge scores and measure of general intelligence (Cianciolo et al., 2006; Fox & Spector, 2000; Sternberg & The Rainbow Project Collaborators, 2006). Sternberg and colleagues (2001), however, obtained negative correlations between scores on a TKI for natural herbal medicines and tests of general and crystallized intelligence in a sample of rural Kenyan children.

Although there is some evidence that measures of practical and general intelligence share some common variance, there also is evidence that TKIs provide incremental validity beyond measures of *g* in explaining individual differences in performance (Hedlund et al., 2003; Wagner & Sternberg, 1990).

Tacit Knowledge and Other Constructs

In addition to experience and general cognitive ability, researchers have explored the relationship of tacit knowledge to several other factors, including personality, learning orientation, gender, and ethnicity.

In regard to personality, Wagner and Sternberg (1990) found that tacit knowledge scores, with two exceptions, exhibited nonsignificant correlations with several personality dimensions in a sample of business executives. Additionally, tacit

knowledge scores consistently accounted for a significant increment in variance beyond the personality measures.

In regard to learning orientation, Armstrong and Mahmud (2008) found that individuals with an accommodating learning style and who worked in a managerial context had the highest tacit knowledge scores. Additionally, individuals who fell in the upper quartile of all four learning orientations (accommodating, assimilating, convergent, divergent) had significantly higher tacit knowledge scores than those who fell in the lowest quartile of participants. Baum and colleagues' (2011) study of entrepreneurs in the printing industry examined the influence of four learning orientations (concrete experience, active experimentation, abstract conceptualization, reflective observation) on practical intelligence. They found that entrepreneurs with a concrete experience or active experimentation orientation exhibited higher practical intelligence.

Finally, traditional intelligence tests often are found to exhibit group differences in scores as a function of gender and race (for reviews, see Loehlin, 2000; Neisser et al., 1996). TKIs, because they are not restricted to abilities developed in school, may be less susceptible to these differences. In Eddy's (1988) study of Air Force recruits, comparable levels of performance on the TKI were found among majority and minority group members and among males and females. The same was not true for scores on the ASVAB. Sternberg and The Rainbow Project Collaborators (2006) found that ethnic group differences on practical intelligence measures were significant but of a smaller magnitude than those observed for the SAT. Additionally, Hedlund and colleagues (2006), whose work is discussed in more detail in the following section, found that practical intelligence measures exhibited less disparity across gender and racial/ethnic groups than did the Graduate Management Admissions Test (GMAT).

Alternative Measures of Practical Intelligence

TKIs have emerged as the predominant method for studying practical intelligence in part because they allow individuals to be assessed across numerous problem situations and they are relatively easy to score. A limitation of TKIs is that they assume that individuals have had the opportunities to acquire domain-specific knowledge. In many cases, organizations must evaluate individuals who have not necessarily had the same opportunities. Alternative methods that measure the potential to adapt and to learn on the job may provide broader applicability.

One approach to assessing practical intelligence focuses on the skills involved in solving practical problems. According to Sternberg (1985, 1997), individuals who effectively solve practical problems are able to recognize that a problem exists, define the problem clearly, allocate appropriate resources to the problem, formulate strategies for solving the problem, monitor their solutions, and evaluate the outcomes of those solutions. Furthermore, in order to understand the problem in the first place, individuals need to be able to filter relevant information from irrelevant information, relate new information to existing knowledge, and compile information into a meaningful picture.

An individual's potential to acquire tacit knowledge can be evaluated by measuring how well the individual defines the problem, decides what information to attend to and how to interpret the information, generates and evaluates alternative possible solutions, and chooses and monitor a course of action (Hedlund & Sternberg, 2001; Matthew & Sternberg, 2009). These processes can be measured using a format similar to case studies or in-basket tests. Individuals are presented with sufficient information to solve each problem so as not to rely heavily on existing knowledge and they are asked to respond to a set of question prompts directly targeting the use of problem-solving and knowledge-acquisition skills. Respondents can be evaluated based on how well they exhibit each of the problem-solving skills as well as the quality of their solution.

This alternative approach to measuring practical intelligence was explored within the context of business school admissions. Hedlund and colleagues (2006) developed two approaches to measuring practical intelligence, one knowledge-based and the other skill-based. The situational judgment problems (SJPs) were akin to TKIs and assessed students' ability to recognize more and less effective responses to managerial situations. The case scenario problems (CSPs) presented a fictitious business case, which consisted of a brief overview of the problem, the respondent's role, a history of the organization, and various documents such as organizational charts, departmental memos, email correspondence, financial tables, and/or product descriptions. The scenarios were followed by a series of open-ended questions aimed at assessing problem identification, solution generation, information processing, and outcome monitoring.

Hedlund and colleagues (2006) administered the SJPs and CSPs to two samples of incoming MBA students (total $N = 792$). Scores on the SJPs and CSPs related significantly to first year and final GPA and exhibited modest but significant correlations with participation in extracurricular activities and leadership positions. There were no significant correlations between either question format and scores on the GMAT and scores on both the SJPs and CSPs explained significant variance in grades beyond GMAT scores and undergraduate GPA.

In comparing the two question formats, Hedlund and colleagues (2006) found that the CSPs exhibited slightly better predictive and incremental validities than the SJPs with regard to academic performance. The SJPs, on the other hand, produced less racial/ethnic disparity in scores than the CSPs. The students preferred the format of the SJPs and evaluated their own performance to be higher on the SJPs but they tended to view the CSPs as more relevant to job performance and more potentially useful in an admissions process. In general, TKIs have the advantage of being easier to develop, administer, and score but measures of practical problem-solving skills may provide broader insight into the skills that underlie knowledge acquisition. They also provide a potential avenue for facilitating the development of practical abilities.

Developing Practical Intelligence

Although the majority of research to date has focused on assessing individual differences in practical intelligence, there is emerging interest in identifying ways to

develop practical intelligence. These efforts may involve directly teaching the "lessons learned" of more experienced and successful practitioners or helping individuals develop the skills to learn more effectively from their own experiences (Cianciolo, Antonakis, & Sternberg, 2004; Hedlund & Sternberg, 2001; Wagner, 1997).

Sharing Tacit Knowledge

One of the products of research on tacit knowledge is a body of knowledge that can be incorporated into training and development initiatives in order to share the lessons of experience with others. The uncovered tacit knowledge may be shared directly with others (e.g., reading a story about someone's experience) or it may be used to help guide individuals to the types of situations that are conducive to acquiring relevant tacit knowledge. Prescriptions for designing effective training programs suggest that training should build on trainees' prior knowledge, use relevant and concrete examples, help trainees interpret their experiences, provide opportunities to apply general principles, and provide feedback (see, e.g., Campbell, 1988; Howell & Cooke, 1989).

The sharing on tacit knowledge can take the form of "rules of thumb" about how to respond in various situations or case studies that allow learners to assess the situation, evaluate the course of action taken, and assess the consequences of the action. The situations from tacit knowledge inventories can be developed into behavioral role-playing scenarios or simulations, which have been shown to be effective methods for developing practical competencies (Burke & Day, 1986; Keys & Wolfe, 1990; Latham, 1988; Thornton & Cleveland, 1990).

Facilitating Knowledge Acquisition

Even when efforts are made to provide opportunities to acquire knowledge, it is clear that some individuals are more skilled at learning from experience than others. By understanding the processes that underlie the successful acquisition of tacit knowledge, individuals can be taught to be more sensitive to the lessons of experience. Individuals, for example, can be given strategies to help them focus on the knowledge-acquisition components of selective encoding, selective combination, and selective comparison (Sternberg, 1988, 1997). Teaching these strategies could entail providing examples in which the relevant information is highlighted, showing charts or figures that illustrate how the information is combined, and explaining how the new information is related to prior knowledge. Individuals could also be given question prompts to practice using in solving new and unfamiliar problems.

Several studies demonstrate the potential to facilitate knowledge acquisition. Sternberg, Wagner, and Okagaki (1993) assigned participants to one of five conditions that varied in regard to the cues provided to help with tacit knowledge acquisition. For example, in the selective encoding condition, relevant information was highlighted and a relevant rule of thumb provided. Participants in the control group (with no cues) performed the worst in terms of their accuracy in identifying

relevant information. Participants assigned to the selective encoding and selective combination conditions showed the most gain in tacit knowledge scores. These findings suggest that prompting individuals to focus on certain information can enhance the acquisition of tacit knowledge.

Matthew and Sternberg (2009) studied the effectiveness of three training interventions, or critical thinking exercises, that emphasized different aspects of the condition-action structure of tacit knowledge. The condition-focused method was aimed at helping learners focus on problem identification and goal formulation. The action-focused method focused the learner on the link between action and outcomes, including alternative responses. The condition and action-focused method encouraged reflection on both the condition and the action.

In the first study with Army officers, participants in the combined condition and action intervention showed significant improvement in tacit knowledge scores. In the second study, undergraduate students completed the College Student Questionnaire and two college case studies designed for the experiment. There were no significant effects of reflection condition on tacit knowledge scores. Matthew and Sternberg (2009) suggested that the interventions may have been too brief to have had a substantial impact on practical problem-solving skills. However, the findings with the military sample, although modest, provide encouragement that such skills can be developed through intervention.

Razali and Trevelyan (2012) examined the influence of laboratory classes on the development of practical intelligence among engineering students. Students completed a practical intelligence test that consisted of various engineering problems before and after the laboratory classes. The experimental group showed significant improvement in practical intelligence scores and significantly higher posttest practical intelligence than the control group.

In addition to experimental interventions, researchers have explored the influence of human resource (HR) practices on knowledge acquisition and knowledge sharing (Chuang, Jackson, & Jiang, 2016). Their specific focus was on knowledge-intensive teams in the IT industry, whose work involves collaboration among team members to locate, share, create, and apply knowledge. The authors conceptualized knowledge on a continuum from mostly explicit (i.e., easily codified and recorded) to mostly tacit (i.e., more complex and subjective).

Chuang, Jackson, and Jiang (2016) surveyed 172 team leaders and 826 members from thirty-four IT firms in Taiwan. They found that HR practices had the most influence on knowledge acquisition when the knowledge was highly explicit (or less tacit). In other words, HR practices were more effective in facilitating knowledge acquisition of more explicit knowledge but less effective with the acquisition of more subtle, less readily observable tacit knowledge. Supportive HR practices were equally effective at promoting knowledge sharing regardless of whether the knowledge was more or less tacit. They suggest that future research should "explore other potential means for facilitating the acquisition of tacit knowledge since the power of HRM systems appears to be constrained by knowledge tacitness" (p. 545).

The Future of Practical Intelligence Research

Wagner's (2011) chapter in the previous edition of the *Cambridge Handbook of Intelligence* suggested that the convergence of several theoretical perspectives might diminish the need for a distinct focus on practical intelligence. Although some research has raised questions about the distinctiveness of practical intelligence from general intelligence (Cianciolo et al., 2006; Gottfredson, 2003), the body of evidence continues to grow in support of the concept of practical intelligence and the value it adds to understanding performance in a wide variety of contexts. The most prolific area of research on practical intelligence has been the work on tacit knowledge, which has demonstrated its relevance to performance in employment, education, and everyday life.

Among researchers who have studied tacit knowledge, there is a general consensus that efforts should be aimed at facilitating the acquisition and dissemination of such knowledge. Two promising directions for future research reflect these views. The first direction builds on work that has already begun to identify the tacit knowledge that distinguishes novice from expert performers. Researchers should explore the most effective ways to share the lessons of experience in order to facilitate more effective and efficient development of expertise. The dissemination of tacit knowledge would be particularly advantageous in settings where there is high turnover and limited time for reflection (e.g., McQueen & Janson, 2016) or where the stakes associated with allowing novices to perform tasks are high (e.g., Taylor, Van Der Heijden, & Genuchi, 2017). One way of sharing knowledge is through communities of practice, where individuals come together to discuss problems and exchange lessons learned (Wagner, 2011). In the military, tacit knowledge scenarios have been shared through websites and an experimental forum developed to facilitate in-depth discussion and reflection on the problems depicted in the scenarios (Cianciolo et al., 2004). Technological advancements not only increase opportunities to disseminate knowledge but also support dynamic processing of that knowledge. Kahn and Khader (2014), for example, propose that e-learning tools can facilitate the sharing of tacit knowledge with the right person at the right time. They describe a dynamic query-handling system that transfers a query from a novice and matches that query with the appropriate expert.

The second promising area for further research builds on efforts to improve knowledge acquisition through interventions aimed at enhancing problem-solving skills. Research has shown that tacit knowledge acquisition can be facilitated by providing cues to help learners process information more effectively (Sternberg, Wagner, & Okagaki, 1993) or by encouraging learners to reflect on their problem-solving processes (Matthew & Sternberg, 2009). Reflection has long been recognized as vital to experience-based learning but more research is needed to understand what types of reflection methods best facilitate the acquisition of knowledge that typically lies outside of focal awareness. Researchers might also explore how different learning orientations might influence the effectiveness of different reflection techniques. Identifying ways to help individuals more effectively and efficiently learn from experience might prove to be the greatest contribution of the research on

practical intelligence, and secure a place for a chapter on practical intelligence in the next edition of this handbook.

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