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Tacit Social Knowledge Acquisition as a Function of General Intelligence and the Ability To Learn and Utilize Uncertain Social Feedback and Contingencies

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Current research and theories of intelligence support the existence of a social or practical intelligence. The authors of this report adopt components of the triarchic theory of social and practical intelligence and view the ability to acquire tacit social knowledge as a function of general intelligence, the ability to perceive and learn subtle social information and contingencies, and the ability to accurately interpret and combine this information. This theory raises several counterintuitive predictions that are discussed in the report.

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CONTENTS

TACIT SOCIAL KNOWLEDGE ACQUISITION AS A FUNCTION OF GENERAL INTELLIGENCE AND THE ABILITY TO LEARN AND UTILIZE UNCERTAIN SOCIAL FEEDBACK AND CONTINGENCIES

Many theories of intelligence have defined intelligence in terms of the ability of individuals to respond effectively within their environment. Regardless of whether a single intelligence factor is theorized or a number of factors are hypothesized, intelligent individuals are expected to perform at a higher level of competence across a wide variety of academic, practical, and social situations.

Intelligence tests have been used primarily for the prediction of individual differences within academic settings. Binet and Simon (1905) developed and successfully validated the first intelligence scale in order to identify mentally defective individuals in the French school system. Subsequent intelligence scales were usually developed with the intent of predicting performance within an academic or training setting.

Considering the purpose for which most intelligence scales were developed, it is not surprising that performance on academic achievement tests and intelligence scales usually loads on a single factor (Jensen, 1981). The redundancy between individual differences in intelligence and academic performance contradicts the beliefs of the public, which conceptualizes academic intelligence as separate from general and practical/social intelligence (Sternberg, Conway, Ketron & Bernstein, 1981).

Although factor analyses of social intelligence tests have not consistently demonstrated the existence of a social or practical intelligence factor (Thorndike & Stein, 1937; Keating, 1973), this may be due to the fact that many items on traditional scales of social intelligence are academically loaded. Consistent with this interpretation is the finding that factor analyses of peer ratings of social, general, and academic intelligence point to the existence of separate factors (Tisak & Ford, 1983; Marlowe, 1986). In a similar vein, Wagner (1986) has observed that the magnitude of the correlation between practical and general intelligence scales is dependent on the format used by the practical intelligence scale. Wagner found that the magnitude of the correlation between general and practical intelligence tends to be greater when practical intelligence is quantified with a scale that utilizes an academic format than when practical intelligence is quantified with a scale that utilizes a simulation based format. This indicates that past social intelligence scales have been incorrectly designed and that independence might be demonstrated with a simulation based scale.

Much anecdotal evidence supports the view of academic intelligence as separate from practical and social intelligence.

For example, Scribner (1986) describes the (high level) expertise of blue collar workers in a milk factory; Berry and Irvine (1986) document bricolage, which is roughly equivalent to handyman skills, within primitive cultures. Both these studies are similar in that they show that groups of individuals with average levels of academic intelligence can achieve high levels of expertise within specific contexts.

Separation of academic and practical intelligence is also suggested by Ceci and Liker (1986a, 1986b) in their description and analysis of the ability of a select group of horse race gamblers to estimate horse race odds. Their analysis indicates a zero order correlation between traditional measures of intelligence and the success of a highly select group of gamblers. One problem with this type of study is that the lack of significant correlations may represent a statistical artifact stemming from either restriction of range or attenuation of reliability (c.f., Detterman & Spry 1988). Despite this criticism, it is noteworthy that the mean IQ of the successful gamblers, 99.9, is very close to the population mean.

The anecdotal evidence, coupled with the factor analyses, suggests that individual differences in social or practical intelligence may be independent of academic or general intelligence. However, the etiology of this (presumed) independence between academic and social/practical intelligence is not clear.

Intelligence, Learning, and Uncertain Reinforcement

The relationship between learning and general intelligence has historically been viewed as minor on the basis of correlational data (Estes, 1982). This conclusion was surprising because intelligence tests were originally designed to predict academic performance in the French school system (Binet & Simon, 1905; Binet & Simon, 1916). More recent efforts to link learning and intelligence have been better designed and a review by Jensen (1989) confirms the expected relationship between intelligence and learning ability.

An important distinction between academic and social knowledge is that sophisticated social knowledge is rarely explicitly taught. This observation has led to the equating of individual differences in social intelligence with the ability and propensity to utilize tacit social knowledge while interacting with others (H. H. Busciglio & I. King, personal communications, May 1992). This formulation, however, can be criticized because some social skills can be explicitly taught or directly learned with references such as etiquette manuals. Social intelligence might be better conceptualized as based on a body of knowledge, primarily social in nature, a portion of which may be explicitly taught, but more of which is tacitly learned.

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Another way in which tacit social and practical knowledge differs from learning explicit academic knowledge is that most academic knowledge can, and usually is, expressed as a certainty, while social and practical knowledge tends to be more probabilistic. Academic certainty is reflected by the fact that most academic knowledge is presented and tested as unambiguous. In contrast, social and practical knowledge is replete with uncertainty and can often be described as probabilistic. For example, accurately inferring intentions and motivations is probabilistic because mistakes are often made, and the correctness of an inference may be partial and not verifiable. Relatively little research has addressed the process or conditions under which probabilistic contingencies are learned or used.

From a nomothetic perspective, two research traditions suggest differences between the learning of probabilistic and certain knowledge. First, behaviorists, such as Ferster and Skinner (1957), have shown different patterns of performance under a variable (linear) versus fixed (scalloped) interval reinforcement schedule. Second, cognitive studies (e.g., Kahneman, Slovic & Tversky, 1982) demonstrate the existence and importance of a variety of biases from a cognitive modelling standpoint. An important finding from this literature is that individuals with sophisticated mathematical skills do not usually use their mathematical knowledge to interpret professionally relevant events. It can be expected that these individuals would also fail to utilize their mathematical knowledge to interpret commonly encountered social and practical contingencies.

Whether or not humans can be trained to minimize the effects of cognitive biases is an ongoing research question (Fong, Krantz, & Nisbett, 1986; Nisbett, Fong, Lehman & Cheng, 1987). In general, however, the improvement of this ability is not addressed within academic settings. Despite the ubiquity of our cognitive biases, humans do manage to function in many environments that are replete with probabilistic contingencies. It is important to study the role of individual differences in the learning and use of probabilistic knowledge if only because of the impact of uncertain contingencies on our daily lives and the documented discontinuity between the learning of certain and probabilistic information. The study of individual differences in the ability to learn and utilize probabilistic knowledge is also germane to understanding performance in many practical, although non-social, situations. One is reminded of the truism, "In war, the only certainty is uncertainty", and its implication that the success of many military (and civilian) operations can hinge on the ability of the commander (or civilian manager) to function under conditions of uncertainty, i.e., tolerate ambiguity, make decisions with less than complete information, etc.

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Most behaviorists would probably agree that much human behavior is learned under or governed by variable schedules of reinforcement (e.g., Schultz, 1978). This seems reasonable because most natural contingencies are not perfectly predictable. However, this conceptualization is a little simplistic from the standpoint of learning tacit social knowledge because in many social situations individuals have multiple options that can all lead to positive or negative consequences, i.e., the options are reinforced under variable schedules of reinforcement (and punishment). In these circumstances, learning a social contingency is analogous to performance in a discrimination learning paradigm compounded with variable reinforcement contingencies.

Even if only one action is possible, the individual must discriminate the results of the action from background reinforcement noise, i.e., random social reinforcement. From this perspective, learning a social contingency could be viewed as a signal to noise problem. In traditional probability terms, estimating the magnitude of an uncertain contingency, e.g., A usually implies B, requires knowledge of the probability of B given A, $p(B|A)$, and the probability of B given not_A, $p(B|not\_A)$. Although knowledge of $p(B|A)$ may take years of experience, $p(B|not\_A)$ is demonstrably even more difficult to learn in many uncertain conditions.

An important point is that in many social situations, individuals are confronted with the difficult task of identifying the action (option) that maximizes the probability of reinforcement given that several different actions may be reinforced. Although learning this type of contingency can be described through Skinnerian terminology by compounding a forced choice discrimination paradigm with variable schedules reinforcement (Ferster & Skinner, 1957), it is simpler to refer to this as an uncertain contingency. We define an uncertain reinforcement contingency as a contingency in which the $p(B|A_i)$ is not equal to the $p(B|not\_A_i)$, with neither probability equal 1.0 or 0.0.

In the past, learning has usually been studied with paradigms incorporating certainty. Reinforcement will not occur without a response under a fixed or variable reinforcement schedule, is perfectly predictable under a fixed schedule, and will eventually occur by repeating the operant behavior under a variable reinforcement schedule, Thus the task of learning a contingency between A and B can usually be conceptualized as learning that the probability of B given A, $p(B|A)$, is different from 0. The major difference between performance under a fixed and variable schedule is that under a fixed schedule $p(B|A)$ is 1.0, while under a variable schedule $p(B|A)$ is less than 1.0; under both schedules $p(B|not\_A)$ is 0. (Learned helplessness

represents an exception to this generality in that the paradigm creates independence between behaviors and reinforcement, i.e., $p(B|A) = p(B|not\_A)$.) A much more difficult task is to determine whether or not the probability of B given A is different from the probability B given not A, with both probabilities on the open interval from 0 to 1, i.e., $1 > (p(B|A) <> p(B|not\ A)) > 0$.

In contrast to behavioral paradigms, much social and practical knowledge is acquired under complex and uncertain reinforcement schedules. One example of an uncertain reinforcement schedule is a comedian who can only attach a limited level of confidence to the assumption that an audience has responded positively or negatively due to his actions. The comedian's audience may be giddy and laugh easily, or the crowd may be tense and respond with a painful level of silence to well delivered material. Another area of social interaction that requires understanding complex and uncertain contingencies is dating. Would-be romantics must decipher sometimes contradictory and often vague signals to minimize the risks of dating. Mistakes can be catastrophic, while success can be rewarding.

Much of the complexity and uncertainty associated with social situations is created by general social norms that seem intended to facilitate social interactions but make it difficult to understand intentions, plans, and motivations of others. Three sources of difficulty are disingenuousness, dynamic complexity, and individual differences. Individuals are trained from an early age to hide or disguise emotions in order to avoid offending individuals, while simultaneously projecting an image intended to enhance one's prestige and self image. Uncertainty also stems from the dynamic nature of the motivations and goals of individuals; a specific activity may be aversive at one point in time, but attractive later. Individuals also differ in their ability to volitionally project an image, and many actions may be multidetermined. Given these types of considerations, interpreting a pattern of actions becomes complicated, and conclusions often need to be tentative or uncertain.

Tacit Knowledge as Probabilistic Production Systems

Tacit knowledge has been represented as production systems (Sternberg & Caruso, 1985) and the description is consistent with the triarchic theory of intelligence (Sternberg, 1985). Although uncertainty is alluded to several times by Sternberg and Caruso and they assert that "practical knowledge can be probabilistic in nature" (Sternberg & Caruso, 1985, p. 135), in our opinion, one shortcoming of this description is that it does not emphasize that many production rules require the representation of uncertainty to be useable.

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Ceci and Liker also minimize (or ignore) the importance of probabilistic information in their analysis of gambler expertise (1986a, 1986b). They utilize a multiple regression format in order to estimate the experts' efficiency in combining available information to predict race performance. Although a regression analysis can be used to summarize the gamblers' expertise and is required for testing the study's hypotheses, the authors acknowledge that the linear model does not represent the complex interactions that the experts consider (1986b). It is noteworthy that informal production rules are apparent in the sample interview transcript produced in Ceci and Liker (1986b). This implies that the gambler expertise could have been represented as a set of production rules incorporating uncertainty management principles, i.e., traditional probability theory or fuzzy logic principles, to allow the production of complex interactions.

We agree with Sternberg and Caruso (1985) that practical knowledge can be probabilistic in nature, but it also seems reasonable that tacit social knowledge tends to be more probabilistic, i.e., less certain, than other realms of practical knowledge. Most examples of tacit social knowledge are chosen for their simplicity and do not convey this uncertainty, e.g., Sternberg and Caruso (1985) present the following production rule as an example of tacit knowledge, "if I leave a mouse in my wife's soup, she will be angry." Although this rule lacks uncertainty (at least in the home of one of the authors), it is of little practical importance because there is no desire to ruin soup or destroy rodents in the process.

A less trivial example of tacit social knowledge is contained in the following two production rules, "if I leave the towel on the floor, then my spouse is likely to be angry" and "if I do not leave the towel on the floor, then my spouse might possibly be angry". These rules imply that the spouse may not be angry, or may be angry because of something else. According to these rules, it might be reasonable to leave the towel on the floor under some circumstances.

Propagating Certainty and Uncertainty

Production rules increase their utility when combined with other rules to produce new information. Properly combining certain rules is an exercise in deduction, e.g., the two rules "if a then b", and "if b then c", imply the rule, "if a then c." Syllogistic reasoning (deduction) tasks have been argued to be measures of fluid intelligence (Sternberg, 1985), which is highly correlated with general intelligence (Jensen 1980). Data indicate that individual differences on deductive tasks correlate highly with performance on spatial ability tasks (Sternberg, 1985; Thurstone, 1938; Frandsen & Holder, 1969).

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Many academic programs teach this skill and much academic knowledge can be represented as definitive (certain) production rules, e.g., mathematical proofs. Because this skill is academically relevant and formally taught, it should not be surprising that performance on deductive reasoning tasks correlates with academic measures of intelligence.

Combining uncertain rules or contingencies is less straight forward. If precise numeric probabilities are available, then it is possible to utilize Bayes theorem to calculate interdependent probabilities. However, numeric probability estimates are often imprecise and most individuals have never been taught Bayes theorem. Despite a lack of numerical precision, most individuals can easily compound uncertainty. For example, the following two uncertain production rules, "if I leave my towel on the floor, then my spouse is likely to be angry," and "if my spouse is angry, then supper will probably be poor," can be combined to form the rule, "if I leave my towel on the floor, then supper may be poor." In the resultant rule, the modifier, "may" represents the compounding of the uncertainty contained in the conclusions of each of the original two rules, i.e., "likely", and "probably."

Accurately interpreting social feedback in the context of other uncertain information further complicates social functioning because the uncertainty of the information must be collected from multiple sources and combined or propagated. Returning to the comedian example, an occasional restrained audience might be expected, but a pattern of restrained responses justifies changes to the comedian's material or delivery. However, the comedian is still faced with the dilemma of determining how much evidence is required to justify a modification.

Interpreting feedback in some social situations can be compared to the results of a Bayesian probability analysis across a large set of interrelated conditional probabilities. However, it is difficult to imagine any individual using Bayesian analyses because the number of calculations needed for Bayesian probability estimates is a combinatorial function of the number of interdependencies. It may be of interest that fuzzy logic calculi are utilized by artificial intelligence programs to minimize the number of calculations required for Bayesian probability estimates, otherwise the hardware can be overwhelmed by the computational requirements of the program.

Despite the potential complexity of uncertainty propagation, individuals are able to collect and interpret uncertain information from many sources. Individual differences in the ability to learn and combine uncertain contingencies may be an important predictor of the ability to function in many ambiguous social situations that are frequently encountered, e.g., dating,

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peer management, child rearing from the parental perspective, employee supervision, etc. Performance in some practical (non-social) situations also requires the learning of uncertain information. For example, an expert automobile mechanic will use vague customer complaints coupled with his own observations to diagnose mechanical problems.

Other social situations are characterized by much less ambiguous feedback. For example, child development experts stress the importance of using clear and consistent feedback while interacting with a child. Total Quality Management principles require setting clear standards and providing consistent feedback to employees. Education colleges train teachers to clearly set and state standards and consequences of behavior to control classroom conduct. Appropriate behavior in many formal situations can be identified in etiquette guides such as **Miss Manners**.

The extent to which parents, teachers and managers are consistent with these guidelines, releases children, students and employees from the necessity of perceiving and interpreting subtle differences between conditional probabilities. It follows that individual differences in the ability to learn and utilize uncertain information and contingencies is less likely to be related to performance in these types of situations.

Individual differences in the ability to utilize uncertain information may explain the puzzling observation that some individuals appear intelligent in some social situations, but not in others. For example, a teacher's pet (i.e., a teased student) and a popular student may be of similar academic intellect and have a similar need for social approval. But the teacher's pet tends to be incapable of obtaining peer approval or influence, while the popular student can both influence peers and control teacher interactions. In some instances, this pattern could be explained as a differing expression of the need for social approval, i.e., peer versus authority figure, but this explanation is circular and ignores cases in which a teased child is traumatized by the experience. According to the uncertainty management theory, this pattern would indicate an inability of the teacher's pet to learn and interpret the uncertain contingencies that characterize peer relations, while the popular student can effectively learn and interpret both ambiguous (peer) and unambiguous (teacher) feedback.

An important point to be made with respect to the ability to manage uncertainty is that this skill can be expected to have less relevance to academic performance. This is because academic settings are structured to provide a constant supply of accurate and consistent feedback to the students. The meaning of test scores is clear, and education colleges never encourage teachers to provide inconsistent academic feedback.

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The suggestion that this skill has less direct relevance to academic performance does not necessitate that this ability will be orthogonal to academic performance. It can be expected that students who can effectively interact with an instructor are more likely to be successful in the instructor's courses; this expectation is consistent with Sternberg's claim that student success is related to the consistency between the mental styles of a student and teacher (1988). However, academic environments are structured to minimize the impact of uncertainty, and the ability to manage uncertainty may be relatively independent of academic performance.

Theoretical Implications

One limitation to many theories of intelligence is that they do not provide a convincing argument for expecting independence between general (academic) intelligence and practical/social intelligence. (For a compendium of theories of intelligence, refer to Sternberg & Detterman, 1986). Most theories of intelligence either explicitly refer to learning and/or behavioral adaptation as a central concept, or implicitly provide for learning and adaptation by hypothesizing cognitive mechanisms or processes (Sternberg & Berg, 1986), e.g., elementary cognitive processes or metacognitive components. It is difficult to expect or explain independence between academic and social/practical intelligence with these theories because the cognitive mechanisms (or processes) hypothesized to support multiple intelligences should overlap, e.g., social/practical and academic intelligence should utilize similar elementary cognitive and metacognitive processes. From this perspective, individual differences in academic, social and practical intelligence should be redundant and highly correlated.

According to the model described in this paper, independence between academic and social/practical intelligence would be due to the differing demand characteristics of socially and academically intelligent behaviors. The model theorizes that the ability to manage uncertainty is central to successful functioning in many social and practical situations and is less relevant to functioning in academic situations. If this ability is not g-loaded, then differences in the ability to manage uncertainty could account for (partial) independence between social/practical and academic intelligence. Demonstrating the hypothesized relationships between uncertainty management and social intelligence would support the conception of academic intelligence as separate from social/practical intelligence (c.f., Sternberg, 1985) and explain the etiology of the (partial) independence.

The hypothesis that social/practical intelligence is a function of the ability to learn and manage uncertain information is consistent with the view that social intelligence is a subset

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of practical intelligence (Sternberg, 1985). According to the uncertainty management model, the ability to perform effectively in both social and practical situations often requires the ability to manage uncertain information. Social and practical intelligence are viewed as different to the extent that performance in social and practical situations requires differing levels uncertainty management.

The uncertainty management model is conceptually consistent with the componential subtheory of intelligence, which is a part of the triarchic theory of intelligence (Sternberg, 1985), in that uncertainty management is hypothesized to be important when acquiring knowledge (learning), combining knowledge (management), and acting in social situations. These activities are viewed as separate processes that roughly correspond to the knowledge acquisition components, the metacomponents, and the performance components hypothesized by the componential subtheory of intelligence (Sternberg, 1985).

Research Hypotheses

Loadings of Cognitive Tasks. The uncertainty management theory hypothesizes that the ability to learn and manage uncertain information is relatively independent of g, or general (academic) intelligence. It follows that if a g-loaded cognitive task was modified to incorporate uncertainty, then the modified task should load on measures of general intelligence to a lower extent and on measures of social intelligence to a greater extent than the unmodified version of the task.

If the ability to manage uncertain information is an independent determinant of practical or social intelligence, then increasing task difficulty by incorporating uncertainty into the task should result in the task becoming increasingly loaded on a social intelligence factor and less loaded on g. This finding would strongly verify the outlined theory because the outcome is counter intuitive, i.e., the loading of a cognitive task on intelligence would not be expected to decrease as a task is made more complex by incorporating uncertainty into the task. Although many cognitive tasks can probably not be modified to incorporate uncertainty, e.g., an inspection time task, several tasks that might be modified are described below.

If the ability to learn or manage uncertain information is a function of general intelligence, then incorporating uncertainty into a cognitive task should result in an increase in the loading of the task on g. This result would be equivalent to demonstrating that a task's loading on g will increase as the cognitive complexity of the task increases, and the hypothesis that "uncertainty management" is an independent skill would not be confirmed. This finding would not necessarily be trivial because the demonstration that the ability to manage uncertain

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information can be quantified may have implications for performance prediction in jobs that require this ability.

It is important to note that the uncertainty management theory predicts that the magnitude of an increase in the loading of a modified (uncertain) cognitive task is a function of the method by which social intelligence is estimated. Returning to the teacher's pet example, a smaller increase would be expected for a social intelligence scale based on teacher interactions, a larger increase for a social intelligence scale based on peer interactions. In general, the increase in loading should be greater for social intelligence estimates based on inherently uncertain situations such as dating and peer management, and less for social competence estimates based on situations that are not characterized by uncertainty, such as teacher interactions or table manners.

Factor Analysis Hypotheses. Because the ability to manage uncertainty is conceptualized as a general ability that is required to a variable extent as a function of the uncertainty of social situations, it follows that the ability to function across social situations should cluster around the level of uncertainty inherent in the social situations. Thus correlations among social intelligence estimates based on uncertain situations should correlate at a higher level with each other than with social intelligence estimates based on certain social situations. Likewise, cognitive tasks incorporating uncertainty should correlate at a higher level with each other than cognitive tasks that do not incorporate uncertainty.

Proposed Cognitive Tasks

The preceding section hypothesizes a number of relationships for tasks that are not yet existent. This section is intended to describe proposed tasks that may be created in order to test the hypotheses.

Concept Formation Task. One task that could be adapted to test the uncertainty management theory is the Concept Formation task (Mayer, 1977). This task utilizes pairs of stimuli that vary along several dimensions, e.g., alphanumeric value, case, and position. Stimuli are presented simultaneously and subjects are required to select a stimulus. Feedback is then given indicating whether or not the subject chose the correct stimulus. For example, on a given trial the subject may be presented with a lower case letter "a" on the left and be told that this is the "correct answer". On the following trials, the subject tests different hypotheses, e.g., "lower case stimuli are correct", "stimuli on the left are correct", or "letter 'a' stimuli are correct", until the dimension that needs to be attended to is discovered through trial and error.

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The task can be made increasingly difficult by increasing
the number of stimulus dimensions or imbedding patterns into the
correct responses. For example, the correct response might
alternate across trials between the lower and upper case stimuli.
The task could also be made more difficult be incorporating
uncertainty into the feedback, e.g., the feedback for 75 percent
of the trials might remain accurate while the feedback for a
randomly selected 25 percent of the trials be made inaccurate.
In this condition, a subject would be informed that a response is
the correct response seventy-five percent of the time and that an
incorrect response is incorrect seventy-five percent of the time.
Across twenty-five percent of the trials the subject would be
misinformed, i.e., informed that the response is correct when it
is incorrect or incorrect when it is correct.

The uncertainty management theory would be validated by
demonstrating that the loading of the Concept Formation task on a
social intelligence scale increases as the task is altered by
requiring subjects to learn under an uncertain reinforcement
schedule. The uncertainty management theory also predicts that
the loading of the task on g would decrease with increasing
uncertainty management requirements. The uncertainty management
theory predicts that the opposite pattern of loadings would occur
if the task was made more difficult by increasing the number of
stimulus dimensions or imbedding patterns into the correct
responses.

Syllogistic Reasoning Task. A second task that could be
adapted to incorporate uncertain information is the Syllogistic
Reasoning task. This task typically poses several relational
statements and requires the subject to integrate the information.
For example, the two relations (1) "John is taller than Paul" and
(2) "Paul is taller than Pat" implies the (definite) conclusion
that "Pat is (must be) shorter than John".

Uncertainty can be introduced into this task through the
incorporation of uncertain modifiers. For example the relations
(1) "Men tend to be somewhat taller than women", (2) "Mike seems
to be a little taller than Joe", and (3) "Mary seems to be a lot
taller than Nancy", suggests that Mary is probably as tall as
Mike and Joe. Adding an additional assertion that Nancy is very
short for a female changes the most likely conclusion concerning
Mary to "Mary is a little shorter than Mike and Joe". Adding the
two assertions that Mike is very tall for a male and that Nancy
is very short for a female changes the most likely conclusion
concerning Mary to "Mary is about average for a woman and is
somewhat shorter than Joe". Note that none of these conclusions
can be definite.

Another uncertain syllogistic reasoning example has the
following premises: (1) "Albert is a little taller than Burt",
(2) "Cyril is much taller than David". These statements imply

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that the mostly likely ordering of height is: "Cyril is taller than Albert is taller than Burt is taller than David".

Although the syllogistic reasoning task has not been used in the past to measure individual differences as described above, Sternberg (1985) has modified the task so as to produce a set of indeterminate syllogisms. An indeterminate syllogism is defined as one that could not be answered, e.g., the two premises, "Al is taller the Bob" and "Al is taller than Mike", allows no conclusion regarding the shortest male. This syllogism varies from the proposed uncertain format in that tentative conclusions can not be proposed concerning Bob and Mike; an uncertain syllogism would allow a tentative conclusion.

Classifications Task. The Classifications task provides a subject with several representative instances of a class of objects, followed by a list containing several non-instances of the class and one instance, e.g., "cow, sheep, pig: goat, car, tower". Typically the subject is given one unambiguously correct item and several incorrect items. The subject's task is to choose the item that is most consistent with the list. The task can be made more difficult by choosing instances of increasingly obscure lists.

The task could also be altered to provide the subject with a set of alternatives that vary in their consistency with the elements. The subject's task would be to rate the consistency of each alternative on a Likert scale. One such item might contain the class exemplars, "Cat, Chimp, Cheetah", and the requirement to rate the consistency of the following alternatives,"Lion, Eagle, Chicken-hawk, Frog, Rabbit, Cow, Coyote". Performance on the task would be estimated by the covariation between the ratings of the individual and the ratings of a reference group in accordance with the method described by Wagner and Sternberg (1986). Uncertainty is embedded into the task through the use of a range of ambiguous instances.

Perceptual Tasks. Learning in social situations differs in at least one other important way from learning academic information. This is that many social cues and reinforcement are subtle and easily missed. From this perspective, it is reasonable to expect that individuals with heightened sensitivity to social cues and reinforcement will tend to have higher levels of social intelligence.

Based on this argument, it is expected that performance on an inspection time task utilizing pictures of human expressions will load on a social intelligence factor to a greater extent then performance on an inspection time task utilizing standard stimuli, e.g., lines or grids. It is also expected that the loadings of the two tasks will have the opposite pattern of loadings on measures of general intelligence. Utilizing an

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inspection time task is particularly appropriate for this purpose because many studies have demonstrated high correlations between performance on inspection time tasks and intelligence.

Social Intelligence Scales. The above predictions assume the existence of social intelligence scales that estimate individual differences in the ability to function in specific social situations. Such scales could be developed by following Wagner and Sternberg's low fidelity simulation approach (1986), or by utilizing peer ratings of individuals modifying the approach of Sternberg, Conway, Ketron and Bernstein (1981). The low fidelity simulation approach is preferable because it results in a scale that can be used for much broader applications and populations.

Summary

Current research and theories supporting the existence of a separate social intelligence factor do not adequately explain the etiology of independence between academic and social intelligence. Research is proposed that tests the hypothesis that social intelligence is a function of general intelligence, the ability to perceive and learn subtle social information and contingencies, and the ability to accurately interpret and combine this information. This theory raises several counter-intuitive predictions.

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