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ABSTRACT

A study determined whether sensate and intuitive learners differed in their capacity to recall and recognize images given two different times of exposure. The 158 subjects--elementary school technology teachers in Southern California--put themselves into 2 groups of 80 and 78 by registering for a first or second session of the Elementary Summer Technology Training Institute. Three images from three categories were developed: men's faces, animal faces, and letters of the alphabet. Nine equal-sized posters using three of the images, one from each category, were hung in the student cafeteria for three (first session) or four (second session) consecutive days. On these days, subjects ate three meals in this facility. Those in the 3-day exposure period were exposed to the images for about 8 hours, those in the 4-day exposure period for about 12 hours. After each exposure period, the images were removed. Subjects were administered the Myers Briggs Type Indicator. A week later, a questionnaire was distributed that probed the extent to which sensate and intuitive subjects were able to recall and recognize those images. Data analysis revealed that, although sensate subjects in the 8-hour group were significantly less able to recall these images than the intuitive subjects, they were able to recall the same number of images after 12 hours of exposure. There were no significant differences, however, between intuitive and sensate subjects in their ability to recognized over 8 or 12 hours of exposure. (Contains 18 references) (YLB)

RECALL AND RECOGNITION IN INDUSTRIAL TECHNOLOGY EDUCATION STUDENTS

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Abstract

In this two-factor experiment with two dependent variables, 158 subjects placed themselves into two groups of 80 and 78 subjects by registering for either a 1st or 2nd summer session workshop. Each group was exposed to three images for a period of eight or twelve hours. After the exposure period, the images were removed. Subjects were administered the Myers Briggs Type Indicator. A week later a questionnaire was distributed that probed the extent to which sensate and intuitive subjects were able to 1) recall those images and 2) recognize them. Analysis of the data revealed that while sensate subjects in the 8-hour group were significantly less able to recall these images than the intuitive subjects, after 12 hours of exposure they were able to recall the same number of images. There were no significant differences, however, between intuitive and sensate subjects in their ability to recognize over eight or 12 hours of exposure.

## Introduction

Edmunds & Schultz (1989) have shown that, within the industrial education population, students who score as sensate (S) or intuitive (N) learners on the Myers-Briggs Type Indicator (MBTI) appear disproportionately in the various sub specializations of the industrial education discipline. Generally, the more "hands on" the industrial education specialty is, the more the learners who are attracted to it score as sensate. The more cerebral the specialty, however, the more intuitive learners who are attracted to it. These findings are echoed in the large body of occupational research collected and maintained by the Center for Application of Psychological Type (CAPT) at Florida State University. In these "type tables" it is apparent that the more psychomotor skills predominate as primary requirements of the occupation, the higher the proportion of sensate individuals who populate it while the more cognitive skills are required, the more intuitives predominate. For example, looking briefly at the Atlas of Type Tables from CAPT, we find that 96% of a sample of bus drivers, 86% of a sample of steelworkers and 65% of a sample of mechanics score as sensate while 57% of a sample of aeronautical engineers, 73% of a sample of photographers and 82% of a sample of architects score as intuitives. (Macdaid, G.P., McCaulley, M.H., & Kainz, R.I., 1986)

One cannot assume causality, of course, but these strong and persistent associations across occupation and perception preferences suggest that the manner in which students prefer to perceive has a profound relationship with later career aspirations and achievements. It has a profound relationship with how well subjects perform on standardized tests, too. McCaulley and Myers (1985) noted a wide disparity in performance on achievement and intelligence tests between those learners who score as Ss or Ns with intuitive learners collectively scoring as much as one standard deviation above sensate learners. For example, in the test manual for the MBTI, Myers reports that eighth-grade math achievement scores on the Stanford Achievement Test varied significantly between sensate and intuitive students across math computation, math concepts and math applications by 8, 18 and 19 points (with standard deviations (SD) of 15.8, 21.5 and 20.3 respectively). Similarly, reporting the results of Myer's Longitudinal Study of the Medical School Aptitude Test with about 2000 subjects, sensate subjects consistently lagged about one SD behind intuitive subjects across verbal, quantitative and science measures. Even on the Armed Service Vocational Aptitude Battery, sensate subjects scored significantly lower on electrical, motor mechanical, general mechanical and general technical test measures than intuitives and this was in fields in which sensate workers later come to populate disproportionately. In all of these reports, sensate students scored significantly lower than intuitives. What accounts for this discrepancy? What is it about students who score as sensate learners that makes them perform less well on paper-and-pencil problem-solving tests than their intuitive counterparts?

## Literature Review

In 1984 Dunn began asking the question, "Why do intuitives score higher on standardized tests?", and developed two experimental approaches to examine the phenomena. In the first study, (Dunn, R.B., VanCleaver, R. & Hymes, D., 1984), Dunn postulated that if individuals showed differing preferences on the sensation/intuition and thinking/feeling scales of the MBTI, then consistent with Jung's theory they should show different performance scores on the Closure Speed Test (CST) because "Ns search for patterns and relationships in the stimulus field" and "Thinkers make decisions based on rational, logical and objective thought processes." In other words, Dunn thought that there were theoretical differences that explained why intuitives did better than sensates on standardized tests and he thought that this experiment should validate those theoretical constructs. The CST rates individuals in their ability to perform closure in an unorganized or incomplete stimulus field. The CST was designed to measure Thurstone's "first closure factor," or the ability to perceive an apparently disorganized or unrelated group of parts as a meaningful whole.

Unfortunately, despite his report that "the Sensing-Intuition (S-N) dimension is the most correlated with various measures of academic success or ability, grades, IQ test scores, etc.", Dunn chose to use temperament rather than trait as one of his independent variables. The MBTI may be used as a measure of trait, temperament, (the interaction of two separate traits); or of Jungian type, (the interaction of all four preferred traits). In this experiment Dunn chose to use the MBTI as a measure of Jungian temperaments and combine the interaction of the perception and judgment functions into the four possible trait pairs: intuition/thinking (NT), intuition/feeling (NF), sensation/thinking (ST) and sensation/feeling (SF).

Dunn asked the question, will there be significant differences in these four groups in how fast they will be able to find closure. He hypothesized that the group SF would be significantly less able and that the group NT would be most able to perform this task. Although there was a significant difference in the group it was that NF was the lowest and the only one significantly different from the other three groups. His choice of temperament was unfortunate because it muted the interaction of the intuition/sensation dichotomy on the question. The central question should have been do intuitives differ significantly from sensates in their performance on this task.

Dunn's second study (1985) was still flawed in its choice of using the MBTI as a measure of temperament rather than trait. In this study Dunn presented 40 words to 34 subjects in five-second exposures by projecting them on a screen. The subjects, who had all been administered the MBTI the week before, were shown the words twice. Immediately after the second presentation, they were given five minutes to recall the words in any order they wished. The trick to the study was that the words were in eight-word groups of five categories and that once the subjects discovered the inherent categories, they could remember more words. The hypothesis that Dunn postulated was that Jungian temperament NT would be most successful at this task, again consistent with Jung's theoretical constructs. Again, although his clustering of the subjects into Jungian temperaments was logically built on the theoretical constructs of the MBTI, because he dealt with temperament rather than the the two traits associated with the perception function, he did not achieve significant results.

Both of his efforts, however, identified two critical factors with regards to standardized testing differences in sensate and intuitive learners: time and memory. He was not the first to make this identification. Bloom (1974) noted that the achievement level of the upper 20% of test takers was generally reached by most of the rest of the test takers at some point in the next two years. Indeed, a decade earlier Carroll (1963) had arrived at the same conclusion, stating "*time* is the central variable in school learning". Bloom concluded his article with a formula which enumerated the phenomena: the attainment of a set criteria differs by a ratio of about 5:1 under a variety of learning conditions. Block (1971) summarized the earlier work of Bloom, et al, in the abstract for the book stating: "faster students master materials five to six times as quickly as the slower".

Dunn's recognition of time as a factor in how achievement test performance was related to preference for perceiving the world in a sensate or intuitive manner was apt, but he did not fully appreciate its utility as a factor. He used time as a static limit rather than a continuous variable. Either of these experiments would have been more revealing if task achievement had been allowed to vary with a continuous measure of time.

His appreciation of the importance of memory to achievement on standardized tests is an obvious observation. A researcher does not study achievement for long before the realization is made that memory plays a key role in the ability to solve problems. In order to solve a problem, one first needs to recognize the problem, recall old techniques of solution and evaluate the appropriateness of those techniques before attempting to apply them. Once applied, the problem solver must reevaluate to determine if one of those techniques had worked. If they did not work, the problem solver must modify the techniques, reapply and reevaluate. If no existing solution is viable, the problem solver must refocus on the characteristics of the problem and turn these over either physically or in the problem solver's mind until other possible solutions occur or the problem can be redefined. Each of these processes make incessant demands on one's capacity for memory. Clearly, problem solving on standardized tests and memory are intimately linked.

Although Dunn had only one statistically significant finding in these two studies, and even then it was for a different temperament than he expected, his research showed insight into the factors that come into play in test taking. Specifically he showed that how one prefers to take in information from the environment, how much time one has to solve problems and how one uses his or her memory are important factors.

Memory has been studied repeatedly for more than a century and we know some things fairly completely: we know with some certainty that memory consists of the sensory register, short-term memory, and long-term memory. Knowledge about how these faculties operate, whether they are biochemical mechanisms or locale specific in the brain, whether they are highly accurate, machine-like apparatus coded in in an associative manner or inherited schema-like faculties with ample room for error are still fairly speculative.

In the early 1990s, several new approaches to conducting research on the brain, (and therefore the brain's processes like memory), have been engaged and promising new insights have been gained. Central to the approaches of cognitive neuropsychology and sociopsychology is the idea that no change in structure or function of the brain is viable unless it fosters the survival of the species. In other words, processes like memory could be thought of as evolutionary adaptations. Given this perspective, researchers have presented substantial evidence that people are born with schemata for such things as understanding, for language and quantification, for facial recognition and making visual sense of the world. (Gazzaniga, M.S., 1998)

An alternate way that memory has been examined is Allan Paivio's Dual Coding Theory (DCT) (1971). DCT postulates that humans have a multimodal system of memory, one, a largely unconscious memory that perceives and stores those sensorimotor stimuli as memories called *imagen* . At some point some of those perceptions change into parallel memories of verbal/symbolic representations which can be consciously recalled and these are stored as abstractions or *logogen.* It is clear that animals and preverbal infant humans (as well as fully functioning adult humans) process stimuli and have *imagen* memories of events. Humans, however, are the only species that seem compelled to store these symbolically as language or *logogen.* Much of Paivio's research focuses on the phenomena that words can evoke memory for image and vise versa, that image can evoke words. His work differs from much of the research in associative memory theory because of his multimodal approach and because he was interested in individual differences in memory for images and symbolic representations.

One of the ways that these individual differences was studied was by Paivio and Ernest (1971). In this experiment, high and low-spatial ability subjects were shown familiar pictures or geometric forms tatiscopically; that is, to the right-hemisphere or left-hemisphere visual fields for brief durations and then tested on their ability to recognize. Field was found to have no effect, but high-ability subjects were far superior to low-ability subjects in recognition of pictures presented to either field. In a review of 30 years of research into DCT, Paivio (1991) noted that this "is especially significant because it occurred despite the fact that the subjects indicated their recognition by naming the pictures, which is a verbal referential task that might be expected to favour the left hemisphere." The flaw in this research, (indeed in several others that Paivio cites), is that Paivio tests recognition memory by recalling words. He thereby misses unconscious recognition memories that have not been abstracted into conscious semantic memories and makes erroneous judgments about the superior performance of high-spatial ability subjects on recognition tasks. Could this phenomena, the conscious memory for semantic abstractions but the unconscious recognition of images, account for some of the discrepancy between sensate and intuitive learners in how well they do on standardized tests? This is the question that this study addresses.

In summary, it has been noted that some industrial education subspecialties are disproportionately filled with sensate or intuitive students. Sensate and intuitive students appear to achieve differently on standardized tests with intuitive subjects scoring as much as one standard deviation above sensate subjects. Over the course of one's life, performance on standardized tests has a profound affect on a student's placement in school, in career selection, on acceptance to a college program and on a variety of affective factors such as self-esteem and motivation. Achievement on standardized tests has been shown to be related to time and memory. Memory has been examined from a variety of perspectives, one of which tested high-spatial ability subjects against low-spatial ability subjects on a test of recognition, which required recalling semantic abstractions of images. Given the above, a study contrasting sensate and intuitive learners abilities to recall and recognize images may prove illuminating when one considers how problem solving capabilities differ particularly when time is a factor. The central question of this research is: Are there differences in two facets of memory, recognition and recall, in sensate and intuitive subjects when the time of exposure varies?

## Research Questions:

The following research questions represent the focus of this study:

1) Is there a significant difference between intuitive learners and sensate learners in their ability to recall images?

2) Is there a significant difference between intuitive learners and sensate learners in their ability to recognize images?

3) Are there significant differences between intuitive learners and sensate learners exposed to images for 8 hours when compared to those exposed for 12 hours in their ability to recall images?

4) Are there significant differences between intuitive learners and sensate learners exposed to images for 8 hours when compared to those exposed for 12 hours in their ability to recognize images?

## Procedures

The study proceeded in the following manner: A computer search was conducted for the prior 30 years of research in the literature of testing, memory and problem solving. The literature was analyzed and a literature review written.

### Instruments

A pilot form of the questionnaire was developed at the University of Nebraska in 1984. A pilot test of this instrument was conducted in April of 1984 on 34 graduate students in an educational psychology class at the University of Nebraska. Feedback from the pilot testing indicated that a rating scale to show how certain the respondent was about the recognition would be useful. This scale was included on the revised instrument and images from the procedures below incorporated as well.

The other instrument, the Myers-Briggs Type Indicator (MBTI), was selected as a measure of abstraction/concreteness of subjects. The MBTI is a self-report inventory widely used in counseling, ministerial, occupational and educational settings. The manual reports that test-retest reliabilities range from .75 to .85 across 10 recent reliability studies (Myers, 1985, P. 23-25). Validity of the instrument has been demonstrated in several ways. The manual reports numerous studies undertaken to demonstrate instrument validity under three broad categories of questions: 1) Do MBTI continuous scores correlate in the expected directions with other instruments that appear to be tapping the same constructs?; 2) Is there evidence that the behavior of the MBTI types is consistent with behavior predicted by theory?; and 3) What can knowledge of type differences contribute to understanding of other issues of importance to psychology? The evidence is pursuasive that MBTI scores measure to some substantive degree the attributes that it purports to measure. Additionally, the Center for Application for Psychological Type maintains a database of over one million MBTI subjects from a host of occupational, academic and avocational communities and the distributions of "types" within these communities stand as a profound testament to the validity of the scores for the MBTI at least with regards to occupational and educational choice (Macdaid, G.P., McCaulley, M.H., & Kainz, R.I., 1986).

Subjects

The Elementary Summer Technology Training Institute provided 205 volunteers to participate in the study. The subjects were elementary school technology teachers in Southern California. Because of attrition, absences, or unusable forms, only 158 subjects were used in the study.

Methods

Nine images were developed so that there would be three images from three categories of images: men's faces, animal faces, and letters of the alphabet. The audio/visual department at California State University at San Bernardino created the images and printed nine equal-sized posters using three of these images, one from each category. These nine posters were hung in the student cafeteria for three (first summer session) or four (second summer session) consecutive days. On these days, the subjects ate breakfast, lunch and supper in these facilities. This was the only eating facility nearby. It is unlikely that subjects ate elsewhere. The nine pictures were three copies of one of the human faces, three copies of one of the animal faces and three copies of the letter "O". Those in the three-day exposure period meant that the subjects were exposed to the images for about 8 hours. Those in the four day period were exposed for about 12 hours. There was no explanation was given for the images being on display and no attention was drawn to them by any of the workshop presenters or the lunch room staff. Undoubtably, some workshop participants did not notice the images at all, which reduces the likelihood of a significant result.

During the first week of each of the four week long summer session, the MBTI was administered to the subjects. The subjects were told that there was some indication that the style of computer use might be related to personality and that this use of personality attributes was an attempt to discover some of the factors relating to this style. Scoring of the Myers Briggs Type Indicator revealed that there were approximately equal numbers of intuitive and sensate subjects in the two groups.

After the images had been removed from the cafeteria for two weeks, the one page questionnaire was administered to 80 subjects in the first summer session and 78 subjects in the second summer session. After the questionnaire had been completed, subjects were given the results of the MBTI and debriefed as to the true nature of the study. Data were analyzed as a two factor ANOVA with two dependent variables using SPSS.

## Results

The purpose of the study was to determine if there were differences between sensate and intuitive learners in their capacity to recall and recognize images given two different times of exposure. The results are organized by the research questions presented above..

## Research questions:

1) Is there a significant difference between intuitive and sensate learners in their ability to recall images?

No significant differences were found between intuitive and sensate learners in their ability to recall images when the time of exposure factor is removed.

2) Is there a significant difference between intuitive and sensate learners in their ability to recognize images?

No significant differences were found between intuitive and sensate learners in their ability to recall images when the time of exposure factor is removed.

3) Are there significant differences between intuitive and sensate learners exposed to images for 8 hours when compared to those exposed for 12 hours in their ability to recall images?

Significant differences were found between intuitive and sensate learners exposed to 8 hours when compared to those exposed for 12 hours in terms of their ability to recall. More important was the significant interaction between learner type and exposure time. To assess the implications of the interaction, a simple effects analysis was conducted. After 12 hours of exposure, intuitive subjects were not significantly better than intuitive subjects exposed for eight hours at recalling images. After 12 hours of exposure, sensate subjects were significantly better than the sensates exposed to images for 8 hours at recall of images. In other words, sensate subjects took significantly longer to encode their observations as abstractions than intuitive subjects. These findings are shown below in Table 1 and in Figure 1. Here the F test revealed that there were significant differences in recognition across the 8 and 12 hour groups of sensate subjects while there were no significant simple effects for the intuitive group across time.

Table 1

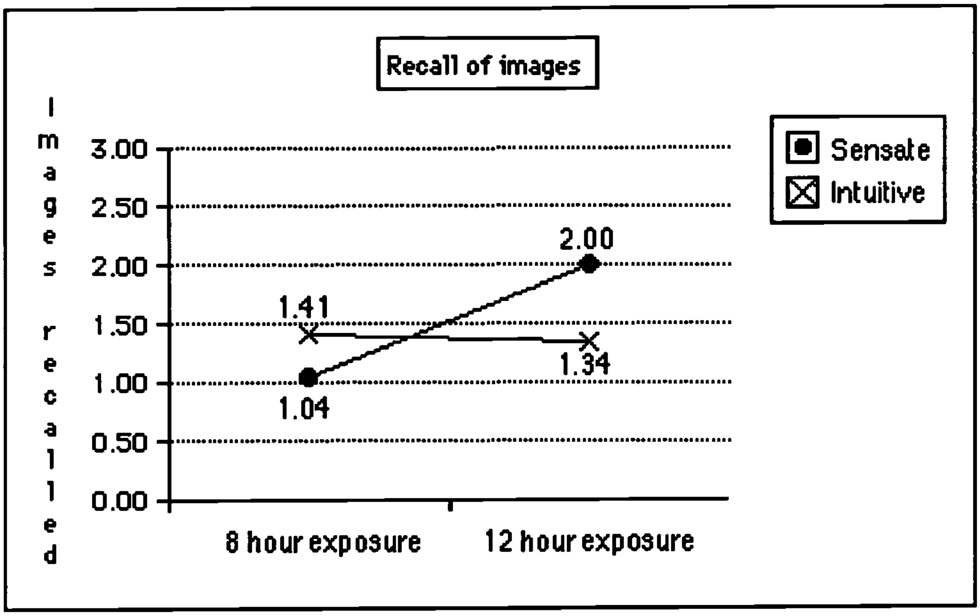
Test of Significance for Recall among Intuitive and Sensate Subjects over 8 and 12 Hours of Exposure to Images Using UNIQUE Sums of Squares

| Sources of Variation | SS | DF | Sig of F |
|---|---|---|---|
| Within cells | 209.87 | 154 | |
| Exptime | 7.47 | 1 | .020* |
| NvsS | .75 | 1 | .459 |
| Exptime by NvsS | 9.99 | 1 | .008** |
| (Total) | 227.47 | 157 | |

Effect Size Measures

| Source of Variation | Partial ETA Sqd. |
|---|---|
| Exptime | .034 |
| NvsS | .004 |
| Exptime by NvsS | .045 |

Figure 1




4) Are there significant differences between intuitive learners and sensate learners exposed to images for 8 hours when compared to those exposed for 12 hours in their ability to recognize images?

Significant differences were found between intuitive and sensate learners exposed to 8 hours when compared to those exposed for 12 hours in terms of their ability to recognize as shown in Table 2 below. Following up the significant interaction effects, simple effects were analyzed. After 12 hours of exposure, intuitive subjects were not significantly better than intuitive learners exposed for eight hours at recognizing images and the same is true of concrete subjects. After 12 hours of exposure, concrete learners were not significantly better than the sensates exposed to images for 8 hours at recognizing images.

Table 2

Test of Significance for Recognition among Intuitive and Sensate Subjects over 8 and 12 Hours of Exposure to Images Using UNIQUE Sums of Squares

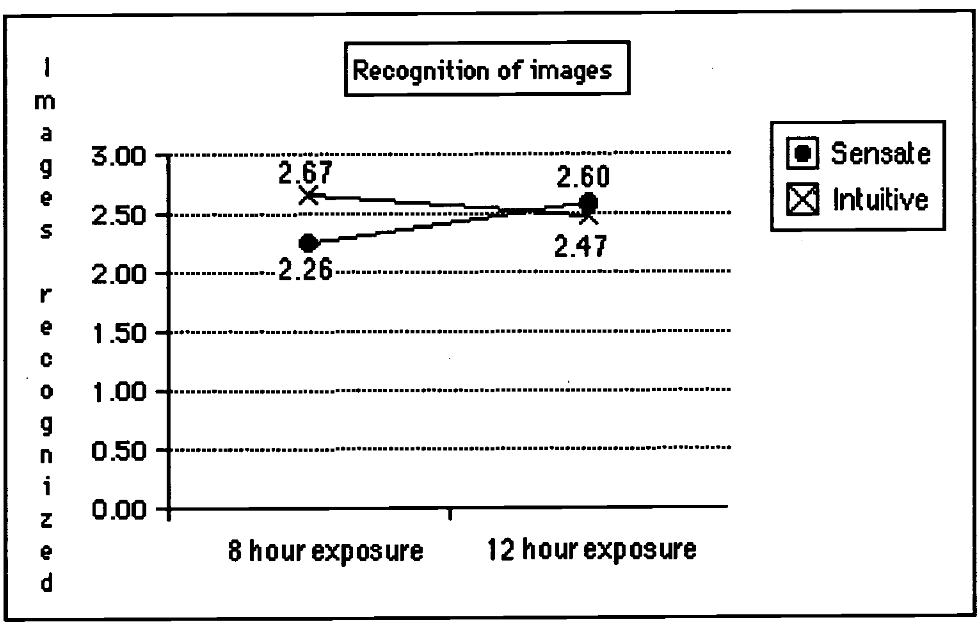
| Sources of Variation | SS | DF | Sig of F |
|---|---|---|---|
| Exptime | .19 | 1 | .568 |
| NvsS | .77 | 1 | .255 |
| Exptime by NvsS | 2.62 | 1 | .036* |
| Within cells | 90.11 | 154 | |

| | | |
|---|---|---|
| (Total) | 227.47 | 157 |

Effect Size Measures

| Source of Variation | ETA | Partial Sqd. |
|---|---|---|
| Exptime | | .002 |
| NvsS | | .008 |
| Exptime by NvsS | | .028 |

On the other hand, Figure 2 above shows that although the same comparison for recognition may have been significant, the differences between 8 and 12 hours of exposure were less substantive than they were for recall. Figure 2 also reveals that after 8 hours of exposure, intuitive subjects recognized an average of 2.67 images while sensate subjects recognized 2.26 images. After 12 hours of exposure, however sensate subjects recognized 2.60 images on average while intuitives recognized an average of 2.47 images. Table 2 reports that this difference was a significant one with an F of 4.48 and p<.036.



## Conclusions

In summary, sensate subjects recognized the same number of images as intuitive subjects regardless of whether they were exposed to those images for 8 or 12 hours. On the other hand, sensate subjects were not able to recall as many images as intuitives after 8 hours of exposure to those images, but they were able to recall the same number of images as intuitives after 12 hours of exposure.

Do sensate people need more time on task in order to recall and recognize than intuitive people? This study seems to suggest that this is true. Does it follow that sensate test takers may do less well on timed paper-and-pencil exams than intuitives because of this phenomena? Perhaps. Why this phenomena occurs, however, is certainly unclear.

Another interesting phenomena observed in this study, was the modest drop in achievement levels for both recall and recognition among intuitives who endured the longer exposure times. Could intuitives abstract events sooner than sensates and then given further stimulus, reexposure to the images, merely use that stimuli as a trigger to memory rather than a further imput of stimuli features? If this is the case, then perhaps the errors created during reconstructive nature of schematic memory accounts for this modest decline.

The whole notion of the traits "intuition" and "sensation" might simply be a reflection of how much "hard data" (real sensory input) is required by the learner before abstraction occurs. This brings to mind Rosch's (1975) experiments with prototypicality. How much data do we need from a stop sign before we know to stop? Must it be red, octagonal, outlined in white, with the white letters spelling STOP clearly in view or is the octagonal shape of the sign in the right location enough to get people to stop? I suspect, given the results of this experiment, we might find sensate drivers needing more concrete information from the sign than intuitives to elicit the same stopping behavior. Or perhaps we might find that intuitives make quicker and more error-ridden mistakes about what constituted a stop sign. (Moates & Schumaker, 1980)

Off of the highway and back in the shop, one wonders if the acutely empirical world of "shop" aids sensate students in absorbing enough sensory details so that they can solve problems more easily? What happens to the sensate student's level of achievement on paper-and-pencil problem solving tasks when the student learns how to solve the academic problem in a physical way in addition to the paper-and-pencil manner? As the integrated learning partnerships that are occurring in our best schools apply math, science and language skills in the real world experiences of the Industrial Education labs, these will be important and interesting questions to answer.

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