The Search for the Elusive "Spidey Sense"

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ABSTRACT

The military has been interested in the so-called "spidey sense" or intuition for at least 200 years. In his classic treatise "On War," von Clausewitz (first published in 1832) spoke of intuition and its importance in decision making in tactical situations. Recently, studying and identifying characteristics of intuitive behavior has become popular because having and using this "spidey sense" could be advantageous for identifying threatening situations. To study the behavior, we must first define it. A widely accepted definition is that intuition is a subconscious preliminary perception of a pattern or meaning, most commonly experienced as a gut feeling that biases thoughts and decisions (Volz & von Cramon, 2006). Researchers have studied intuition from many perspectives. Some researchers are looking for behavioral indicators of intuition to test intuitive decision making abilities (Frederick, 2002; Bowers, Regeher, & Balthazard, 1990). Other researchers use self-report inventories to assess preference for using intuition (Pacini & Epstein, 1999; Betsch, 2008). A weakness of this work is the lack of integration between these various methods of assessing intuition. In this study, we combine the behavioral and preference measures of intuition along with individual differences measures (i.e., working memory capacity task, personality inventory, and a test of observation and clear thinking) to examine characteristics of people who display intuitive behaviors. Intuitive individuals in our study performed better on the test of observation and clear thinking, had a lower degree of "agreeableness" as a personality characteristic, and indicated that they were more rational when making decisions. While this is a preliminary investigation into capturing the essence of "spidey sense," these results help us to understand the underlying characteristics of intuition and more investigation into this topic may help us to train our war fighters to sense when danger is lurking.

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INTRODUCTION

The military's interest in a so-called "spidey sense" or intuition is not new. For example, in his classic treatise "On War," Carl von Clausewitz (first published in 1832) spoke of intuition and its importance in decision making in tactical situations. Von Clausewitz stated "The man responsible for evaluating the whole must bring to his task the quality of intuition that perceives the truth at every point." (von Clausewitz, 1976, p.59). More recently, an article in the New York Times spoke about Sergeant First Class Edward Tierney and his heroic hunch that saved his nine person team on patrol in Mosul, Iraq (Carey, 2009). It was a hot day in 2004 and the patrol came across a car with its windows tightly closed containing two young boys. One of the soldiers wanted to give the boys water, but Sgt. Tierney suddenly got a strong sense of danger, refused the request, and ordered his men to retreat. Moments later, the bomb exploded.

There are many examples and anecdotal accounts of the use of intuition in the military as well as in other real-world situations. It is apparent that intuition is valuable in making quick decisions. Recently, studying and identifying characteristics of intuitive behavior has become popular because having and using this "spidey sense" could be advantageous for identifying a threatening situation. In order to study intuition, we must first define it. Many definitions exist, but, for this paper, we are defining intuition as a subconscious preliminary perception of a pattern or meaning, most commonly experienced as a gut feeling that biases thoughts and decisions (Volz & von Cramon, 2006).

Researchers have studied intuition from many perspectives. Some researchers have looked for behavioral indicators of intuition to test intuitive decision making abilities. Of these researchers, one perspective is to look at negative consequences of intuition (making the wrong decision because it seemed to be the intuitive choice). For example, Frederick (2002) looked at these negative consequences in regards to problem solving questions like the following: A bat and a ball together cost $1.10. The bat costs $1 more than the ball. How much is the ball? Many people think the answer is $0.10 because it is their gut reaction to the question. However, the correct answer is $0.05, which most people discover after further analysis. Those who answer the problem with $0.10 are evaluated as using intuitive processing to solve the problem.

Studies have also looked at the positive perspective of decision making, by looking at how and when intuition assists individuals in making the correct decision. For Instance, Bowers, Regeher, and Balthazard (1990) developed two tasks that examined intuition. One task used words and the other task used pictures. In both cases, participant responses were classified as intuitive when, given ambiguous information, they were able to correctly sense the presence of an underlying pattern without being able to explicitly identify that pattern. In other words, they could identify that the picture is an object but cannot name the object, or they are able to determine that a group of words such as "goat, pass, green" have something in common, but they are unable to identify the solution ("mountain").

Other researchers use self-report inventories to assess preference for using intuition. One inventory used is the Rational Experiential Inventory (REI; Pacini & Epstein, 1999). The REI asks individuals to assess the way they make decisions by ranking their agreement with statements like "I hardly ever go wrong when I listen to my deepest gut feelings to find an answer" and "I often go by my instincts when deciding on a course of action." Another example is the Preference for Intuition and Deliberation scale (PID; Betsch, 2008). Like the REI, the PID asks individuals to rank their agreement with statements regarding their decision making preference (e.g. "Before making decisions I first think them through" and "I listen carefully to my deepest feelings"). Both the REI and the PID rank individuals on their preferences to use intuitive or analytic processes for making decisions.

While there have been many studies on intuition that look at it from different perspectives, there has been a lack of integration between the different methods. In this study, we combine the behavioral and preference measures of intuition along with individual differences measures (i.e., working memory capacity task, a personality inventory, and a test of observation and clear thinking) to examine characteristics of people who display intuitive behaviors. Combining these measures into a single study allows us to test the validity of the self-report inventories and will assist in determining if there are individual differences or cognitive skills related to intuition. These measures were chosen because of their use in past research (behavioral and preference measures) and because we hypothesize that intuition requires a great deal of mental processing as does working memory and observation. Combining these measures into one study allows us to analyze these measures together to determine if preferences are actually linked to behaviors and to see if the cognitive measures are related to behaviors as well. The more we know about intuition, the more we can leverage this knowledge for improving intuitive, and possibly lifesaving, decisions in the field.

METHOD

Participants

A total of 173 participants completed the study. Participants were students from local universities and were given extra credit for their participation. The participants consisted of 74 males and 93 females (six participants did not identify their gender). Their ages ranged from 18 to 48 years, with an average age of 22 years.

Materials

Most of the study was completed using paper and pencil. Power point slides were presented on an overhead projector to display two of the tasks. The lights were dimmed to prevent glare and the projections were displayed on a standard classroom screen.

Procedure

To start, participants reviewed an informed consent document. This was followed by eight surveys and tasks that assessed behavioral indicators of intuition (positive and negative), subjective assessments of intuition, measures of cognitive skills, and a few individual differences measures. A summary of the measures used in this study are given below.

Behavioral Assessments of Intuition
1. The Waterloo Gestalt Closure Task
2. Decision Making Scenarios

Subjective Assessments of Intuition (Surveys)
3. The Preference for Intuition and Deliberation
4. Rational-Experiential Inventory

Cognitive Skills Tests
5. Raven Progressive Matrices
6. Lag Task

Individual Differences Questionnaires
7. Demographics questionnaire
8. The Big Five Inventory

Behavioral Assessments of Intuition

Two behavioral measures of intuition were included in this study. To link our study back to past research, we included both positive and negative assessments of intuition. We used the Waterloo Gestalt Closure Task as the positive behavioral measure of intuition because we expected intuition to assist participants with the task. The Waterloo Gestalt Closure task used in this study was created using a subset of stimuli created by Luu et al. (2010). In this task, participants were presented with either a distorted object or random lines on power point slides that

were projected onto a classroom screen. There were 100 of these images and the images appeared on the screen for three seconds each. After each image was presented, participants were asked to indicate if the image contained an object and to then name the object if they were able to identify it. Participants were told to go with their gut feeling because time to make a decision was limited. The identity of the distorted objects is not meant to be obvious from a quick glance and that is why the task is a good behavioral measure of intuition. Figure 1 shows two images from the task (an object and a non-object).

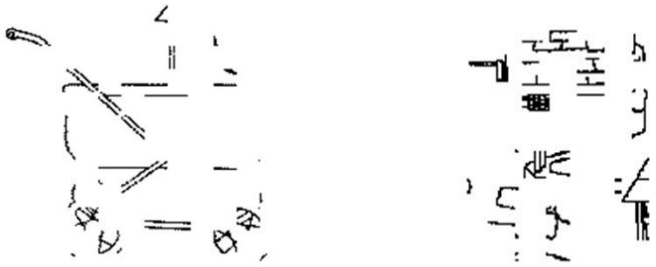

Figure 1. An object (pram/baby carriage) and a non-object from the Waterloo Gestalt Closure Task.

To assess the negative effects of intuition, we wrote five scenarios for participants to read and give their reactions to. Each scenario laid out a sequence of events along with another sequence that would have the same effect, but had some differences in details (e.g. you miss a flight by 5 minutes versus missing it by 30 mins). After each scenario was presented, participants were asked which of the two options would be worse. The scenarios were used to assess whether the participants were thinking intuitively (picking an option that seemed worse) or rationally (saying that the two sequences are equal in effect). This task was classified as a negative effect of intuition because the intuitive answer was the incorrect answer. An example of one of the scenarios follows.

> You are scheduled to leave on a 5pm flight out of MCO. On your way to the airport you are caught in a traffic jam and arrive at the airport after your scheduled departure time. When you get to your departure gate the agent tells you that you missed your flight by 30 minutes. Now imagine the same scenario except this time the gate agent tells you that your flight was delayed and you missed your flight by 5 minutes. In both scenarios you had dawdled for 10 minutes before leaving home.
>
> In which scenario do you feel like your dawdling was more foolish?

Subjective Assessments of Intuition (Surveys)

Two subjective assessments of the individual's preference for using intuitive processes, from previous research, were used: The Preference for Intuition and Deliberation (PID) from Betsch (2008) and the Rational Experiential Inverntory (REI) from Paccini and Epstein (1999). As mentioned earlier, both surveys ask participants to rate the degree to which they prefer to use their intuition or gut reaction (called experiential decision making on the REI) or deliberation (called rational decision making on the REI) when making decisions. Both surveys used a five point Likert scale for ranking agreement to the statements that assess preferences. The REI was comprised of 40 statements and the PID had 18 statements.

Cognitive Skills Tests

The Raven Progressive Matrices (sets A, B, C, D & E), a standardized assessment of "observation and clear thinking," was administered as a test of non-verbal reasoning and cognitive skill (Raven, 1998). Each of the five test sets contains twelve problems (a total of 60 problems). The problems contain a pattern with a missing piece. Participants must select the pattern from several choices that fits in the empty spot. The patterns start off easy and become more difficult as they progress through the test. Two example problems are given in Figure 2. The Raven test assesses participant's ability to recognize patterns, a cognitive skill that could be linked to intuitive behavior.

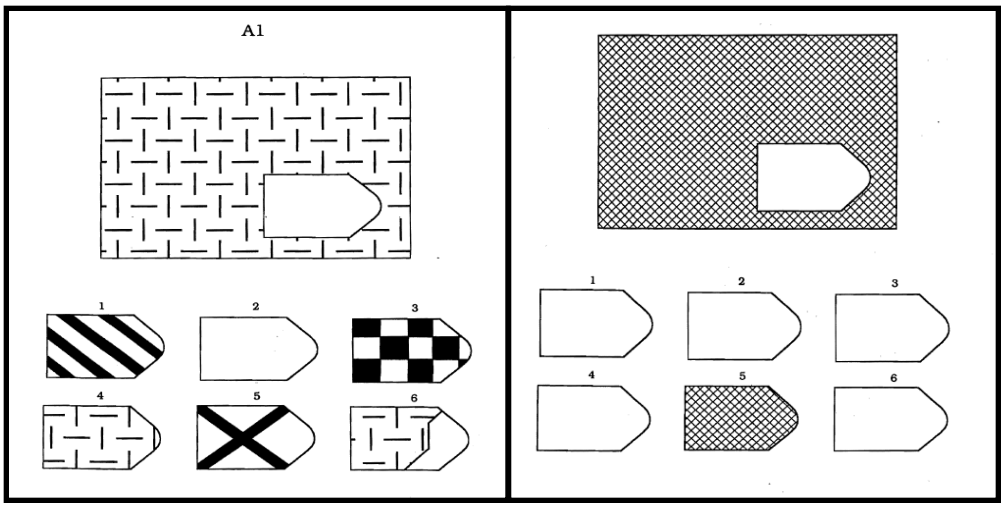

Figure 2. Two easy problems from the Raven Progressive Matrices.

A lag task, or n-back task, was used to assess working memory. The lag task developed for this study was based on the task described in Shelton, Metzger and Elliott (2007) and used the words from Appendix B (common words in the English language that are 4-5 letters long). Participants were presented with a list of words that appeared on the screen one at a time for one second each. The lists were of varying length and participants were asked to remember the words in order. At the end of the list, participants were asked to recall either lag 0 (last word they saw), 1(one before the last word), or 2 (two before the last word). A total of 24 lists were presented. The lag task is another cognitive measure included in this study to determine if cognitive skills may be related to intuitive performance.

Individual Differences Questionnaires

In addition to the intuitive and cognitive measures, the study also included two individual differences assessments. The first was a demographics questionnaire that asked for descriptive data about each participant including gender, age, GPA, SAT/ACT scores, and level of education. The second was the 44-question version of the Big Five Inventory (BFI), which assesses personality traits (John, Donahue & Kentle, 1991). The BFI evaluates five trait dimensions: extroversion versus introversion, agreeableness versus antagonism, conscientiousness versus lack of direction, neuroticism versus emotional stability, and openness versus closedness to experience. These measures were included to assess whether personal characteristics may be related to intuition.

Scoring/Coding

In order to run analyses on the data from this study, scoring and coding of some of the measures had to be completed. For the Waterloo Gestalt Closure Task, a five part coding scheme was created to categorize participant responses. Responses were coded as either 1. Recognition of the object, 2. Intuition that the image contained an object (saying the image contained an object when it did, but not being able to name the object), 3. A false alarm (thinking there was an object in the image when there was not), 4. A non-object hit (indicating that the image did not contain an object and being correct), or 5. An object miss (thinking there was not an object in the image when there was an object). A summary of the categorization is shown in Table 1.

Table 1. Categorization of responses for the Waterloo Gestalt Closure Task.

	Is it an Object?		**Object Named?**
Participant Answer	**YES**	**NO**	**YES**
YES	Intuition (object not named)	False Alarm	Recognition/Hit
NO	Object Miss	Non Object Hit	N/A

Responses for the Decision Making Scenarios were simply categorized as being intuitive or rational. If a participant picked one of the options as being worse than another, the response was coded as an intuitive response. If a

participant indicated that neither option was worse than the other (that they had an equal effect), the response was coded as rational.

Standard scoring was used for the Preference for Intuition and Deliberation and the Rational-Experiential Inventory. The PID gave a preference score for Intuition and a preference score for Deliberation for each participant. The REI yielded a preference score for Rational and for Experiential decision making.

Standardized scoring was also used for the Raven Progressive Matrices. Each participant was given a score that indicated the number of items they correctly answered. The Lag Task was also scored by summing the number of correct responses.

The Big Five Inventory was scored according to John, Donahue and Kentle (1991). Participant data yielded one score each for extroversion, agreeableness, conscientiousness, neuroticism, and openness.

RESULTS

To start, we assessed the validity of the self-report measures. To do this, we first looked at how the measures related to each other using a Pearson's Correlation. We found a significant positive correlation between the Rational score on the REI and the Deliberation score on the PID ($r = .44$, $p < 0.001$). Additionally, there was a significant positive correlation between the Experiential score on the REI and the score for Intuition on the PID ($r = 0.55$, $p < 0.001$). However, these measures were not related to the positive measure of intuitive behavior (Waterloo Gestalt Closure Task) in a predictable way. Neither intuition nor experiential decision making preferences were related to intuitive behavior. There was one significant relationship between the closure task and the REI, which will be discussed below.

Next, we wanted to assess whether certain cognitive abilities and individual differences are related to intuitive behaviors. For this paper, we focused on the positive behavioral measure of intuition (Waterloo Gestalt Closure Task). There are many ways to analyze the data from the closure task. When looking at our definition of intuition (a subconscious preliminary perception of a pattern or meaning, most commonly experienced as a gut feeling that biases thoughts and decisions), it seems unfair to exclude "recognitions" and "non-object hits" when assessing intuitive performance. Since the task gave three seconds of observation time, it is possible that these responses started out as an intuition and turned into recognition. On the other hand, misses and false alarms are more clearly an indicator of a lack of intuition because they were errors. False alarm and misses in a war time situation could be the difference between life and death. If a soldier/warfighter misses a target, he could endanger himself and others and if he has a false alarm, an innocent bystander could be killed. Therefore, we will look at the amount of times people make these mistakes in our assessment of individual differences in intuitive behavior. The two measures were summed into one number for our analyses (number of misses + number of false alarms).

We performed a median split to compare participants with a high number and participants with a low number of object misses and false alarms on the Waterloo Gestalt Closure Task. We performed this split so that we could compare the performance of the two groups on the other measures to see if those who performed better on the behavioral measure also performed higher on other measures. The median number of misses and false alarms we used for the split was 18. The group that had a lower number of misses and false alarms had between 6 and 17. Eighty-two participants were in this low group. The group that had a higher number of misses and false alarms had between 18 and 46 misses and false alarms. Eighty-seven participants were in this high group. As a manipulation check we ran a t-test comparing the number of misses and false alarms between the high and low groups and the difference was significant, as expected ($t = -13.44$, $p < 0.001$). Next we ran t-tests to compare the two groups on our cognitive and individual difference measures. The tests revealed a significant difference between the high and low groups on the Raven Progressive Matrices score ($t = 3.28$, $p = 0.001$), on agreeableness on the Big Five Inventory ($t = -2.93$, $p = 0.004$), and on the rational score on the REI ($t = 2.4$, $p = 0.016$). Means and standard deviations for the two groups on these measures are given in Table 2. There were no significant differences between the two groups based on gender, age, SAT score, grade point average, lag score, intuition use on the decision scenarios, intuition or deliberation scores on the PID, experiential score on the REI, extraversion, conscientiousness, neuroticism, or openness.

Table 2. Means and Standard Deviations for the Low and High Groups on measures that were significantly difference between the two groups.

Measure	Group	Mean	Standard Deviation
Number of Misses and False Alarms on the Waterloo Gestalt Closure Task	Low # Misses and False Alarms	13.5	2.9
	High # Misses and False Alarms	22.4	5.3
Score on the Raven Progressive Matrices	Low # Misses and False Alarms	51.9	5.3
	High # Misses and False Alarms	48.9	6.8
Score on Agreeableness on the Big Five Inventory	Low # Misses and False Alarms	33.8	5.8
	High # Misses and False Alarms	36.1	4.5
Rational Score on the REI	Low # Misses and False Alarms	65.1	9.9
	High # Misses and False Alarms	61.3	9.9

DISCUSSION

In this experiment, we combined behavioral measures of intuition, self-assessment measures of preferences for using intuition, cognitive skills assessments, and individual difference measures to explore intuition more deeply. We showed that both the PID and REI similarly assess intuition/experiential preferences and rational/deliberate preferences and thus, this study lends additional validity to those measures on judging these participant preferences. However, these preferences did not relate to the behavioral measure of intuition in the predictable way. Participants who indicated that they preferred to be rational on the REI, were actually the ones who performed better on the behavioral measure of intuition. Preferences for using intuition or experience were not related to performance on the closure task. Therefore, these measures may be internally consistent, but they do not necessarily predict performance on intuitive tasks.

Participants who had less misses and false alarms on the Waterloo Gestalt Closure Task, our positive behavioral test of intuition, rated themselves as more likely to make rational decisions, scored higher on the Raven Progressive Matrices, and had a lower score on agreeableness than participants in the group with more mistakes. Individuals who said they prefer to make rational decisions on the REI performed better on this task possibly because the measure does not actually indicate performance over preference or it could very likely mean that rational decision making is still needed in intuitive tasks. As we hypothesized, participants who made fewer mistakes on our intuitive task also scored higher on the Raven Progressive Matrices. This indicates that observation and pattern recognition may be essential for making intuitive and correct decisions. Additionally, our results indicated that individuals who tend to be more agreeable and less antagonistic, made more mistakes on the behavioral intuition task.

Therefore, individuals who were more intuitive in our study performed better on the test of observation and clear thinking, were less agreeable, and reported that they preferred to make decisions in a rational manner. While this is a preliminary investigation into capturing the essence of "spidey sense," these results help us to understand the underlying characteristics of intuition and more investigation into this topic may help us to train our war fighters to

sense when danger is lurking. Additionally, a better understanding of individual variability in intuitive processing may assist with selection decisions for positions that would benefit from intuitive decision making (e.g. surveillance, IED detection, etc.).

Future Work

Additional research needs to be done to explore intuitive behavior. For example, there have been some researchers studying the psychophysiological aspects of intuition (Volz & von Cramon, 2006) and it would be interesting to combine this work with our combination of measures. Additionally, including more cognitive and individual difference measures would help us to gain more insight into intuitive behavior (e.g., vigilance, Myers Briggs Test). It would also be advantageous to include additional behavioral measures of intuition. In particular, a scenario based test of intuition would have more face validity and be more relatable to real-world use of intuition.

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DISCLOSURE

The views expressed herein are those of the authors and do not necessarily reflect the official position of the Department of Defense or its components.

REFERENCES

Betsch, C. (2008). Chronic Preferences for intuition and deliberation in decision making: Lessons learned about intuition from an individual differences approach. In Plessner, H. Betsch, C., & Betsch, T. (Eds.) *Intuition in Judgment and Decision Making.* New York, NY: Lawrence Erlbaum Associates.

Bowers, K., Regehr, G., Balthazard, C., & Parker, K. (1990). Intuition in the context of discovery. *Cognitive Psychology, 22,* 72–110.

Carey, B. (2009). In Battle, Hunches Prove to Be Valuable. *New York Times*. Retrieved from http://www.nytimes.com/2009/07/28/health/research/28brain.html?pagewanted=all&_r=0

Frederick, S. (2002). Automated choice heuristics. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 548–558). New York, NY: Cambridge University Press.

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory--Versions 4a and 54*. Berkeley, CA: University of California, Berkeley, Institute of Personality and Social Research.

Luu, P., Geyer, A., Fidopiastis, C., Campbell, G., Wheeler, T., Cohn, J., & Tucker, D. (2010). *Reentrant processing in intuitive perception*. PLoS ONE 5(3): e9523. doi:10.1371/journal.pone.0009523

Pacini, R., & Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Journal of Personality and Social Psychology, 76*, 972-987.

Raven, J. C. (1998). Standard Progressive Matrices. San Antonio, TX: Pearson.

Shelton, J. T., Metzger, R. L., & Elliott, E. M. (2007). A group-administered lag task as a measure of working memory. *Behavior Research Methods, 39 (3),* 482-493.

Volz, K.G. & Von Cramon, D.Y. (2006). What neuroscience can tell about intuitive processes in the context of perceptual discovery. *Journal of Cognitive Neuroscience, 18*, 2077-2087.

Von Clausewitz, C. (1976). *On War*. New York: Oxford University Press, Inc.