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The Accuracy of Self-Reported Intuitive and Analytical Ability

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Abstract

The current study aimed to establish whether individuals can accurately report their experiential (intuitive) and rational (analytical) processing abilities on the Rational-Experiential Inventory (REI) in relation to their performance on the Serial Reaction Time (SRT) and the Operation Span (Ospan) tasks. Previous research has indicated that the rational subscale may have predictive validity, but evidence of the predictive validity of the experiential subscale is mixed. To determine why previous researchers have struggled to establish this link, the current study introduced a manipulation of the knowledge of the psychological definition of intuition and its value in cognitive processing. The researcher hypothesized that the manipulation might have an impact on the correlations between self-reported intuitive ability and performance on the SRT, and that there would be a correlation between self-reported analytical ability and performance on the Ospan in both conditions. The results indicated that the relationship between self-reported rational favorability scores and Ospan performance was significantly higher in the control condition than it was in the experimental condition, but that all participants, regardless of condition, struggled with accurately reporting their intuitive ability. The implications for the use of self-report measures of intuitive and analytical ability are discussed.

The Accuracy of Self-Reported Intuitive and Analytical Ability

Psychologists often employ self-report measures to assess a variety of constructs ranging from personality and mood to preferences and abilities. In many situations, such measures are useful for evaluating a construct that would have otherwise been difficult for researchers to quantify. For example, it may be extremely difficult for a researcher to assess personality in a convenient, quantitative manner, without a self-report measure such as the NEO Big Five Personality Inventory (Costa & McCrae, 1992). One must wonder, however, whether such measures are accurate, as there may be limits to what individuals are consciously aware of or what they are willing to report (for a review of the accuracy of self-report measures in many different domains see *The Science of Self-Report*, 2000). In these situations, self-report measures would fall short of assessing their supposed constructs, and would therefore limit the external validity of studies that implement them.

Many researchers question the ability to utilize self-report measures to assess analytical and intuitive processing (e.g., Handley, Newstead, & Wright, 2000; Klaczynski, Gordon, & Fauth, 1997; Newstead, Handley, Harley, Wright, & Farelly, 2004). In particular, these researchers question whether individuals are able to report their intuitive thinking, due to its unconscious nature. It is the goal of the present study to expand upon previous research, particularly that of Pacini and Epstein (1999) in their creation of the new Rational-Experiential Inventory (REI), to determine whether individuals can accurately report their ability to utilize analytical and intuitive processing. More broadly, in the current study I test several hypotheses about why individuals might struggle with self-reporting these abilities.

Evidence for Two Modalities of Thinking

Many researchers agree that thought processing involves two parallel systems: (1) a conscious, analytical, effortful, logical, and slower system, and (2) a non-conscious, holistic, effortless, affective, associative, and faster system (e.g., Epstein, 1990, 2008; Newstead et al., 2004; Witteman, Bercken, Claes, & Godoy, 2009). Epstein (1990, 2008) called this parallel thought system the cognitive-experiential self-theory, or CEST model of human thought, and referred to the two systems, respectively, as *rational* and *experiential*. Other researchers refer to the two processes by other names: for example, Witteman and colleagues (2009) referred to the two branches as the conscious and automatic thinking modes, while Newstead and colleagues (2004) referred to them as System 1 and System 2 to encapsulate the different terminology used by other researchers. There are some researchers, however, who challenge the dual processes approach. For example, Osman (2004) proposed a single-system continuum of thought requiring differing levels of consciousness, ranging from implicit, to explicit, to automatic thinking, instead of the dualistic approach. Nevertheless, the dual process model is widely accepted within the field and supports a clear distinction between conscious and non-conscious thought.

FMRI data on neurological processing provides further evidence of the existence of, and distinction between, these two processing systems. In a study of self-knowledge, Lieberman, Jarcho, and Sapute (2004), found two different neurological systems: one for analytical, deliberate thought about what an individual was good at (the *C-System*) and another for intuitive, automatic thought about an individual's abilities (the *X-System*). The C-System, which is involved in effortful cognition, utilized the lateral prefrontal cortex, hippocampus, medial temporal lobe, and posterior parietal cortex, suggesting that participants were actively analyzing their previous memories about their strengths and weaknesses. Meanwhile, the X-system, which is involved in automatic cognition, utilized the ventromedial prefrontal cortex, nucleus accumbens, amygdala, and lateral temporal cortex, suggesting that participants were using a more affective thought process regarding their strengths and weaknesses. In another study, participants used the orbitofrontal cortex for intuitive judgments regarding the coherence of sounds on the correct trials, but not the incorrect trials (Volz, Rubsamen, & von Cramon, 2008). PET scan evidence also supports the notion that there are two separate neural processing centers for analytical and intuitive processing. Specifically, during analytical processing, participants utilized the anterior cingulate/medial prefrontal cortex, but not during intuitive processing (Destrebecqz et al., 2005). Overall, these neuroscience studies support the use of two distinct areas of the brain for analytical and intuitive processing; however, the exact brain regions associated with each of the processing systems have yet to be conclusively established.

Individual Differences in Intuitive and Analytical Processing

Before exploring whether or not people can accurately report their intuitive and analytical abilities, it is first essential to determine whether individual differences exist in these two modalities. In order to correlate self-report accuracy and task performance, individuals must differ in task performance. While many people are aware that individual differences exist in analytical processing (e.g., Unsworth & Engle, 2005b), less evidence of individual differences in intuitive processing has been produced (e.g., Kaufman et al., 2010). Nevertheless, previous research supports the notion that findings regarding both modalities exhibit sufficient variability to enable correlations with other self-report measures of ability (e.g., DeCaro, Thomas, & Beilock, 2008).

Psychologists often use intelligence tests to assess individual differences in analytical processing. For example, Unsworth and Engle (2005b) found a significant, moderate, positive correlation between working memory capacity on the Operation Span (Ospan) task and fluid intelligence on the Raven Advanced Progressive Matrices. Other researchers have found individual differences in other forms of analytical processing, such as deductive reasoning ability (Newstead et al., 2004), statistical judgment accuracy (Shiloh, Salton, & Shirabi, 2002), and success rate on rule-based categorization tasks (DeCaro et al., 2008). Overall, these individual differences in analytical processing make it possible to correlate analytical processing tasks with self-report measures of analytical processing, such as the REI (Epstein, Pacini, Denes-Raj, & Heier, 1996).

There is more controversy, however, as to whether or not individual differences exist for intuitive processing. Researchers, such as Reber (1989, 1992), have argued that individual differences in implicit, or intuitive, processing ability display much less variability between participants than explicit, or analytical, processing. In his research, Reber described the intuitive system as evolutionarily old and has having minimal individual differences. In fact, in his research he has failed to find a correlation between intuitive processing ability and IQ (Reber, Walkenfeld, & Hernstadt, 1991). However, recent research has found individual differences in intuitive processing ability. For example, a study by Szymura, Gruszka, Balas, and Zyla (2007) found that extraverts were more sensitive to unconscious influences in the form of negative subliminal messages during the presentation and assessment of an advertisement logo. The same study also found performance on an intuitive task, the Artificial Grammar task (Reber, 1967), to have a positive correlation with self-reported perseveration and a negative correlation with self-reported briskness. Another example of individual differences in intuitive processing involves evidence that convergent thinking, divergent thinking, and breaking frame abilities, all predict ability to solve insight problems independently (DeYoung, Flanders, & Peterson, 2008). By breaking frame abilities, DeYoung and colleagues (2008) examined a participant's ability to abandon an old rule that no longer works in order to begin to develop a new one. DeCaro and colleagues (2008) also detected individual differences in the ability to learn information-integration categorization rules, which requires an intuitive process. Participants' information-integration abilities were negatively related to their working memory capacity. Finally, implicit learning abilities were significantly correlated with self-reported intuition on the Myers-Briggs Type Indicator ($r = .25$, $p < .01$) and openness to experience ($r = .30$, $p < .01$; Kaufman et al., 2010). Overall, recent research suggests individual differences in intuitive processing abilities are detectable, and suggests that several aspects of self-reported personality are associated with intuitive task performance.

Self-Report Measures of Preferences for Intuitive and Analytical Processing

The emphasis of the current study is on the accuracy of self-reported intuitive and analytical abilities. Consequently, I utilized several measures to analyze the ways in which participants self-reported their abilities and to determine whether such abilities are related to specific personality traits. Specifically, I am interested in the ability of participants to report their preference for and ability to utilize the two processes on the REI. I also gave the participants other self-report measures to determine whether different measures of preference for intuition versus analysis, preference for different types of intuition, or different factors of personality are associated with increased accuracy to report intuitive and analytical abilities. Specifically, participants completed The Big Five Aspects Scale (BFAS; DeYoung, Quilty, & Peterson, 2007), the Types of Intuition Scale (TIntS; Pretz & Brookings, 2009), the Myers-Briggs Type Indicator (MBTI; Myers et al., 1998), and the REI (Pacini and Epstein, 1999).

The Rational-Experiential Inventory. The REI is the self-report measure that is central to the current research question. The REI assesses not only an individual’s preference for rationality and experientiality, but also an individual's self-reported ability to utilize each modality (Pacini & Epstein, 1999).

Several researchers have found individual differences on the preference aspects of both the experiential and rational portions of the scale. For example, Epstein and colleagues (1996) established that individuals often report a preference for one modality of thinking or the other. Witteman and colleagues (2009) furthered this research by establishing that not only do individuals report preferences for one modality of thought over another, but that they also utilized their preferred modality more often, especially when they are trying to learn new information. Furthermore, on the rational portion of the REI, researchers have found a clear distinction between the way participants report about their preference and ability on the two rational subscales (Brookings & Pretz, 2010; Handley et al., 2000; Pacini & Epstein, 1999). However, the same studies have found a lack of such distinction in the experientiality subscale. Overall, there seems to be a lack of consensus within the field as to whether the REI is a valid measure of rational and experiential ability, specifically in terms of each subscale's predictive validity.

Predictive Validity of REI Rationality. The REI appears to be a relatively accurate assessment of rational ability. Several studies have related task performance to reported rational ability on the REI. For example, participants' REI rationality scores significantly correlated with performance on a series of logic problems, vignettes, the jellybean task, and logical tasks in one study (Witteman et al., 2009). In the jellybean task, participants are given the choice to attempt to pick a red jellybean from either (1) a tray containing 9 white jellybeans and 1 red jellybean, or (2) a tray containing 100 jellybeans in which all were white except for 10, 9, or 7 red jellybeans. Pacini and Epstein (1999) also used this jellybean task in their initial assessment of the revised

REI scale. In this study, individuals who reported high rational ability provided fewer non-optimal, or lower ratio, responses in the jellybean task, in comparison to their low rational ability counterparts. Furthermore, rationality scores positively correlated with the statistical accuracy of numerical judgments (Shiloh et al., 2002). An additional testament to the ability of participants to report accurately their rational abilities is the clear distinction between the preference and ability subscale scores on the REI rational measure (Pacini & Epstein, 1999). This distinction suggests that individuals are able to consider separately whether they prefer to use analysis and whether or not they are good at analytical thinking.

There are analytical constructs, however, that do not correlate with REI rational scores. Specifically, it appears as though REI rational scores are not associated with increased performance in deductive reasoning tasks causing Newstead and colleagues (2004) to state that their research "poses a question mark over the use of self-report measures of cognitive style such as the REI" (p. 56). It also appears that rationality scores do not correlate significantly with verbal or inductive ability, as assessed by an aptitude test (Klaczynski et al., 1997). Overall, it appears as though the REI rational scale may assess something different from general intelligence and deductive reasoning, yet it does assess many other forms of analytical thought, such as the accuracy of statistical judgments and logic problem solving ability. Because there is a clear distinction between the preference and ability subscales and because there is a correlation with many types of task performance, it appears that, in general, participants are accurate at reporting their analytical abilities and preferences on the REI rational subscale.

Predictive Validity of REI Experiential. Results regarding the accuracy of the REI experiential scale are less consistent than they are for the rational subscale. Some studies have found the experiential scale to have predictive validity, but others have not. Witteman and colleagues (2009) found the experiential scale to be indicative of the manner in which participants complete a task. While they did not find experiential scores to be associated with accuracy on any particular task, they did find that participants with higher experiential scores took less time to solve a vignette problem. These results suggest that reported preference for intuitive thinking may correlate with the process chosen to employ in problem solving. Experiential processing scores have also been associated with increased evidence of biases in decision-making (Klaczynski et al., 1997). This finding suggests that individuals are using their preferred thought process because, by definition, intuition relies upon mental associations, or shortcuts. Shiloh and colleagues (2002) found similar results in their study in which participants who reported having more faith in intuition (or higher experiential scores) on an older version of the REI made more heuristic judgments than participants who reported having less faith in intuition (or lower experiential scores). Based on these results, individuals may be good at reporting their preferences for intuition on the new REI experiential scale. This is evidenced by the way past research has found participants' self-reported preferences for intuitive thinking to be associated with faster, and more heuristic-based thinking. There is, however, more to the REI experiential scale than whether or not participants prefer to use rapid, associative thinking; for example, the scale often asks a participant about their preferences for and use of "intuition" specifically.

The problem with the REI experiential scale appears to lie in its capacity to measure an individual's ability to utilize the experiential processing system. As previously mentioned, the distinction between preference and ability is not clear on the REI experiential subscales (Pacini & Epstein, 1999; Handley et al., 2000). Very few researchers have analyzed the associations between the experiential ability subscale specifically and intuitive tasks. However, researchers in one recent study found no significant correlations between performance on two implicit tasks, the Artificial Grammar (AG) and Serial Reaction Time (SRT) tasks, and REI experiential ability scores (Pretz, Totz, & Kaufman, 2010). Several hypotheses exist as to why there is a lack of correlation between reported intuitive processing ability and task performance, two of which are investigated herein: (1) a lack of understanding of the psychological construct of intuition and its usefulness and (2) a lack of metacognitive awareness of intuition.

Both Pacini and Epstein (1999) and Rogers and Wiseman (2006) provided support for the first of these two hypotheses – that participants lack a psychological understanding of intuition. In Pacini and Epstein’s study, there was no main effect for experientiality and the number of non-optimal responses made on the jellybean task. The researchers hypothesized that this relationship may be lacking because participants did not have access to objective information about the quality of their experiential ability, such as an IQ score for rational ability (p. 975). Rogers and Wiseman provided further support for this hypothesis. In their study, they asked individuals who claimed they were highly intuitive to describe their abilities. While many of the participants did describe their intuitions as a "gut-feeling" or non-conscious process, a quarter of the sample reported that their intuitions were a “sixth-sense” and another eight percent said that their intuitions were a “spiritual guide.” When asked to justify their claim of high intuitive ability, a large portion of the sample surmised that their expertise in intuition was due to their increased ability to predict the future or make snap judgments regarding the thoughts or personality of another individual at first meeting. Because their understanding relied so heavily on the social domain, it is apparent that studies that utilize tasks such as the proportions of jellybeans in a jar or the learning of artificial grammar sequences may not be measuring the same construct as a participant’s self-reported experiential ability on the REI. In particular, when individuals respond to REI questions about trusting one's intuitive hunches without a clear definition of these constructs, the individuals' responses may not coincide with the researchers' intended definition of intuition.

Furthermore, participants, particularly those from a Western sample, may lack an understanding of the benefits of intuition. Consequently, participants from such a sample show lower preferences for intuitive decision making in the workplace in comparison to an Eastern sample (Buchtel & Norenzayan, 2008). Lieberman (2000) pointed out that Western cultures see intuition "as mysterious and unexplainable at best and as something inaccurate, hokey, or epiphenomenal at worst" (p. 109). Overall, members of Western cultures are hesitant to trust their intuitions, and instead prefer to utilize analysis and other "verbalizable reasons" instead of relying on intuitive thinking (Dijksterhuis & Nordgren, 2006, p. 105). Consequently, it is possible that a lack of social desirability may affect an individual's self-reported preference for and abilities to utilize intuition.

The second hypothesis is that there may be a barrier of metacognitive awareness in the ability to report about intuitive processes. Specifically, Klaczynski and colleagues (1997) suggested that when participants take the REI, they must be able to think beyond their personal opinions on the two modalities and consciously assess when they used each form of processing and how accurate it was in each situation. Because this process is deliberative and conscious, it would seem to be an analytical thought process, and, therefore, would more often align with the assessment of rational thinking preference and ability and, thus, seemingly contradict the assessment of experiential thinking preference and ability. This idea of metacognitive awareness is directly linked to an older controversy within the cognitive psychology literature concerning whether individuals have introspective access to certain factors of their cognition. Specifically, Nisbett and Wilson (1977) supported the notion that there are some forms of thinking that do not lend themselves to introspection, particularly when a stimulus is covert.

In a recent study, participants were asked to introspect regarding the thought process they used to identify a pattern in the artificial grammar task (Dienes & Scott, 2005). The participants were given the options of memory, rules, intuition or guessing. The interesting aspect of this study is that individuals were equally likely to report using guessing and intuition. Furthermore, those who reported guessing and those who reported utilizing intuition did not score significantly differently from one another on task performance, yet both scored significantly above chance. These results suggest that participants reporting both strategies were utilizing unconscious, intuitive processing. In addition, there was no relationship between a participant's estimate of their accuracy, and their actual accuracy on the task for those in the guessing category. Consequently, it appears as though individuals are not aware that they are using automatic, intuitive processing, and, consequently, may not be able to report their experiential abilities on a self-report measure such as the REI due to this metacognitive block.

Cognitive Tasks Using Intuitive and Analytical Processes

Cognitive processing in each mode can be assessed using carefully devised tasks. Tasks involving implicit learning, such as Artificial Grammar (Reber, 1967) and Serial Reaction Time (Schvanevdeldt & Gomez, 1998), seem to rely heavily on implicit, intuitive processing (Shanks, 2005). In contrast, tasks used to assess working memory and intelligence are believed to rely on explicit, analytical processing (Witteman et al., 2009). For the purposes of the current study, I focus on the Serial Reaction Time (SRT) Learning Task and the Operation Span (Ospan) Task as representative tasks that engage the two processing modes. I chose these tasks because of the extensive research on each indicating they are valid assessments of their respective processing system and because there is evidence of individual differences in performance on each task.

The Serial Reaction Time Learning Task. In the current study, I used the probabilistic SRT learning task to measure intuitive processing ability. In this task, participants press keys on the keyboard to indicate the location of a dot on the computer screen. The dot location follows a complex probabilistic pattern, and evidence of learning is assessed by the difference in response times between the probable and improbable trials. Specifically, participants demonstrate faster response times on trials in which location follows the probable pattern, and slower response times on trials in which location follows the less probable pattern. While some researchers believe that the SRT involves explicit processing (Wilkinson & Shanks, 2004), most other researchers, notably Destrebecqz and Cleermans (2001), have found strong evidence that the SRT is a valid implicit learning task. In their study, the researchers countered the claims that it was possible to use explicit processing when completing the SRT learning task. The results of their study indicated that when there was no delay between a participant's response and the presentation of the subsequent stimulus, explicit understanding of the pattern was significantly reduced in comparison to trials where there was a delay. The researchers' findings indicated that removing the time between the trials prevented participants from being able to deliberate their responses analytically. Furthermore, this task does not overtly ask participants to find a pattern or to memorize any pieces of information. Because identifying a pattern or memorizing words would require an analytical process, the fact that the SRT does not promote the use of these processes makes it a more intuitive task. In addition, the probabilistic SRT also adds less probable control trials, occurring only 15% of the time, ensuring that participants are using intuitive versus analytical processing. This inclusion of improbable control trials encourages intuitive processing by more closely resembling a real world situation in which a person would rely on intuitive processing in that it is too complex to be solved using analysis (Jiménez & Vázquez, 2005). In two related studies of a similar task, researchers established that participants were unable to consciously identify such complex patterns regardless of the motivation, in the form of a monetary reward, or intellectual capacity of the participants (Lewicki, Czyzewska, & Hoffman, 1987; Lewicki, Hill, & Bizot, 1988). Consequently, it seems reasonable to suggest that the SRT is a valid measure of intuitive processing.

In addition, Kaufman and colleagues (2010) found the SRT to be a valid measure of implicit learning ability. Implicit learning ability is closely linked to intuitive ability, in that an intuition is usually seen as a manifestation of a notion that was learned through an implicit process (Reber, 1989, p. 233). Consequently, the SRT, which involves implicit learning, utilizes intuition, as on each item participants begin to anticipate where the dot will appear next. Furthermore, individual differences in implicit learning ability and, consequently, intuitive ability on the SRT makes the task appropriate to use in this study (Kaufman et al., 2010).

The Operation Span Task. This study used the Ospan Task as the analytical task. The Ospan is a working memory task that assesses the number of items that an individual can hold in his/her working memory while trying to solve several simple mathematical operations. This task has been found to consistently correlate with performance on higher order cognitive tasks, particularly those measuring fluid intelligence (Unsworth & Engle, 2005a; Unsworth & Engle, 2005b; Engle, Tuholski, Laughlin, & Conway, 1999). These researchers hypothesize that this connection may be due to a common link with executive function between higher order cognitive tasks and working memory. Because such measures of fluid intelligence assess "the ability to solve novel problems" and include tasks that require participants to analyze matrices and figures, it seems logical that the Ospan task, which is highly positively correlated with fluid intelligence assessments, will also be indicative of analytical processing ability (Engle et al., p. 313). Furthermore, researchers have found individual differences in performance on the Ospan (Unsworth, 2009). Each of these characteristics makes the automated Ospan a valid measure of analytical ability to use in the current study.

The Present Study

The current study aims to establish whether individuals can accurately report their intuitive and analytical processing abilities on the REI in relation to their performance on the SRT and the Ospan, respectively. A further goal is to determine why previous researchers have struggled to establish this link between self-reported intuitive ability and performance on intuitive tasks. To further understand this self-report difficulty, I manipulated a participants' knowledge of the psychological definition of intuition and its value in cognitive processing. In the experimental condition, participants received a psychological explanation of intuition and a statement of its utility in an attempt to determine whether the anticipated lack of an association with SRT performance and self-reported experiential scores is due to a lack of understanding of intuition or a metacognitive block. The control condition received no such explanation. Additional analyses were conducted to establish the existence of individual differences in intuitive and analytical processing. Finally, exploratory analyses were conducted to determine if accuracy of self-reported intuition is impacted by personality traits as assessed by the BFAS (DeYoung et al., 2007), a particular type of intuition as assessed by the TIntS (Pretz & Brookings, 2009), or with intuitive and analytical preferences as assessed the MBTI (Myers et al., 1998).

I hypothesized that there would be a correlation between reported analytical ability and performance on the Ospan in both the experimental and control conditions based on evidence that individuals can accurately report their analytical abilities (Pacini & Epstein, 1999; Witteman et al., 2009). Due to the evidence that individuals cannot accurately report their intuitive abilities, no correlation between self-reported intuitive ability and performance on the SRT was anticipated in the control condition (Pacini & Epstein, 1999). In the experimental condition, I posed two competing hypotheses: either (1) there would be increased accuracy of self-reported intuition among those receiving the manipulation, or (2) there would be no difference in the accuracy of self-reported intuition across experimental condition. If first of these competing hypotheses is supported, then the results would be evidence that the problem in self-report accuracy was due to a lack of understanding intuition and its usefulness (Dijksterhuis & Nordgren, 2006; Lieberman, 2000; Rogers & Wiseman, 2006). If the second competing hypothesis is true, then the results would support the lack of metacognitive awareness hypothesis (Klaczynski et al., 1997; Dienes & Scott, 2005).

Method

Participants

One hundred and fifty-six students from a small liberal arts college in the Midwest were recruited for the study. Students were randomly assigned to either the experimental condition or the control condition; there were 78 participants in each condition. I used two recruitment strategies. First, I recruited participants from the General Psychology classes via posting of the research opportunity on a campus website; these participants were compensated with class credit. Second, professors of other psychology classes verbally invited their students to participate; these participants were compensated with extra credit. Sixty-one of the participants recruited from the first recruitment method had previously provided consent for the researcher to obtain their ACT scores from the registrar.

Ninety-one females (58.3% of the sample) and sixty-three males (40.4% of the sample) participated in the study, and two participants (1.3% of the sample) chose not to disclose their gender. The age range of participants was 18 to 22 years (*M* = 18.98, *SD* = 0.98). In addition, based on concerns that different cultures value intuition and analysis differently, I investigated biculturalism on the demographic questionnaire by asking participants to indicate their ethnic background and whether English is the primary language spoken at home (Buchtel & Norenzayan, 2008; Nisbett & Miyamoto, 2005). The majority of the sample (89.7%) self-identified as White, non-Hispanics, and all except four participants (97.4%) reported English as their first language. Consequently, cross-cultural comparisons were not made due to an insufficient sample size.

Tasks

Serial Reaction Time (SRT) Learning Task. The version of the SRT learning task utilized in this study resembled that used in a study by Kaufman and colleagues (2010) on which there was no delay between a participant's response and the presentation of the subsequent stimulus. In their prior research, Kaufman and colleagues found the SRT to have acceptable split-half reliability. This computer-based task includes one practice block and eight training blocks. The practice block is merely for participants to learn the correct key-dot placement associations. The training blocks were utilized to obtain a participant’s score on the task. Each of these training blocks contains 120 stimuli for a total of 960 stimuli across the eight training blocks. In each of these blocks Sequence A, the sequence trials, were present 85% of the time, and Sequence B, the control or random trials, were present 15% of the time. The order of the trials within each block was originally randomized, but then each participant received the same fixed-order of the task. It is important to note that no dot location was more probable than another.

To determine an individual’s score on the SRT learning task, I used the same process as Kaufman and colleagues (2010). First, the reaction time differences by block were inspected for an indication of where learning initially began; determined by the block at which reaction time for sequence trials becomes lower than the reaction time for control trials. Because learning began in block three, as is evidenced by a significant difference in reaction time to the probable and improbable trials, only blocks three through eight contributed to the remainder of the scoring (see Figure 1). For each block, an individual's reaction time difference between their average sequence trial reaction time and average control trial reaction time was calculated. If an individual's reaction time difference was equal to or greater than the significant learning effect throughout blocks three through eight, then they were said to show evidence of learning. The average effect size, as measured by Cohen's *d*, for the difference between probable and improbable reaction times for blocks three through eight was 0.26. Therefore, the following formula was used to determine whether an individual learned on each block. $M_{\text{RTprobable}} < \text{RT}_{\text{difference}} - d(SD_{\text{RTimprobable}})$, where $d = 0.26$. If the previous statement was true, then the individual was given a score of *1* for that block. If the previous statement was false, then the individual was given a score of *0* for that block. Each participant's score was summed across blocks three through eight to create their overall SRT learning score. Consequently, scores ranged from *0*, indicating that the participant did not demonstrate learning on any of the blocks, to *6*, indicating that a participant demonstrated learning on all of the blocks.

Operation Span (Ospan) Task. An automated version of the Ospan, similar to the one presented in Unsworth et al. (2005) was utilized for this study. Unlike the version utilized in Unsworth and colleagues, however, participants in the current study did not have to state the mathematical operation and answer aloud. Instead, participants were presented with a simple mathematical operation to solve, such as "Is (9/1)-5 = 1?," and they pressed the *Y* key on the keyboard if the answer to the question was "yes," or the *N* key if the answer was "no." After selecting their answer, the computer presented participants with a word to store in their working memory, such as the word "CAT," which they were later asked to recall. Participants completed these operation-word strings, which varied in length from two to six items, until the computer asked them to recall the words they had memorized, in the correct order, and type them into a text box on the screen. Operation-word string lengths of two, three, four, five, and six were presented in a random order. Each string length was presented three times throughout the task, for a total of 60 operation-word presentations and 60 words to be remembered and later reported.

Before the test phase, participants completed three practice problem sets, each containing two operation-word strings. Based on these practice problems, the computer assigned participants a given amount of time to solve the mathematical operations during the trial phase. Specifically, the cut-off time was a participant’s average time during the practice trials plus 2.5 standard deviations (SD). This time limit calculation method accommodated individual differences in calculation time, while ensuring that participants were focusing on solving the mathematical operation and not taking time to deliberate on the memorized words.

The analytical ability score was an individual's performance on the Ospan task. Scores were the sum of all the words that were correctly recalled (Kaufman et al., 2010).

Post-Task Questionnaires. For both the SRT and the Ospan, participants answered post-task questions to ensure that they were using the appropriate processing system. For the SRT, the questions asked whether the participants felt they were able to anticipate the location of the dots, and whether they were looking for or able to identify any patterns in the stimuli. For the Ospan, questions asked about the difficulty of the task, the effort the participant put in to the task, and whether they used a strategy to remember the words. If participants utilized a strategy, they were also asked to explain it.

Measures

The REI. The present study utilized the REI (Pacini and Epstein, 1999) to assess self-reported rational and experiential processing preferences and abilities. The REI rational subscale and the REI experiential subscale each consist of twenty items: 10 assessing preferences for utilizing each modality and 10 assessing ability to process in each modality. Each item asks participants to rate their support for statements such as “I am not a very analytical thinker” or “I don’t have a very good sense of intuition” on a five-point scale from (1) *definitely not true* to (5) *definitely true* (Pacini & Epstein, 1999, p. 976). After reverse coding when necessary, overall rationality scores were the mean response for each of the twenty rationality items and overall experientiality scores were the mean response for each of the twenty experiential ability items. Separate scores for ability and preference were also calculated for both experientiality and rationality by calculating the mean response to items in those subscales. High scores indicated a greater preference for and/or ability to utilize that modality of thinking.

Overall, all subscales of the REI were found to have adequate internal consistency reliability, as is demonstrated by Cronbach's Alpha levels greater than 0.70 (See Table 1; similar to Handley et al., 2000; Pacini & Epstein, 1999; Witteman et al., 2009). The measures have also been found to have adequate test-retest reliability (Handley et al.). Furthermore, researchers have translated the measure into other languages, such as Dutch and Spanish, and found it to be reliable cross-culturally (Witteman et al.). This study utilized the English version presented in Pacini and Epstein (1999).

The BFAS. Participants were asked to complete the Big Five Aspect Scales (BFAS) inventory of personality (DeYoung et al., 2007). This personality inventory not only measures the degree to which participants display the standard Big Five personality traits (Costa & McCrae, 1992), extraversion, agreeableness, conscientiousness, neuroticism, and openness/intellect, but also measures subcategories within each of these traits. Overall, the inventory measures volatility, withdrawal, compassion, politeness, industriousness, orderliness, enthusiasm, assertiveness, intellect, and openness. The 100 item BFAS includes ten questions assessing each of the ten different personality aspects. Responses are given on a 5-point Likert scale where a response of *1* indicates *definitely not true of me* and a response of *5* indicates *very true of me*. A participant's score on the BFAS was the mean of his/her responses for each trait after any necessary reverse coding. The BFAS has been found to be both valid and reliable (Norma et al., 2006). With the current sample, each of the subscales was found to demonstrate sufficient internal consistency reliability as each had a Cronbach's Alpha level greater than 0.70 (see Table 1).

The Types of Intuition Scale. The TIntS is a self-report measure that assesses an individual's preference for three varieties of intuition: affective, inferential (or heuristic), and holistic intuition (Pretz & Brookings, 2009). The TIntS is based on evidence that different kinds of intuition exist, and that people can differ in their preference for the different types of intuition (Pretz & Totz, 2007). Affective intuition is associated with the interpretation of emotion. Inferential intuition is exemplified in expertise with which one can skip certain steps in the normally systematic decision-making process. Finally, holistic intuitions are those based on the automatic integration of large amounts of information.

Participants were to respond to 36 items assessing these three types of intuition. Nine of these items assess holistic intuition (e.g., “I enjoy thinking in abstract terms”), 12 assess inferential intuition (e.g., “My intuitions are based on my experience”), and 9 assess affective intuition (e.g., “I believe in trusting my hunches”). The remaining six items were not utilized in the scoring of the measure because the creators of the scale altered the scoring method to increase the reliability of the measure. Responses to each item were based on a 5-point Likert scale. Scores were calculated for each type of intuition by averaging the responses for each item within that category after any necessary reverse coding. Pretz and Brookings (2009) found the TIntS to be a valid measure when compared to participants’ responses on the REI (Pacini & Epstein, 1999), Big Five (Costa & McCrae, 1992), and MBTI (Myers et al., 1998). Similar to previous findings, the affective and inferential subscales were found to demonstrate sufficient internal consistency reliability, but the holistic subscale fell below the 0.70 Cronbach's Alpha cutoff (see Table 1). Nevertheless, I used the scale for the exploratory analyses with the understanding that the scale is still under development.

The MBTI. The Intuitive/Sensate and Thinking/Feeling subscales of the MBTI were utilized as another self-report measure of preference for intuitive and analytical thinking (Myers et al., 1998). The Intuitive/Sensate subscale contains 24 items and the Thinking/Feeling subscale contains 26, for a total of 50 items. The items from each scale were intermixed. Each item provided the participant with a forced choice in which each response indicates preference for one aspect of the scale. The Intuitive/Sensate subscale assesses an individual’s preference for theoretical and abstract concepts (intuitive) versus their preference for realistic and concrete ones (sensate). The Thinking/Feeling subscales measures a participant’s preference for using logic to problem solve (thinking) versus using emotions to problem solve (feeling). A participant’s score was calculated by summing the number of responses indicating a preference for intuition for the former subscale, and indicating the number of responses indicating a preference for thinking on the latter subscale. Participants' scores could range from 0-24 for the Intuitive/Sensate subscale, on which a higher score indicates a stronger preference for Intuitive over Sensate, and from 0-26 for the Thinking/Feeling subscale, on which a higher score indicates a stronger preference for Thinking over Feeling (Pretz & Totz, 2007). The Cronbach's Alpha reliabilities of the two subscales can be found in Table 1.

ACT Scores. The America College Test (ACT; *ACT*, 2010) scores for the 61 participants providing consent (39.1% of the sample) were obtained from the registrar. There are four subtests factored into the composite score: English, Mathematics, Reading, and Science. Each of the sections of this standardized test are multiple-choice and assess an individual's problem solving and critical thinking abilities related to the subject of each subtest. The ACT was used as an alternative assessment of cognitive ability.

Experimental Manipulation

In the experimental manipulation, half of the participants received a detailed psychological definition of intuition, as well as a statement describing how it can be useful in certain situations. In contrast, participants in the control condition did not receive any information regarding the definition or utility of intuition. The experimental group received the following explanation prior to the completion of the REI:

> The last measure is the Rational-Experiential Inventory. This questionnaire asks about your preferences for intuitive and analytical thinking. Please try to be as accurate as possible in reporting your responses to these items.
>
> In the field of psychology, intuition is defined as a rapid and automatic thinking that is developed without conscious awareness. Intuition can be used in making

> impressions of others, making snap decisions, and in solving real life problems that are sometimes too complicated to analyze. The dot location task you completed earlier is another instance when intuition can be useful. Research has shown that with practice people become good at anticipating the location of the dot, showing that they are intuitively learning the complex pattern governing its location. Even participants who think they did poorly on that task often show evidence of good intuition for the dot location, regardless of whether they can explain it. In general, intuition is useful in various forms of problem solving that involve complex rules. Keep this in mind when reporting on your own preference for intuition on this next questionnaire.

Meanwhile, the control group received only the first paragraph of this explanation.

The aim of this manipulation was to determine whether individuals have struggled in other studies at self-reporting their intuitive and analytical process due to a metacognitive block or due to other factors. In particular, the experimental manipulation attempted to overcome a lack of cultural importance placed on intuition versus analysis (see Buchtel & Norenzayan, 2008; Nisbett & Miyamoto, 2005) and a lack of understanding of the psychological definition of intuition (Rogers & Wiseman, 2006). Of specific interest is whether this manipulation increased the accuracy of participants' the self-reported of intuitive processing abilities in comparison to those who did not receive the explanation and statement of utility. If the explanation and statement of utility resulted in no change in the accuracy of participants self-reported intuitive abilities, then the metacognitive block hypothesis would be supported.

Procedure

Participants were tested using a computer in groups of 3 to 10 people in a computer lab classroom. Participants giving informed consent were randomly assigned to either the experimental or control condition. Participants were first instructed to complete the SRT and the Ospan tasks, the order of which was counterbalanced across participants. Following each task, participants completed the corresponding post-task questionnaire. Immediately following the completion of the latter task and post-task questionnaire, participants were asked to complete the BFAS, the TIntS, and the MBTI. Next, participants either received the instructions for the experimental condition or the control condition. Then, all participants completed the REI. After completing the REI, participants completed the demographic information. Finally, participants were debriefed on the purpose of the study before leaving the session.

Results

The SRT data from three participants were lost due to computer error, making the overall sample size for the SRT 153. From these 153 participants, all trials where participants responded incorrectly (3.3% of the SRT trials) were discarded. Outliers, defined as trials on which reaction time was three standard deviations above an individual's mean on a specific block, were discarded from the data (1.7% of the remaining correct trials) to ensure that the data were representative of an individual’s ability to learn the sequence. On the Ospan and the REI, outliers were defined as scores that exceeded three standard deviations above or below the mean. For the Ospan, this meant that one person was removed as an outlier because their performance was exceptionally low. For the REI, one participant was an outlier on the experiential favorability subscale, and another participant was an outlier in both the experiential favorability and ability subscales. In both cases, the participants' performance was exceptionally low and the data points were removed for the subscale on which the participant was an outlier, and for the experiential total score.

Before analyzing the effects of the manipulation or any correlations, I conducted an independent samples *t*-test to determine if there were any effects of task order on task performance. Task order did not significantly change a participant's performance on the SRT (if first, *M* = 2.46, *SD* = 1.58, if second, *M* = 2.61, *SD* = 1.51, *t*(151) = 0.61, *ns*) or the number of correctly recalled Ospan words (if first, *M* = 45.36, *SD* = 7.13, if second, *M* = 43.79, *SD* = 7.75, *t*(153) = 1.31, *ns*), so the data were collapsed across task order.

A multivariate analysis of variance (MANOVA) testing the effects of the manipulation and gender on a participant's responses for each of the REI subscales was also utilized to determine any affects of gender. Results are in Table 2. Two gender differences approached significance. First, males scored slightly higher on rational ability (*M* = 3.75, *SD* = 0.50) than females (*M* = 3.50, *SD* = 0.66), *F*(1,148) = 3.60, *p* = .060. Second, females scored slightly higher on experiential favorability (*M* = 3.61, *SD* = 0.65) than males (*M* = 3.45, *SD* = 0.50), *F*(1,148) = 2.80, *p* = .097. None of the interaction effects approached significance. Due to the lack of significant gender differences, I did not use gender as a predictor variable in any other analyses.

The Accuracy of Self-Report

To test the hypothesis that participants could accurately self-report their rational abilities in both conditions, I first examined the correlations between the SRT, Ospan, and the subscales for the REI (see Table 3). Across all participants, contrary to the hypothesis, neither of the REI rational subscales correlated with performance on the Ospan (for REI rational favorability, *r* = .063, *p* = .439; for rational ability, *r* = .032, *p* = .690). As hypothesized, there were also no significant correlations between performance on the SRT and the REI experiential subscales (for REI experiential favorability, *r* = -.055, *p* = .506; for experiential ability, *r* = .008, *p* = .924).

Next, to examine whether there were any effects of the manipulation on REI scores, I reexamined the 2 (gender) x 2 (experimental condition) MANOVA for a main effect of experimental condition (see Table 2). The MANOVA revealed that the main effect of condition on REI experiential favorability scores approached significance, $F(1, 148) = 3.86$, $p = .051$. Inspection of the cell means revealed that participants in the control condition who did not receive the explanation of intuition ($M = 3.63$, $SD = 0.58$) reported higher preference for intuitive thinking than participants in the experimental condition who received the explanation ($M = 3.46$, $SD = 0.60$). However, the same MANOVA revealed that there were no significant differences across experimental conditions for the experiential ability, rational ability, and rational favorability subscales. These results suggest that, as anticipated, the manipulation did change an individual's self-reported experiential scores. However, unlike the hypothesis that the manipulation would affect the way participants' reported their intuitive ability, the manipulation actually lowered participants' intuitive preferences.

In order to test the effect of the experimental manipulation on accuracy of self-reported preferences for intuition and analysis, I created separate correlation matrices for each experimental group (see Table 4). The purpose of this analysis was to test the competing hypotheses that the accuracy of a person's self-reported intuitive ability would either remain the same across conditions or be better in the experimental condition. These correlational analyses revealed that there was no change in the correlation between SRT and the REI experiential ability subscale across condition (for the control condition, $r = .016$, $p = .893$; for the experimental condition, $r = -.018$, $p = .881$; $Z = 0.20$, *ns*). Similarly, there were no changes in the correlation between experiential favorability and the SRT across condition (for the control condition, $r = -.103$, $p = .380$; for the experimental condition, $r = -.035$, $p = .764$; $Z = -0.83$, *ns*). As hypothesized, no correlation differences were present between the rational ability subscale and performance on the Ospan (for the control condition, $r = -.063$, $p = .589$, for the experimental condition, $r = .106$, $p = .368$; $Z = 0.35$, *ns*). There was a difference, however, between the accuracy of a participant's rational favorability scores in the control condition ($r = .247$, $p = .029$), and the experimental condition ($r = -.187$, $p = .105$). A Fisher's z' transformation revealed that the two correlations were significantly different from one another, $Z = 2.68$, $p < .001$ (calculations based on Cohen & Cohen, 1983; see Figure 2). These results indicate that, in the control condition, participants were able to self-report their motivation to employ analytical thinking, as represented by their successful performance on the Ospan. However, providing participants with an explanation of intuition significantly altered this relationship between motivation to engage in analytical thinking and analytical task performance.

In order to determine whether a metacognitive block prevented participants from introspecting about their intuitive abilities, I examined the SRT post-task questionnaire data. Specifically, 65 out of the 150 participants (43.3%) reported that they were looking for a pattern on the SRT, and 63 out of 150 participants (42%) reported that they found a pattern on the SRT. I compared those participants who reported looking ($M = 2.63$, $SD = 1.57$) to those participants who reported not looking ($M = 2.40$, $SD = 1.51$) using an independent samples *t*-test and found that the two groups did not differ significantly on their SRT performance, $t(148) = 0.91$, $p = .36$. Furthermore another independent samples *t*-test also found that there was no significant difference in SRT performance when comparing those who claimed to have detected at least a portion of the SRT pattern ($M = 2.43$, $SD = 1.51$) to those who did not make such a claim ($M = 2.55$, $SD = 1.56$), $t(148) = -0.48$, $p = .63$. These results support the hypothesis that participants are unaware of the intuitive learning that is occurring while they are completing the SRT.

Exploratory Analyses

In addition to the analyses testing the accuracy of self-reported intuitive and analytical ability, I also conducted exploratory analyses to gain a better understanding of other correlates of the REI and the SRT. Through these analyses, I hoped to determine if individual differences existed in SRT performance and self-reported REI experiential scores. Because there is doubt within the field that such individual differences exist (Reber, 1989; 1992), I must determine if the lack of correlation between the SRT and REI experiential scores is due to a lack of individual differences or due to a metacognitive block.

Evidence of Individual Differences in SRT performance. Performance on the SRT ranged from *0*, indicating that participants did not learn on any of the blocks, to *6*, indicating that participants learned on each of the blocks. Despite this variability in SRT performance, no correlations were found between task performance on the SRT and other self-report measures. As can be seen in Table 5, the SRT did not correlate with any of the factors of the BFAS personality scale, indicating that individual personality traits are not associated with performance on this intuitive task. There were also no correlations among the subscales of the other measures of intuition (TIntS and MBTI) and performance on the SRT. The lack of correlations between self-report measures of intuition and performance on the SRT supports the hypothesis that there may be a metacognitive block preventing participants from introspecting about their intuitive processing (the absolute values of the correlations range from $r = .011$ to $r = .076$).

However, SRT scores were correlated with ACT composite scores ($r = .298$, $p = .021$; see Table 5). Overall, because the measure was correlated with cognitive ability as measured by the ACT, these results suggest that the lack of an association between the SRT and the REI experiential scores was not due to a lack of individual differences on the SRT.

Evidence of Individual Differences in REI Experiential Scores. In order to find evidence of individual differences in REI experiential scores, I analyzed the correlations between scores on the REI experiential subscales and the other measures of intuition and personality (see Table 5). As might be expected, there were many significant correlations between REI experiential scores and scores on other measures of intuition. Both REI experiential subscales were negatively associated with the MBTI Thinking/Feeling subscale (for ability, $r = -.211$, $p = .008$; for favorability, $r = -.427$, $p < .001$) and positively associated with the MBTI Intuitive/Sensate subscale (for ability, $r = .202$, $p = .012$; for favorability, $r = .387$, $p < .001$). These correlations between the MBTI and the REI experiential subscales suggest that as participants demonstrated increased self-reported abilities and preferences for intuition on the REI, they also reported a preference for feeling over thinking and intuition over sensation. In addition, each of the TIntS subscales was significantly positively correlated with REI experiential scores (see Table 5). The only exception was the correlation between REI experiential ability and TIntS Holistic, which was marginally significant in the expected direction ($r = .155$, $p = .055$). These results suggest that as people reported more intuitive abilities and preferences they also reported more preferences for using each of the three different types of intuition. Overall, these results suggest that individuals were reporting their preferences for intuitive processing consistently across the different self-report measures of intuition.

Furthermore, there were also significant correlations between the BFAS personality measure and reported REI experiential scores. In particular, the REI experiential ability scale was positively correlated with compassion, enthusiasm, assertiveness, intellect, and openness, and negatively correlated with withdrawal (see Table 5). The REI experiential favorability scale also correlated positively with compassion, enthusiasm, assertiveness, and openness. These correlations between personality traits and REI experiential scores demonstrate that there are individual differences for self-reported intuitive preferences and abilities.

These relationships between other self-report measures and REI experiential scores demonstrate both a consistency in participants' views of intuition and individual differences in self-reported intuitive processing. Overall, the data show evidence of individual differences in both REI experiential and SRT scores. Consequently, the lack of an association between the REI experiential subscales and performance on the SRT is not due to a lack of individual differences in self-reported intuitive abilities or preferences.

Discussion

Accuracy of Self-Reported Rational Ability

The results of the study for self-reported rational processing demonstrate that participants are able to accurately report on their rational processing, but not necessarily in the way I had hypothesized. In contradiction to the hypothesis that there would be a positive correlation between self-reported rational ability and performance on the Ospan in both conditions, the present study found no such overall relationship. In fact, there was no correlation between the rational ability subscale and performance on the Ospan for either of the conditions. Instead, rational favorability was moderately, positively correlated with Ospan performance in the control condition, and there was a significant difference between this correlation and the non-significant negative correlation in the experimental condition. It would appear that the introduction of an explanation of the definition and usefulness of intuition diminished a person's ability to represent their motivation to use analytical processing, and even trended toward reversing their ability to represent this motivation. It is important to note, however, that the manipulation did not have a significant main effect on participants' rational favorability scores. Instead, the manipulation only altered the correlation between self-reported preferences and performance on the analytical task.

It is possible that the manipulation resulted in an alteration in the introspective ability of participants regarding their analytical processing. The additional information about intuitive thinking may have caused participants to doubt whether their preconceived analytical preferences were correct. It is possible that these doubts interfered with the way they would have normally reported, and may have even resulted in them have reporting opposite what they would have otherwise reported.

Overall, the study demonstrates that under normal conditions participants are able to report their analytical preferences, but that introspection regarding their analytical abilities may not be as accurate when correlated with a working memory task. The Ospan is consistently correlated with measures of fluid intelligence and higher order cognition (Unsworth & Engle, 2005a; Unsworth & Engle, 2005b; Engle, Tuholski, Laughlin, & Conway, 1999), and the same was true in the current study, as is evidenced by the link between the Ospan and ACT scores (see Table 5). Nevertheless, this link between Ospan and ACT performance did not translate in to the participants' being able to accurately report their analytical abilities, as both ACT scores and Ospan total recall scores were not associated with reported rational ability on the REI. These findings indicate that the REI rational ability subscale, but not the rational favorability subscale, may be measuring a different form of analytical thinking than that which is assessed by either the ACT or the Ospan.

REI rational scores have been found to correlate with performance on some analytical tasks such as the statistical accuracy of numerical judgments and on ability to solve logic problems (Witteman et al., 2009). Because none of these studies analyzed the REI rational ability and favorability subscales separately, however, it is possible that there were correlations similar to those found in our study to the separate subscales that went undetected. In order to allow a direct comparison between existing research and the current study, I conducted a post-hoc analysis of the rational total scores and Ospan performance; the correlation was once again not significant, $r = .056$, $p = .493$. This suggests that the analytical task used in this study may not yield the same results as previous literature that has found a link between analytical tasks and REI rational scores.

It is important to note, however, that some other studies have also failed to find a connection between participants' analytical task performance and the REI rational subscale scores. For example, Newstead and colleagues (2004) found that REI rational scores were not correlated with performance on deductive reasoning tasks. It is possible that the use of the Ospan, a working memory task, to measure an individual's analytical ability may not be as representative of the type of analytical processing that individuals call to mind when completing the REI rational subscales. For example, when they approached an REI item such as "I'm not very good at solving problems that require careful logical analysis," participants may not have associated their working memory capacity with their analytical abilities. It is also possible that the use of the Ospan may have differentially affected the rational ability and rational favorability scales because while none of the favorability questions refer to logic, four out of the ten ability items refer to logic (Pacini and Epstein, 1999). Overall, it seems as though the REI abilities subscale focuses more heavily on logical processing, rather than overall analytical processing, and this may prevent certain analytical tasks from correlating with the measure. This notion is supported by evidence that the REI rational subscale is associated with the statistical accuracy of numeric judgments (Shiloh et al., 2002) and performance on logic problems (Witteman et al., 2009).

Accuracy of Self-Reported Intuitive Ability

As hypothesized, participants in this study struggled to accurately self-report their intuitive ability. While there was a marginally significant impact of the experimental manipulation such that experiential favorability was higher in the control condition than it was in the experimental condition, this change did not alter the predictive validity of their experiential favorability scores. The reduced preference for intuition in the experimental condition demonstrates that our manipulation had an effect opposite to that which I had anticipated. I had hoped that this manipulation would augment an individual's understanding of the usefulness of intuition, yet in actuality, the explanation diminished the participants' preference for relying on intuition. It is possible that this alteration could be due to the way the manipulation referred participants back to their performance on the SRT by explaining, "The dot location task you completed earlier is another instance when intuition can be useful." Consequently, those in the experimental condition were reflecting on their experience completing the SRT when they were reporting on their preferences for using intuition. If participants did not enjoy the task, felt as though they performed poorly on it, or felt the task was tedious, then they may have reported less preference for intuition than they would have otherwise.

The lack of an influence of the experimental manipulation on self-report accuracy supports the competing hypothesis that such difficulties in reporting intuitive ability may be due to a lack of metacognitive awareness rather than due to a lack of understanding of intuition. Because the manipulation provided participants with both the definition of intuition and a statement explaining its utility, the results indicate that neither of these is helpful in strengthening the relationship between performance on the SRT and reported intuitive ability. Just as Klaczynski and colleagues (1997) suggested, participants likely use analytical metacognition when completing the REI, assessing their ability to use each form of processing and the success rates of that processing system. Because intuitive processing and analytical processing occur in two separate neural systems (Destrebecqz et al., 2005; Lieberman et al., 2004), it is possible that individuals lack the ability to introspectively analyze their intuitive processing abilities because such a mental crossover either does not or cannot occur.

The results from the SRT post-task questionnaires further support the finding that there is a lack of metacognitive awareness of whether individuals were able to identify the pattern on the SRT or not. Overall, participants were unable to accurately report whether or not they detected a pattern in the stimuli. These results are similar to Woolhouse and Bayne's (2000) findings that implicit learning ability does not relate to the level of confidence that participants report in their performance. Similar to the suggestions made by Nisbett and Wilson (1977), participants may have been unable to introspect in regards to their performance on the SRT because learning was not readily apparent to the participants. These results are also similar to the findings presented by Dienes and Scott (2005b) that participants were unable to distinguish between whether they were relying on guessing or intuition on the artificial grammar task. Overall, the SRT, like the artificial grammar task, appears to rely on covert intuitive processing that individuals are unable to report on in post-task questionnaires and in the REI experiential ability subscale due to a metacognitive block.

Exploratory Analyses

The current study provides clear evidence that there are individual differences in intuitive and analytical abilities. The variability in performance on both the intuitive and analytical tasks alone supports the argument that participants in this study exhibited individual differences in not only analytical ability, but also in intuitive ability. Furthermore, the exploratory analyses indicated that performance on the Ospan and SRT were correlated with performance on the

ACT. These results are similar to the moderate, positive correlation found in another study between participants' performance on the SRT and scores on an academic achievement test called the General Certificate of Secondary Education (Kaufman et al., 2010). Overall, these individual differences between participants call into question Reber's (1989, 1992) theory that participants do not differ on intuitive processing because it is an innate and evolutionarily old system.

Furthermore, the associations between REI experiential scores and other self-report measures indicate that there are individual differences in self-reported intuitive preferences and abilities as well. The associations between the REI experiential subscale and the other measures of intuition indicated that people were reporting their intuitive preferences similarly across the different self-report measures throughout the study. Of greater importance to the hypotheses, however, are the correlations between REI experiential scores and the personality measures. These associations indicate that individuals with higher levels of certain personality traits were more likely to report being intuitive than those individuals with lower levels of the same personality.

For the current study, these results collectively indicate that the lack of an association between the SRT and REI experiential scores is not due to a lack of individual differences in SRT performance or self-reported intuitive ability. Participants in our sample did differ in both analytical and intuitive processing and in their reported preference and ability for the two styles of thinking. Therefore, the fact that participants in our sample were unable to self-report their intuitive abilities indicates that they may lack metacognitive awareness of these abilities.

Strengths, Limitations, and Avenues of Further Research

Overall, there were many strengths in the experimental design of the current study.

Specifically, the use of random assignment and the way tasks were counterbalanced across condition make the study a strong test of the hypotheses. Furthermore, the study used measures and tasks with ample evidence of their construct validity and reliability. The greatest strength of the study, however, is the way it analyzes the REI in a new way by examining the predictive validity of the ability subscales specifically and proposes potential difficulties with each of them.

The research could have been strengthened by the use of a within-subjects design as opposed to a between-subjects design. This choice would have allowed the researcher to compare an individual's before and after scores on the REI to detect any changes due to the effect of the manipulation. In addition, the use of a manipulation check would have ensured that participants were actually reading the explanation of intuition, and allowed the researcher to conclude with more confidence that the manipulation did not influence the predictive validity of the REI ability subscales. Overall, further studies involving this research question should aim to improve each of these limitations by administering the REI both before and after the manipulation, and by asking participants to answer a few questions regarding the information in the paragraph at the completion of the experimental session.

Furthermore, it would be worthwhile to repeat the study with different intuitive and analytical tasks. For future intuitive tasks, it may be beneficial to use a task on which a participant's accuracy is more self-evident. On the SRT, participants were only performing milliseconds faster on the probable versus the improbable trials; therefore, it is reasonable to suspect that many participants were unaware of whether or not they were good at the task. A task such as the Piagetian Balance Scale Task described in Inhelder and Piaget (1958), however, would make a participant's performance more apparent to them by providing immediate feedback after each response. Such feedback would provide participants with a more obvious understanding of their performance on an intuitive task and overcome the problem of participants being unable to report on covert mental processes (Nisbett & Wilson, 1977).

For the reason I suggested earlier, that the Ospan may not correlate with the REI rational ability subscale due to the many references to logic, it would also be beneficial to repeat the study with a different analytical task. By using one of these tasks that have been previously found to correlate with the REI rational subscale, future researchers could determine if the same pattern for REI rational favorability accuracy exists. Furthermore, the use of such an established correlate of the REI rational scale would enable researchers to determine whether there is a distinction between the rational favorability and ability subscales.

Future studies may also find it beneficial to utilize tasks such as the category-learning task described in DeCaro and colleagues (2008) or one of the tasks used in Dijksterhuis (2004) because they enable direct comparisons between intuitive and analytical performance by utilizing the same or similar methodologies, but with different instructions for the intuitive and analytical tasks.

Nevertheless, the current study supports the hypothesis that a metacognitive block prevents participants from reporting their intuitive abilities. Consequently, future research in both cognitive psychology and neuroscience should examine the mechanism behind this metacognitive block. Future neuroscience research could aid the current understanding of metacognitive access to intuition by focusing on the neural processes involved in analytical, intuitive, and metacognitive thought processes. Such research could provide more concrete support for the existence of a metacognitive block. These studies should aim to establish whether the areas of the brain associated with metacognition overlap the areas of the brain utilized for intuitive and analytical processing. If such an overlap exists for analytical thinking, but not for intuitive thinking, this research would provide a neural explanation for a metacognitive block preventing individuals from accessing and assessing their intuitive thinking abilities.

Implications

The current study has demonstrated that both the REI experiential ability and rational ability subscales demonstrate a lack of predictive validity for the SRT and the Ospan respectively. The rational favorability subscale, in contrast, was associated with Ospan performance when participants were not provided with an explanation of intuition, demonstrating that participants, to some extent, were able to introspectively analyze their analytical thinking processes. Such findings support the idea that participants have some level of introspective access to their analytical processing, but not to their intuitive processing. The results could support the ideas of Nisbett and Wilson (1977) that participants are unable to verbally report on covert processes that occur within the brain. In future research, this predictive validity should be explored further to determine what types of rational ability can be predicted by the REI rational ability subscale. In addition, future research utilizing the REI should conduct analyses of the favorability and ability subscale independently to strengthen the literature on these independent subscales. Furthermore, this research would allow for greater understanding of participants' ability to utilize metacognition to assess their analytical and intuitive thinking. In addition, the predictive validity of the REI experiential ability subscale is yet to be determined. Because this subscale appears to lack predictive validity researchers should consider using intuitive task performance as an indication of intuitive ability as opposed to self-report measures.

In conclusion, the current study carefully analyzed two competing hypotheses regarding why individuals lack introspective access to their intuitive abilities. In addition to replicating the finding that individuals lack this introspection to their intuitive processing, the results also support the idea that a metacognitive block rather than a lack of understanding of intuition may be responsible for this phenomenon.

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Table 1

Internal Consistency Reliabilities

Measure	Cronbach's Alpha
REI	
Rational ability	0.84
Rational favorability	0.84
Experiential ability	0.83
Experiential favorability	0.87
BFAS	
Neuroticism-Volatility	0.87
Neuroticism-Withdrawal	0.71
Agreeableness-Compassion	0.88
Agreeableness-Politeness	0.75
Conscientiousness-Industriousness	0.82
Conscientiousness-Orderliness	0.83
Extraversion-Enthusiasm	0.84
Extraversion-Assertiveness	0.87
Openness-Intellect	0.73
Openness-Openness	0.83
TIntS	
Holistic	0.68
Inferential	0.80
Affective	0.90
MBTI	
Thinking/Feeling	0.92
Intuitive/Sensate	0.93

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Table 2

Means, Standard Deviations, and MANOVA Results across Experimental Condition and Gender for REI Scores and Task Performance

	Control Condition			Experimental Condition							
	Females (*n* = 45)	Males (*n* = 30)	Total (*n* = 75)	Females (*n* = 43)	Males (*n* = 30)	Total (*n* = 73)	Total Females	Total Males	F_G	F_{EG}	F_I
REI-RA	3.63 (0.67)	3.66 (0.53)	3.64 (0.62)	3.50 (0.64)	3.85 (0.47)	3.64 (0.60)	3.56 (0.66)	3.75 (0.50)	3.60$^+$	0.10	2.62
REI-RF	3.57 (0.73)	3.47 (0.69)	3.53 (0.71)	3.60 (0.61)	3.56 (0.51)	3.58 (0.56)	3.58 (0.67)	3.51 (0.60)	0.43	0.28	0.11
REI-EA	3.58 (0.59)	3.50 (0.51)	3.55 (0.56)	3.42 (0.58)	3.49 (0.42)	3.45 (0.52)	3.50 (0.59)	3.50 (0.46)	0.00	0.88	0.63
REI-EF	3.64 (0.63)	3.61 (0.51)	3.63 (0.58)	3.58 (0.67)	3.29 (0.43)	3.46 (0.60)	3.61 (0.65)	3.45 (0.50)	2.80$^+$	3.86$^+$	1.80
SRT	2.56 (1.75)	2.80 (1.27)	2.65 (1.57)	2.19 (1.37)	2.60 (1.73)	2.36 (1.53)	2.38 (1.58)	2.70 (1.51)	1.60	2.89	0.11
Ospan	45.96 (7.74)	44.93 (7.83)	45.55 (7.74)	42.74 (7.83)	44.57 (6.17)	43.49 (7.24)	44.39 (7.93)	44.75 (6.99)	0.10	2.02	1.28

$^+p < .10$

Note: With the exception of *F* values, all cells represent *M* and (*SD*). The subscripts $_G$, $_{EG}$, and $_I$ stand for Gender, Experimental Condition, and Interaction, respectively.

Table 3

Correlations between the Analytical and Intuitive Tasks and the REI for the Overall Sample

Measure	**1**	**2**	**3**	**4**	**5**	**6**
1. SRT	(153)					
2. Ospan	.142	(155)				
3. REI-Rational Ability	.018	.032	(155)			
4. REI-Rational Favorability	.081	.063	.486***	(155)		
5. REI-Experiential Ability	.008	-.027	.117	.201*	(154)	
6. REI-Experiential Favorability	-.055	.040	-.169*	.162*	.691**	(153)

*p < .05 ** p < .01 ***p < .001

Note: The numbers in parentheses represent *N*.

Table 4

Correlations among Intuitive and Analytical Tasks and Self-Report Measures by Experimental Condition

Measure	1	2	3	4	5	6
	Control Condition					
1. Ospan	(78)					
2. SRT	.158	(77)				
3. REI rational ability	.055	-.063	(78)			
4. REI rational favorability	**.247***	.080	.548***	(78)		
5. REI experiential ability	-.004	.016	.091	.172	(77)	
6. REI experiential favorability	.012	-.103	-.060	.277*	.753***	(76)
	Experimental Condition					
1. Ospan	(77)					
2. SRT	.103	(76)				
3. REI rational ability	-.002	.106	(77)			
4. REI rational favorability	**-.187**	.082	.410***	(77)		
5. REI experiential ability	-.080	-.018	.146	.249*	(77)	
6. REI experiential favorability	.028	-.035	-.284*	.042	.621***	(77)

*p < .05 ***p < .001

Note: The correlations in boldface are significantly different from one another based on a Fisher's *z*' transformation, Z = 2.68, p <.001. Numbers in parentheses represent *N*.

Table 5

Correlations of REI and Task Performance with, ACT, Other Measures of Intuition, and the BFAS

Measure	REI-EA	REI-EF	REI-RA	REI-RF	SRT	Ospan
***ACT* (*N* = 61)**	-.203	-.231	.123	-.117	.298*	.309*
***TIntS* (*N* = 155)**						
Holistic	.155	.276**	.030	.242**	.051	-.061
Inferential	.567***	.394***	.355***	.293***	.028	-.028
Affective	.567***	.815***	-.357***	-.018	-.058	-.009
***MBTI* (*N* = 155)**						
Thinking/Feeling	-.211**	-.427***	.499***	.080	-.011	.007
Intuitive/Sensate	.202*	.387***	-.138	.374***	.076	.001
***BFAS* (*N* = 154)**						
Neuroticism-Volatility	.033	.159	-.154	.043	-.015	.099
Neuroticism-Withdrawal	-.231**	-.032	-.243**	-.065	.020	.110
Agreeableness-Compassion	.172*	.366***	-.208*	.155	.072	.111
Agreeableness-Politeness	-.011	.071	-.166*	-.093	.053	-.068
Conscientiousness-Industriousness	.149	-.138	.347***	.153	-.007	-.078
Conscientiousness-Orderliness	.063	-.076	.182*	.015	-.048	.001
Extraversion-Enthusiasm	.269**	.354***	-.114	-.029	.014	.066
Extraversion-Assertiveness	.405***	.257**	.338***	.379***	.076	.040
Openness-Intellect	.289***	.068	.571***	.633***	.133	.119
Openness-Openness	.249**	.388***	-.057	.455***	.110	.113
N	154	153	155	155	153	155

*p < .05 ** p < .01 ***p < .001

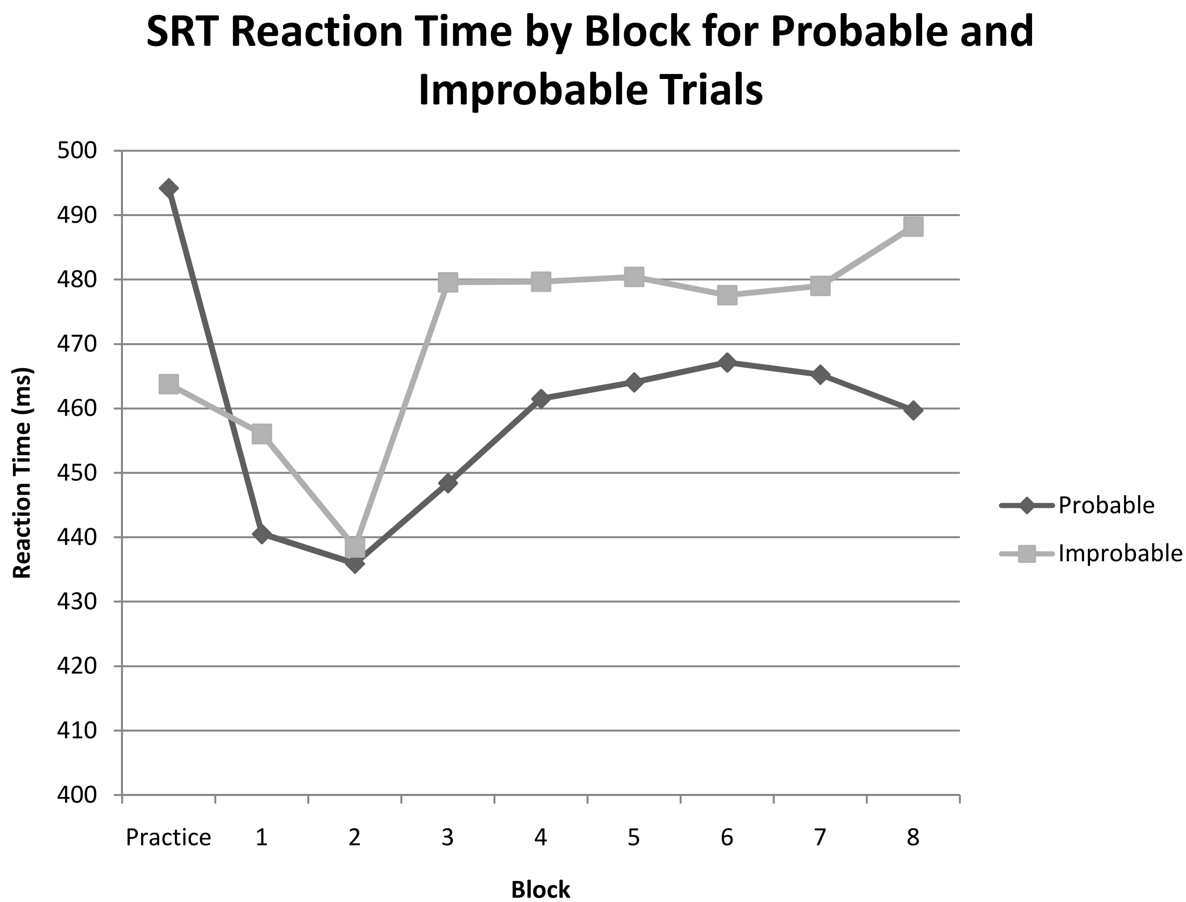

Figure 1: Reaction times for probable trials become significantly lower beginning in block three and continue to be significantly lower through block eight.

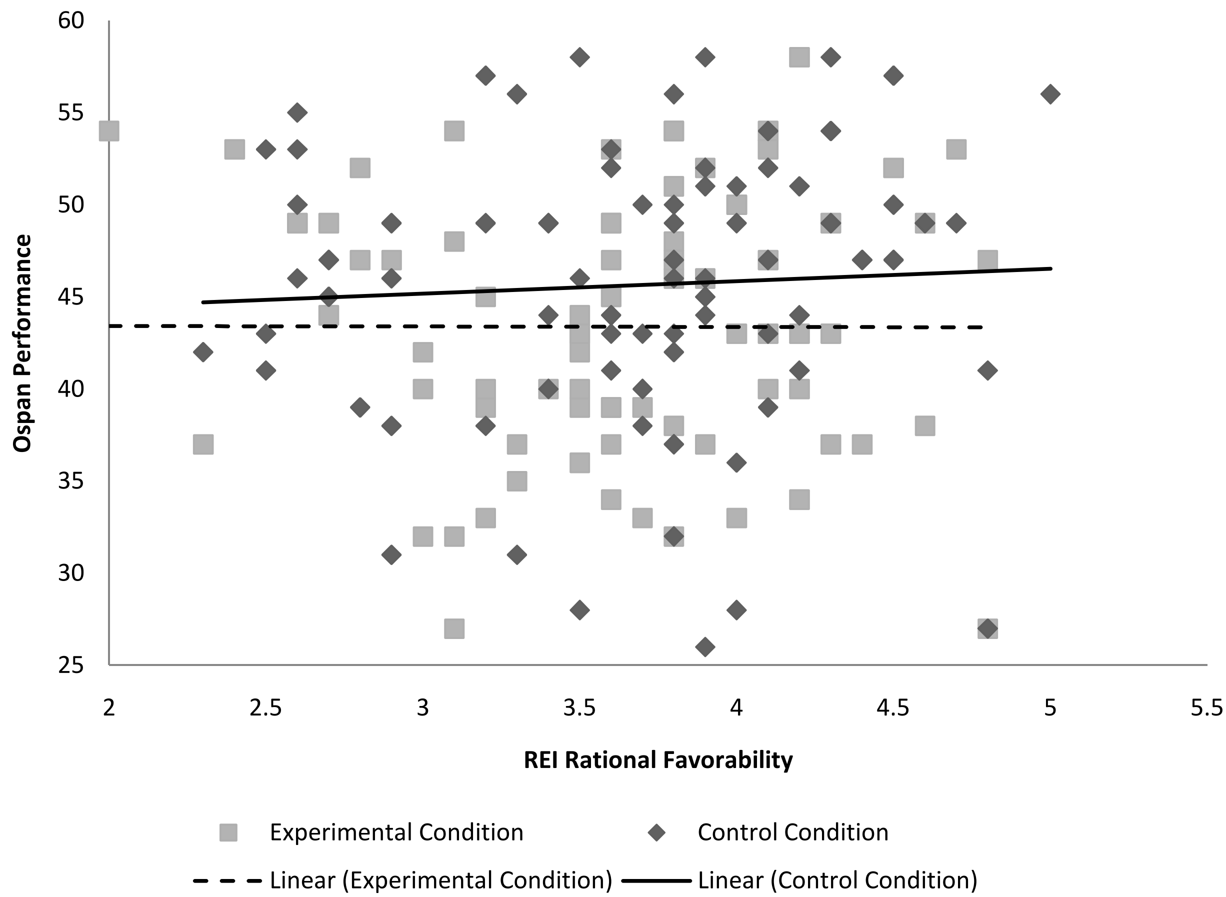

Figure 2: This figure demonstrates the correlation difference between the experimental and control groups between Ospan performance and REI Rational Favorability scores.