Analytical Thinking Mind-sets Undermine Intuitive Processing

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ABSTRACT

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Analytical Thinking Mind-sets Undermine Intuitive Processing

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Four studies measured the relationship between analytical thinking and intuition. The first three studies show support that an analytical mindset can worsen an intuition-based performance. Participants in an analytical mindset were less able to classify correct grammar strings at a level significantly higher than chance. The fourth study gave evidence that cognitive fluency doesn't account for these results by testing the mechanisms that were being influenced by the analytical mindset. Results support the theory that neither affect nor cognitive fluency is the mechanism worsening intuition. It does support the idea that the analytical mindset may be causing a loss in confidence that leads to worse intuitive performance.

Approved: _____

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OVERVIEW

"Intuition must be regarded not as a station, but as a point through which true knowledge must pass... as a mode of cognition by which conceptual knowledge is not so much excluded as concentrated… Both intuition and interpretation are necessary in order to attain truth. Intuition alone is empty." – *The Psychology of Religious Mysticism*, James H. Leuba (1925, p. 708).

The above quote provides insight into the concept and experience of intuition. Research studies have supported the notion that intuition does not merely represent unconscious information, but must also be interpreted as such by the perceiver (e.g., Topolinski & Strack, 2008b). In this sense, the conscious and unconscious must work together. For instance, college students may choose to answer an exam question through a "gut feeling." Even if they are uncertain about the gut feeling itself, the choice is still deliberate (e.g. Kruger, Wirtz, & Miller, 2005). As one gains experience in a given domain and receives consistent feedback, intuition is likely to become more accurate (Dane & Pratt, 2007).

Chicken sexing is an interesting example of intuition-based performance. The chicken farmer's goal is to identify the sex of baby chicks as early as possible because it is important to give extra chicken feed to female chicks in order to ensure a healthier hen and improve chances of reproduction. The first piece of consciously recognizable evidence that identifies the sex of the chicken is the growth of the feathers, occurring three to four weeks after the chick's birth. However, expert chicken farmers have an uncanny ability to simply look at baby chicks and identify whether they are male or female within the first day of birth. Indeed, their accuracy level has been known to attain 99% (Brown, 1999). Yet, when these experts are asked how they distinguish the sex of

the baby chick so quickly, they say they do not think about it. Rather, they "just know" (Horsey, 2002). Their feelings of knowing, however, appear to stem from the fact that they are given ample opportunities to implicitly learn the most diagnostic attributes with regard to sexing. Interestingly, farmers do not learn the sex of the chick until four weeks after its birth. Thus, they cannot rely upon conscious processing at any point earlier than four weeks because the most diagnostic attributes are not consciously recognizable. With every subsequent birth, farmers gain feedback about the chick's sex. The great feedback latency still results in feedback where the farmer slowly learns their mistakes and corrects or them, resulting in higher accuracy. It's assumed that over time the unconscious can become more accurate at detecting subtle patterns between chick characteristics and the sex of the chick (Brown, 1999).

Of course, reliance on intuition does not uniformly lead to accurate judgments. For instance, college students who rely on their "instincts" and stick with their initial responses on multiple choice tests wind up scoring lower than those who are willing to forego their first instinct and switch to a different answer based on further consideration of the options (Kruger, et al., 2005). Yet a great deal of research has found that participants who are instructed to use their intuition are more likely to judge objects or performances similar to expert judges as compared to participants who are instructed to use a deliberate thought process (e.g., Baumeister & Heatherton, 1996; Baylor, 2001; Gigerenzer & Selton, 2001; Halberstadt & Catty, 2007; Halberstadt & Greene, 2008; Halberstadt & Levine, 1999; Wilson & Schooler, 1991) .

The present work seeks to further existing research by illustrating how the prior activation of an analytical mindset in a completely unrelated domain can undermine subsequent performance on tasks that rely heavily on intuition. More specifically, the

study hopes to illustrate that analytical mind-sets are more likely to undermine intuitive processing through a cognitive as opposed to an affective mechanism. To my knowledge, no research has shown that when an analytical mindset is induced preceding an intuition-based task, intuition may suffer. Because intuition remains a "black box" (Plessner et al., 2008), learning what mechanisms influence its effectiveness may help us better understand when reliance upon it is optimal. By understanding what this mindset is altering (e.g. confidence), this research could lead the scientific community into a new avenue of intuition research where the goal is not to decide whether intuition is better than a competing technique, but to better calculate what causes the variability in the activation and correct application of intuition.

The first three reported studies provide supportive evidence that analytical mindsets worsen intuition. After solving math problems or reading counterfactual scenarios known to prime analytical mind-sets, participants failed to perform better than chance (i.e., .50) on an intuition-based artificial grammar task, whereas participants who were not primed with an analytical mindset did perform better than chance. The fourth study examined the mechanism by which analytical mindsets worsen intuition-based performance. Participants were asked to rate either their confidence or liking of grammar strings to uncover whether analytical mindsets disrupt affective processing or the cognitive components, both of which have been shown to independently relate to intuition-based performance (Allwood et al., 2000; Bolte et al., 2003). Judging the 'liking' of the string has been noted to be a direct measurement of affect whereas judging one's 'confidence' towards the strings is an indirect measurement of the affect after it has been cognitively interpreted (Manza & Bornstein, 1995). In other words, the confidence judgment activates a higher level of deliberate processing. This leads to three possible

reasons why participants who are given an analytical mindset perform worse on the intuition task than the control group.

First, the analytical mindset could be obstructing or complicating the reactive affect that emerges after exposure to the grammar string. If this is the case, then liking ratings and confidence ratings should be lower for the analytical mindset group than the control group. Second, the analytical mindset is complicating the cognitive component of the intuition process whereby one over-scrutinizes or distrusts the reactive affect. If this is the case, than the confidence ratings but not the liking ratings should be lower for the analytical group than the control group. Third, the analytical mindset both obstructs the affective reactions and complicates the cognitive process. In this case, both the liking ratings and the confidence ratings will be lower in the analytical mindset group than in the control group. However, the confidence ratings should be more inaccurate than the liking ratings because it will already be worsened by the disruption to the reactive affect then it will be worsened more through the further disruption of the cognitive components. We predict the second explanation where ratings of confidence are significantly lower for participants primed with an analytical mindset than those not primed, but no such differences will be found on ratings of affect. Such a pattern of results would suggest that analytical mind-sets more likely undermines intuitive processing through a cognitive as opposed to an affective mechanism.

Conceptual Underpinnings of Non-conscious Processing

The concept of intuition is usually categorized as a type of experiential thought as opposed to deliberative thought, but this assumption may be too simplistic because both processes are necessary during intuition (Norman & Price, 2008). To better clarify these differences, more details about dual system models will be described.

Dual Process Models

Multiple models have been proposed to describe dual processes, and although each model has unique components (e.g. labels motivations, rules), some details of these models are pervasive and have become the foundation for the dual process concept more generally. The less deliberate process, sometimes called "the experiential system" (Denes-Raj & Epstein, 1994), has been described as experiential, reflexive, associative (i.e., not formed through rules, but having semantic similarities), intuitional, nonconscious, impulsive, tacit, peripheral, slow learning (i.e., learned through repeated past experiences), and quickly initiated (i.e., decisions are made quickly and without deliberation). The more deliberative process called "the rational system" has been described as cognitive, reflective, rule-based, conscious, deliberate, central, and fast learning (e.g., Denes-Raj & Epstein, 1994; Dijksterhuis & Nordgren, 2006; Hogarth, 2002; Lieberman, 2000; Petty & Cacciopo, 1986; Rydell & McConnell, 2006; Sloman, 1996; Stanovich & West, 2008; Strack & Deutsch, 2004). Dual processes models have been applied in the domain of attitudes (e.g., Fazio, 1986; Gilbert, 1991), prejudice and stereotyping (e.g., Brewer, 1988; Devine, 1989; Fiske & Neuberg, 1988), and persuasion (e.g., Chaiken, 1980; Petty & Cacioppo, 1981). Such models often differ in their reliance upon cognitive versus motivational bases of information processing, whether the two processes work sequentially versus simultaneously, or whether they function congruently versus in direct opposition to each other (Smith & De Coster, 2000). The definition of intuition, as described in this article, entails both these processes, though it is usually described in relation to the experiential system because it has many of the traits encompassed by this system such as being slow-learning, but quickly initiated. However, intuition is interpreted through the 'rational process'. Like with other models (e.g. mood-

as-input, two factor theory of emotion) the deliberate mind must recognize the raw affective information and attribute it to a source (Martin, et al, 1997; Schacter & Singer, 1962).

WHAT IS INTUITION

A layperson typically defines intuition as a "gut feeling," meaning that an individual can experience a sense of either repugnance (bad choice) or enticement (good choice) when selecting among decision options (Knowlton, Ramus, & Squire, 1992; Langan-Fox & Shirley, 2003; Radin & Schlitz, 2005). Kahneman defines intuitive thinking as "perception-like, rapid, [and] effortless" (Myers, 2002, p. 1). Baylor (1997) describes intuition as an aggregation of three components: reason, immediacy, and relationships. In other words, intuition occurs immediately, unlike rationality that is a slower process. The choice is made via strong associations and relationships of mental constructs in the mind - the foundation for any preference. Finally, whereas conscious reasoning involves a specific, stepwise, and deliberate thought process, intuition aggregates all reasons.

Categories of Intuition

Pretz and Totz (2007) factor analyzed the Myers-Briggs Trait Inventory (Briggs & Myers, 1976) and the Rational-Experiential Inventory (Epstein, et al., 1996) and isolated three subtypes of intuition: heuristic, holistic, and affective. Holistic intuition, (e.g., Lieberman, Jarcho, & Satpute, 2004; Woolhouse & Bayne, 2000) operates through a Gestalt-like process whereby fragments of hidden information unite below conscious awareness, and from this union a preference may emerge that surpasses all others. Baylor (1997) also describes intuition in a holistic fashion, noting that "…with intuitive thinking, the person may return to the postulate itself and evaluate acceptance of it and consider alternatives…Success in an intuitive mode is realized in seeing, creating a picture in mind, and understanding" (pp. 188-189).

Heuristic intuition is characterized as a mental shortcut (e.g., Osbeck, 1999; Woolhouse & Bayne, 2000). Incorrect associations commonly result from heuristic intuition because it is used to conserve cognitive effort, and not necessarily to resolve ambiguity. An example would be sensing that a person is a cheat on the basis of their physical appearance. Some have argued that heuristic use is not a form of intuitive processing. For instance, Betsch (2008) argues persuasively that heuristics are more deliberate than automatic, entail sequential processing rather than parallel processing, and lack the holistic processing step that intuition is theorized to employ in order to make the optimal decision. As for affective intuition, Pretz and Totz (2007) note that, "…when an emotion is experienced in response to a problem situation, the information that feeling provides is not always easily verbalized. Thus, emotions are often expressed as intuitions, beliefs that cannot always be rationally justified" (p. 1248). Affective intuition is an unconscious reaction to available information. Moreover, affective intuition is used to clarify the strength of implicit knowledge that is relevant for the impending decision. The more that implicit information is reinforced, the stronger should be the affective (i.e., intuitive) response.

Taking a different route towards intuition research, Lieberman (2000) segregated intuition into two categories. The first category, intuitive social action, is exemplified by peoples' learned ability to display their emotions. This intuition is exhibited when, for instance, one leans away from someone with whom they feel uncomfortable, or gazes longer at a person with whom they share an attraction. A second category is intuitive social cognition, defined as the area related to the decoding of non-communicative stimuli such as grammar and language. An example would be performance on the Artificial Grammar Task (Lieberman, 2000), which demonstrates how an individual is

able to learn information about a new grammar and language system without conscious rehearsal.

Dimensions of Intuition

Langon-Fox and Shirley (2003) classify intuition along cognitive, affective, and behavioral dimensions. The cognitive dimension focuses on the retrieval of stored information and how this relates to the accuracy of intuition. The affective dimension represents the intensity of affect that communicates implicitly learned information from the unconscious to the conscious. The behavioral dimension represents how an individual reacts to the presentation of information. Various factors moderate the likelihood that an individual will act upon their intuition. Each dimension adds a distinct level of fallibility. Information may be poorly encoded, the emotion may not be strong enough to attain conscious awareness, and the individual may decide not to react to any emotion that does attain conscious awareness.

The definition of intuition described by Price and Norman (2008) that will be heavily relied upon here is an elaboration of what Mangan (1993) calls "fringe consciousness." This term belies the difficult relationship between the conscious and unconscious during an "intuitive" experience where, even though information is inaccessible, an emotional reaction can still be consciously experienced during decision making. Price and Norman detail three steps that occur during this process. First, an intuitive feeling will be initiated from the unconscious as a reaction to information that is not fully conscious. Because this information is not fully conscious, one feels as though one choice is the right decision despite there being no verbalizable or conscious reason behind the promotion of that choice.

Second, the activated feelings must be consciously recognized. In other words, the emotion initiated in the unconscious must also be recognized in the conscious (Pretz & Totz, 2007; Price & Norman, 2008). Although barriers may exist that cause the fragmenting of conscious and unconscious cognitive processing, emotion is less likely splintered into both unconscious and conscious emotions. Therefore, whatever emotion is evoked in the unconscious should also be felt by the conscious.

Third, this recognized emotion should lead an individual to a subjective evaluation that guides future behavior in a manner congruent with the emotion-based information. This is the behavioral component to intuition. The individual has a choice as to whether or not to use this emotion-based information (e.g., Halberstadt & Levine, 1999). Conversely, the individual may instead choose to use another technique, such as analytical thinking or coin flipping, in order to render a choice. This decision entails a certain level of deliberate thinking. "Certainly, evaluative judgments necessarily involve cognition…The subject must somehow "look inside" for the affective reaction that has arisen in him/her…" (Zajonc & Markus, 1982, p.127).

As a result, there are two mechanisms by which intuition may be worsened by analytical thinking: (a) one's reliance on emotion and/or (b) one's subjective evaluation of their emotional experience could be altered. The emotional experience arises from information outside of one's awareness, but is recognized by the conscious. Consequently, it is important to examine whether analytical thinking actually *alters* the emotional experience (and thereby worsens intuition-based performance). Alternatively, Price and Norman (2008) describe how one's choice and behavior can lead intuition to be ignored. Analytical thinking may influence one's subjective evaluation of their emotional experience when the feelings experienced are held in the conscious long enough to be

overanalyzed and evaluated. In this way, the emotion can actually become the *subject* of the evaluation (i.e., a meta-cognitive feeling). Because the emotion, itself, is being evaluated, the individual can choose to ignore the emotion and instead employ a rational thought process during decision-making. Analytical thinking then leads to the dismissal of, or under-reliance upon, emotional experience, which would also have the effect of worsening intuition-based performance. An alternative explanation is that analytical mindsets add a negative affect or block the intuition-based positive affect. If this were the case, then the analytical mindset group would show worse accuracy when rating their liking of the grammar strings than the control group.

The Artificial Grammar Task

Implicit learning is one of the most conclusive mechanisms found thus far to contribute to intuition (Lieberman, 2000; Zuijin, at el., 2006). The process of implicit learning involves being able to unconsciously learn information and then recall it without consciously understanding the rules. With the exception of pre-intuition (precognition), empirical tests of intuition are built upon this construct, whether the implicitly learned information occurs in one learning event— such as the artificial grammar system— or implicitly learned from repeated experience— such as the semantic coherence task (Bolte & Goschke, 2005; Lieberman, 2000). Explicitly learned information could also be a source of intuition in cases where the activated information learned explicitly isn't strong enough to reach the conscious during retrieval (cf. Kruger, et al., 2005). These varying methods of implicit learning could influence whether the information that evokes intuitive processing comes from semantic memory or working memory. Though not yet studied this difference could influence the strength of accuracy of a given intuition. For

the current research, however, implicit information is learned by the artificial grammar task.

The artificial grammar task has been used extensively to investigate intuition (e.g., Lieberman, 2000; Plessner, Betsch, & Betsch, 2008; Woolhouse & Bayne, 2000). In this task, participants are first told that they are completing a memory task. They are then exposed to what appear to be random strings of letters [e.g. XRMMTXR] and asked to retype them. After this task, they are told that the grammar strings follow a complex structure and that they must use their "gut feeling" to decide whether new grammar strings would be consistent with that structure or not. They are told that the structure is too complex to understand consciously, but that their unconscious should have learned the structure when completing the first task. Therefore, they should try to use emotion to identify the grammar strings.

When using an artificial grammar system to test implicitly learned information, Gordon and Holyoak (1983) found that participants showed an increased liking and an increased confidence for correct grammar strings compared to both incorrect grammar strings and a control group's ratings of the correct grammar strings. The control group was not previously exposed to the grammar strings in a learning phase. Learning this complicated pattern is considered an unconscious learning process because participants are unable to express any reason for their decision. In fact, they believe that nothing has been learned. Still, their performance scores suggest otherwise. When following their "gut feeling," participants perform better than chance at classifying correct grammar strings. Because intuition is such a subtle phenomenon to study in the lab, researchers often analyze the data by comparing the percentage of correctly classified grammar strings against chance levels rather than look for significant differences between

conditions (Knowlton, Squire, & Ramus, 1992; Lieberman, 2000, Seger, Prabhakaran, Poldrack, & Gabrieli, 2000). In a study by Knowlton and colleagues (1992), patients with and without amnesia were shown letter strings and asked to classify new letter strings as correct or incorrect on two occasions. Both groups performed significantly above chance at classifying new grammar strings. However, the amnesiac group could not recognize the exemplars and their performance was worse when they were instructed to classify strings by making explicit comparisons with exemplars. Given the results, the authors concluded that this task was more likely to measure implicit memory over explicit memory.

Manza and Bornstein (1995) studied the difference found between measuring the 'liking' of the grammar strings verses the 'grammaticality' of the grammar strings in non-amnesiac groups. Though they did conclude that answering questions concerning grammaticality involved more explicit processes, no significant difference was found between the two techniques and both had comparable results. However as stated earlier, these techniques may differ once an analytical mindset is induced; the difference depending upon which measurement (liking verses confidence/grammaticality) suffers in the analytical mindset group compared to the control group.

Intuition and Analytical Thinking

A great deal of research thus far has been devoted to the debate over which thinking process leads to better decision-making outcomes: intuitive or analytical. The current trend appears to be focused on complex preferences or evaluative judgments (e.g., Baylor, 2001; Halberstadt & Hooton, 2008). Many studies indicate that intuitive-type thinking is effective when the objects being evaluated are too complex to be simultaneously contemplated during deliberate thinking (e.g., Dijksterhuis, 2004;

Halberstadt, 2008; Smith & DeCoster, 2000). Studies where participants judge popular paintings, jams, posters, and basketball players have all found that instructions that rely upon one's intuition result in better evaluations (Halberstadt & Hooton, 2008; Halberstdt & Levine, 1999; Ubel & Lowenstein, 1997). In a study by Halberstadt and Green (2008), for instance, when judging two Olympic dives with a thirty-minute break between the two judgments, participants who were exclusively instructed to make their first judgment using analytical thinking were worse at evaluating both dives compared to a control group who was not given any instructions for either judgment.

From these results the authors surmised that participants instructed to use analytical thinking made a general shift in their decision strategy that then influenced their second evaluation. The present research will extend these findings in that analytical thinking will be induced in a completely unrelated domain from the intuition task via mindset priming (e.g., Gollwitzer & Kinney, 1989). By so doing, this work will show that intuition can be worsened after an analytical mindset is induced, and not just from a shift in decision strategy. In this case, intuition-based performance would be unrelated to those factors that actually induced analytical thinking.

Factors that Worsen Intuition

In this section, four possible causes for the failure of intuition will be described. These causes are: a) intuitive affect being disrupted or replaced by another emotion or process; b) intuitive affect never reaching consciousness; c) the individual consciously choosing to ignore the intuitive affect; and d) the intuition conveying flawed information.

First, given that affect appears to be at the core of intuition, it makes sense that a second emotion could interfere with the intuition-based emotion. Bolte, Goschke, and Kuhl (2003) showed that the activation of negative affect exerts a detrimental effect on

intuition-based performance. Specifically, by recalling a negative memory, participants experienced negative affect that disrupted intuition-based affect. Although their study did not show that positive affect significantly worsened intuition, their method of memory recollection as mood induction may not have elicited a positive mood strong enough to disrupt the affect associated with intuition. Moreover, affect is not the only factor that could obstruct intuition. If one focuses on a specific type of information, such as information that is consciously accessible, they may not actively notice the affect even though it reached consciousness (i.e., it was a "fleeting thought"). This may be similar to having a thought rush into one's mind, only to be quickly replaced by another thought. Before one becomes aware of it, a decision was made without remembering the original thought. Similarly, a cognitive process may disrupt emotion. One may have been aware of the emotion but *unintentionally* focused on other information, thereby decreasing one's reliance on an emotional experience that might contribute to making a decision.

Second, intuitive processing may be undermined when the affect used to express the unconscious information is not strong enough to achieve consciousness. This possibility is informed by research on implicit versus explicit memory. Ideally, the information could still be implicitly learned but its strength may not reach the threshold needed to create an affective experience that is recognizable to the conscious. No extant research has addressed this possibility.

Third, worsened intuition-based performance may occur if an individual uses another (most likely deliberate) source for their decision-making after either consciously choosing to ignore the intuition or no longer considering the intuition as accurate information. The term "cognitive feeling," where emotion replaces the event as the subject and becomes over-evaluated, could be an example. In this case, an individual may

lack confidence in the affect that they recognize and therefore choose to make a decision based upon different reasoning.

As opposed to the case where the intuition is *subjectively* judged to be incorrect, a fourth possibility is that the intuition-based judgment is *objectively* incorrect. Overreliance on heuristics, for example, can lead to sub-optimal decision-making (e.g., Tversky & Kahneman, 1974). In addition, some researchers have suggested that the unconscious has difficulty processing negations (Dijksterhuis & Nordgren, 2006; Gilbert, 1991; Strack & Deutsch, 2004). If information when implicitly learned excludes negations that were originally included, then it is logical that the activation of this information during intuition would be incorrect because the negation may not be activated.

By deductive reasoning, some of these possibilities may be discounted as explanations for the disruptive effect of analytical thinking on intuition. For instance, it is unlikely that analytical thinking lowers the strength of affect because the affect strength is determined in the unconscious and an analytical mindset should primarily influence the conscious. Rather, it seems more reasonable to posit that analytical thinking disrupts intuition on a cognitive level. Halberstadt (2008), when describing his Affect Disruption Hypothesis, theorizes that intuition is worsened by analytical thinking via three mechanisms that will be described later. In kind, the present work will attempt to isolate the specific mechanisms by which the activation of analytical mindsets subsequently worsens intuition-based performance. One possibility that will be addressed is that one's confidence towards the intuitive affect is lowered following analytical mindset priming and, as a result, one's ability and/or willingness to rely upon these cues to classify grammar strings correctly is diminished. In the proposed study, affect toward grammar

strings as well as confidence regarding the correctness of grammar strings will be compared between groups who either do or do not first perform an analytical task. It is hypothesized that confidence will be the variable that is most influenced by analytical thinking.

Distinguishing Between Conceptual Priming and Mindset Priming

Given that these studies employ an analytic mind-set manipulation, it may be useful at this point to draw a distinction between conceptual priming and mind-set priming (e.g., Bargh & Chartrand, 2000). Conceptual priming is thought to evoke the activation of specific mental representations (e.g., traits, stereotypes, goals) which then serve as interpretative frames in the processing of subsequent information (e.g., Higgins,1996). Mind-set priming, on the other hand, activates procedural knowledge. Thus, what is primed is a "way" of thinking. Bargh and Chartrand (2000) also distinguish mind-set priming from conceptual priming by noting that most studies of mind-set priming involve having participants first intentionally use a given mental procedure rather than simply exposing them to words related to a particular construct. In this way, mind-sets are thought to involve the nonconscious carryover of an intentionally pursued mental procedure (e.g., Gollwitzer, Heckhausen, & Steller, 1990).

The proposed study will employ a counterfactual mind-set manipulation that has been used in a number of previous studies to induce an analytical mindset (e.g., Galinsky & Moskowitz, 2000; Kray & Galinsky, 2003), with the assumption being that thinking counterfactually in one context should increases the tendency to (unconsciously) use mental simulation as a cognitive process when solving a variety of problems (see also Galinsky, Gruenfeld, & Magee, 2003).

OVERVIEW OF CONDUCTED STUDIES

Three studies examined how an analytical mindset influences intuition-based performance. All studies included three primary tasks. The first task involved implicitly learning artificial grammar strings. The second task involved inducing an analytical-mindset. The third task involves correctly identifying grammar strings that follow a pattern learned from the implicit learning task. The grammar strings in this third task were never the same strings used in the implicit learning task.

Study 1

An analytical mindset was induced in Study 1 by having participants complete a math task. It was hypothesized that inducing an analytical mindset would undermine performance on an implicit learning (i.e., artificial grammar) task relative to control participants.

Method

Participants

Eighty-three male and female undergraduates at Ohio University completed the study in return for course credit. Twelve participants were removed for either not following the directions or exceeding two standard deviations beyond the mean number of times a single response was answered [seven participants from the analytical condition and five participants from the control condition]. For example, a participant who identified every grammar string as correct (or incorrect) would be removed. This resulted in a final sample of 71 participants.

Procedure

Implicit learning task. To begin, participants were told that they would be completing a memory task. They were then shown 24 grammar strings, one at a time, and each time were asked to retype the letters (e.g. VMRTMXR). Nine letters covered the number pad on the computer, and participants used these to retype each grammar string.

Mindset manipulation. Participants were randomly assigned to one of two conditions. In the *mindset* condition, participants were asked to correctly answer 5 multiple choice math questions. They were told that they would be given up to 20 questions until they answered 5 correctly. In the control condition, participants were shown 5 different hidden-object pictures and asked to find an object embedded in the picture. The picture had been separated into four quadrants and the participants had to identify in which quadrant the object was hidden. If they identified the wrong quadrant, the same picture was shown to them for another attempt.

Intuition task. Participants were then given the following set of instructions…

"All the letter strings that you retyped in the first task followed the rule system. Even though you weren't paying attention, your unconscious may have detected this complex pattern. I will now show you new letter strings. You can access the knowledge that your unconscious has by using your "gut feeling". Then you can identify new letter strings as grammatically correct or incorrect based upon the previous letter strings. Now you will be shown some new letter strings. Please use your 'gut feeling' in order to identify the following letter strings as grammatically correct or incorrect based upon the previous learned grammar strings. In other words, do you FEEL as though the new letter string is correct or incorrect based upon the rule system that the previous letter system followed?"

Process questionnaire. Following completion of the intuition task, participants were asked to report on the process or rules they used to classify the grammar strings. Specifically, they were asked to circle one of five choices: "I used my gut feeling;" "I followed a pattern;" "I guessed;" "I randomly clicked any button;" "I don't know." Participants who circled "I randomly clicked any button" were removed from subsequent analyses. Following completion of this measure, participants were debriefed and thanked for their participation.

Results

Separate t-tests were conducted for each condition that compared the mean percentage of correctly classified grammar strings against chance (50%). As depicted in Table 1, the results indicated that whereas participants in the control condition did classify correct strings at better than chance levels, (M = .627), $t(36) = 3.744$, p = .001, participants in the analytical-mindset condition did not perform significantly better than chance, (M = .5471), $t(33) = 1.340$, p >.10. These results support the hypothesis that the induction of an analytical mindset would worsen performance on an intuition-based task. There were no significant difference between conditions, correct grammar strings were $F(1,69)=2.680$, p>.10 and incorrect strings were $F(1,69)=.183$, p>.10.

Table 1

Mean Classification of Correct Grammar Strings

Condition	N	Mean	Standard Deviation
Math Condition	34	.55	.20
Control Condition	37	.63*	.21

Note: Significant compared to chance at the *p<.003

Study 2

An alternative explanation for the results of Study 1 is that rather than inducing an analytical mind-set, completion of the math task undermined performance relative to completion of the control task because the former is a more effortful task than the latter. To instantiate analytical thinking more subtly, Study 2 employed a mind-set priming procedure developed by Galinsky, Kray, and colleagues (e.g., Galinsky & Kray, 2004; Galinsky & Moskowitz, 2000; Kray & Galinsky, 2003; Kray, Galinsky, & Wong, 2006). In this procedure, participants read a scenario about a woman named Jane who attends a rock concert. In the two counterfactual versions of the scenario, Jane changes her seat to move closer to the stage and either wins tickets to a Hawaii trip in her new seat (downward counterfactual) or fails to win the tickets after moving out of the winning seat (upward counterfactual). In the two non-counterfactual versions of the scenario, Jane does not change her seat and either wins or fails to win the tickets. All four versions of the scenario are depicted in Appendix A.

Employing this procedure, Galinsky, Kray and colleagues have demonstrated various downstream consequences of the instantiation of a counterfactual thinking mindset. For instance, Galinsky and Moskowitz (2000) found that the consideration of alternate realities reduces the confirmation bias, and Liljenquist, Galinsky, and Kray (2004) found that counterfactual mind-sets improve decision accuracy by increasing the discussion of unique information critical for group decision-making and promoting synergistic cooperation. These researchers have conceptualized counterfactuals as promoting a relational processing style – a cognitive style characterized by a consideration of relationships and associations. In support of this conceptualization, Kray et al. (2006) found that counterfactual mind-set activation enhanced performance on the analytical section of the Law School Admissions Test (LSAT), a section that assesses one's ability to understand and apply rules, determine relationships between concepts, analyze situations and draw conclusions, and apply logic to ambiguous or complex situations.

In Study 2, it was hypothesized that exposure to counterfactual scenarios (either upward or downward) would undermine intuitive performance (i.e., to chance levels), whereas exposure to non-counterfactual scenarios would not undermine intuitive performance (i.e., participants should perform at better than chance levels).

Method

Participants

Ninety-one male and female undergraduates at Ohio University completed the study in exchange for course credit. Fifteen participants were removed either for not

performing the second task correctly or exceeding two standard deviations beyond the mean number of times a single response was answered, leaving a final sample of 76 participants.

Procedure

Participants completed the implicit learning task, were exposed to the mind-set manipulation, completed the intuition task, and then responded to the REI (Epstein, Pacini, Denes-Raj, & Heier, 1996) and the Positive and Negative Affect Scale (PANAS; Watson & Clark, 1994) to assess mood differences.

Scenario conditions. Participants were randomly assigned to one of four conditions that required them to list thoughts after reading a scenario. In each scenario, Jane attends a rock concert where free tickets to Hawaii are awarded to whoever is sitting in a randomly drawn seat. In the two counterfactual conditions, Jane changes seats to move closer and either wins the tickets in her new seat (downward) or loses the tickets after moving out of the winning seat (upward). In the two non-counterfactual conditions, Jane does not switch her seat and either wins (win) or fails to win (loss) the tickets (see Appendix A for the full scenarios).

PANAS. The PANAS was used to examine if emotional responses differed between conditions. Participants rated their current emotions (e.g., jittery, hostile, nervous, attentive, determined, alert) on a 1 (not at all) – 9 (very much) scale.

REI. The REI includes 10 questions that measure need for cognition and faith in intuition. Following completion of these measures, participants were debriefed and thanked for their participation.

Results

REI

A one-way ANOVA conducted on the Need for Cognition (α=.767) and Faith in Intuition (α=.799) subscales yielded no significant differences as a function of Scenario Condition, Fs < 1.

PANAS

A principal components factor analysis conducted on the PANAS identified two factors that appeared to represent positive (α = .85) and negative (α = .89) emotions. Separate ANOVAS revealed no significant differences between conditions for the former, F (3, 72) = 1.46, p >.10, or latter, F (3, 72) = 1.93, p >.10 (see Table 2).

Intuition Task

As in Study 1, separate t-tests were performed on each condition, comparing performance on the intuition task to chance. Results indicated that neither participants in the upward (*M* = .56, *SD* = .1984, *t*(19) = 1.352, *p* > .10) nor downward (*M* = .435, *SD* = .2396, *t*(16) = 1.113, *p* > .10) counterfactual conditions performed better than chance. On the other hand, participants in the win control condition (*M* = .5944, *SD* = .1862), *t*(17)= 2.152, *p* < .05) and loss control condition (*M* = .5857, *SD* = .1797, *t*(20)= 2.186, *p* < .05) conditions performed significantly better than chance (see Table 2). These results support the hypothesis that the induction of an analytical mindset lowers performance on an intuition-based task.

Table 2

Mean Classification of Correct Grammar Strings

Condition	N	Mean	Standard Deviation
Upward Counterfactual	20	.56	.20
Downward Counterfactual	17	.44	.24
Upward Control	18	.60*	.19
Downward Control	21	.59*	.18

Note: Significant compared to chance at *p<.05

Study 3

A potential alternative explanation for the results of Study 2 is that the counterfactual mind-set conditions did not evoke an analytical thinking mindset, per se but, rather, differentially taxed working memory because of the uncertainty evoked by considering counterfactuals (cf. Zeigarnik, 1967). To address this concern, all participants in Study 3 considered counterfactuals that varied in structure. Markman, Lindberg, Kray, and Galinsky (2007) presented evidence suggesting that subtractive counterfactual thoughts (e.g., "if only I had NOT") induce an analytical mindset, whereas additive counterfactual thoughts (e.g., "if only I HAD") induce a creative mindset. In this work, participants were directed to generate either additive or subtractive counterfactuals. According to the results, subtractive counterfactual thinking enhanced performance on two analytical tasks (i.e., the Remote Associates Task and a syllogism task) relative to

additive counterfactual thinking, whereas additive counterfactual thinking enhanced performance on two creative generation tasks (i.e., a Scattergories task and generating novel uses for a brick) relative to subtractive counterfactual thinking. In Study 3, it was hypothesized that participants would perform above chance levels after generating additive counterfactuals, but perform at chance levels after generating subtractive counterfactuals.

Method

Participants

Forty-nine male and female undergraduates at Ohio University completed the experiment in exchange for course credit. Twenty participants were removed for either not following the directions or exceeding two standard deviations beyond the mean number of times a single response was answered. This left a final sample of 29 participants.

Procedure

Participants completed the implicit learning task, were exposed to the counterfactual structure manipulation, completed the intuition task, and responded to the REI and PANAS.

Counterfactual structure manipulation. Participants were randomly assigned either to the "additive" or "subtractive" condition. In both conditions, participants read a vignette about a man who occasionally smoked and exercised and had to get a lung biopsy. After reading the vignette, participants in the "additive" condition were directed to list up to ten things the man *could have* done to improve his situation, whereas those in the

"subtractive" condition were directed to list up to ten things the man in the vignette *could have NOT* done to improve his situation.

Following completion of the intuition task, REI, and PANAS, participants were debriefed and thanked for their participation.

Results

REI and PANAS

Preliminary analyses indicated no differences between conditions on the Faith in Intuition or Need for Cognition subscales of the REI, $F < 1$ and $F(1, 27) = 1.453$, $p > .10$, respectively. In addition, no differences were found for the negative emotion subscale of the PANAS, $F(1, 27) = 1.37$, $p > .10$. A marginally significant difference, however, was found on the positive subscale of the PANAS, $F(1, 27) = 2.67$, $p < .07$, such that participants reported being in a more positive mood following additive counterfactual generation ($M = 2.833$) than following subtractive counterfactual generation ($M = 2.23$) (see Table 4). However, the correlation between positive mood and percentage correct was nonsignificant ($r = .236$, $p > .10$).

Intuition Task

Separate t-tests were performed in each condition that compared the mean percentage of correctly identified correct grammar strings against chance. Results indicated that participants in the subtractive condition did not perform significantly better than chance, ($M = .5$, $SD = .2076$), $t < 1$, whereas participants in the additive condition did perform significantly better than chance, ($M = .593$, $SD = .1438$), $t(14) = 2.514$, $p < .03$ (see Table

3). These results again support the hypothesis that the induction of an analytical mindset will worsen performance on an intuition-based task.

Table 3

Mean Classification of Correct Grammar Strings

Condition	N	Mean	Standard Deviation
Additive Counterfactual	15	.59**	.14
Subtractive Counterfactual	14	.50	.21

Note: Significant compared to chance at **p<.03

Study 4

The purpose of Study 4 is to examine some of the cognitive and affective components of intuition-based performance and uncover the possible mechanisms (e.g. affect and confidence) underlying the effects of analytical thinking mind-sets on diminished intuitive performance. In Studies 2 and 3, participants classified grammar strings as grammatically correct or incorrect based upon their gut feelings. In the proposed study, participants will instead rate either their liking towards the grammar strings or their confidence that the grammar string is correct. Gordon and Holyoak (1983) found that participants were more likely to rate correct grammar strings as more likeable and they were also more confident about correct grammar strings.

It is expected that participants induced into an analytical mindset through counterfactuals will rate their confidence towards the correct grammar strings significantly lower than participants who are not induced into an analytical mindset through a control condition. However, this difference should not be found for incorrect grammar strings. In other words, it is also expected that the discrimination confidence rating will be significantly smaller for the analytical group than the control group. This prediction was not possible to make for the previous three studies because performance in separate conditions was simply compared against chance performance. The continuous measures of confidence and liking employed in the proposed study, however, will allow for such between-group comparisons. The overall hypothesis is that any significant difference in confidence found between the analytical mind-set and control group will illuminate the mechanism by which intuitive performance is diminished by an analytical mindset. Moreover, although Gordon and Holyoak (1983) did find that likeability ratings increased for correct grammar strings, it is hypothesized that liking will not be influenced by an analytical mindset because such mindsets would seem to share more in common with cognitive than affective processes. This hypothesis deviates from an accumulation of recent research that indicates the importance of fluency and affect in intuition-based performance. Therefore, it is important to also discuss these components and how they may or may not be related to the results found in the last three studies.

Affect Disruption and Cognitive Fluency

Halberstadt and Hooten (2008) examined analytical thinking and cognitive fluency in judgments about the likeability of art. Participants in the analytical condition

had to state at least two reasons why they liked or disliked a painting before rating their likeability of the painting, whereas the Feeling condition was told to use a "gut feeling" in order to make likeability judgments. Not surprisingly, the analytical group was slower to render likeability judgments and liked the paintings less. Based on these findings, the authors concluded that analytical thinking lowers positive affect and attitude consistency. Halberstadt (2009) described the affect disruption hypothesis, whereby "…analytic thought interferes with the detection and/or use of affective responses" (p.17) and delineates multiple explanations for why analytic thinking might produce this effect.

First, "feeling states" are difficult to verbalize, too subtle, or arise from various stimuli, and thus may not be interpreted as information relevant to the decision. As a result, information that is verbally communicated or consciously accessible plays a larger role in the decision-making process. Second, even if affect is interpreted as some type of useful information, the individual may not accurately ascribe it to the source, and misattribution of emotion may result (Topolinski & Strack, 2008b). Third, cognitive fluency can direct the decision, in that an increase in cognitive fluency may lead to a higher level of positive affect identified as intuition, and analytical thinking may lower this fluency. Fourth, analytic thinking may create an additional affective reaction that can mislead intuitive processing.

Past research has supported the notion that cognitive fluency influences the accuracy of intuition. Correct triads in a semantic coherence task are shown to elicit more cognitive fluency, as indicated by shorter response latencies. (Topolinski & Strack, 2008a). This cognitive fluency also tends to elicit a slight amount of positive affect

(Topolinski & Strack, 2008a; Topolinski et. al., 2009). The question that arose became whether it was positive affect alone or positive affect deriving from cognitive fluency that enhanced intuitive performance. To investigate, Topolinski and Strack (2008b) tested the separate effects of manipulating emotion and cognitive fluency. They found that altering the source effects worsens intuition-based performance when it is related to emotion, but not when the source effect alters the perception of cognitive fluency. They also used a source misattribution paradigm to test the process. Specifically, background music was played during the participants' sessions after telling them that the music would either influence the ease that stimuli can be brought to mind (cognitive fluency), the way they feel (affect), or would have no influence at all (control). Results support the worsening influence of affect on intuition. For the affect misattribution group, the percentage of identified coherent triads was not significantly different from the percentage of misidentified incoherent triads. For the cognitive fluency misattribution group and the control group, however, the percentage of identified coherent triads was significantly higher than the percentage of misidentified incoherent triads.

These results support the notion that mechanisms that alter affect may have a negative effect on intuition. On the other hand, the alteration of the perception of cognitive fluency does not itself appear to have a negative effect on intuition. Rather, it is the affect that derives from the fluency experience that enhances intuition and accuracy, not affect independently activated. Topolinski and Strack (2009) further tested this hypothesis by manipulating fluency and affect by changing backgrounds, showing semantically affective words, and priming faces. Intuition was measured using both the

semantic coherence task and artificial grammar task. The results of these studies appear to support the theory that cognitive fluency triggers positive affect that is the basis of intuition. When the presentation of the word triads were made more difficult, subjects were more likely to state them as incoherent. The inverse effect also took place. That is, incorrect word triads were made more cognitively fluent than correct word triads resulting in participants falsely identifying these triads as correct than incorrect.

It is argued here, however, that cognitive fluency is not responsible for the effects of the analytical mindset. First, analytical thinking does not appear to evoke additional affect. Secondly, it has been argued that nonverbal information is either overshadowed or weighted less than information that can be verbally communicated. This line of reasoning implies that analyzed verbal information will trump nonverbal (affective) information that is related to the judgment in question. The work of Halberstadt and colleagues supports this theory because those studies used the same context for the intuition task as they did for the analytical thinking task (e.g., Halberstadt & Green, 2008; Halberstadt & Hooten, 2008). However, in the three completed studies described in this proposal, the analytical thinking that is initiated via mind-set activation does not have to convey any information about the judgment needed for the intuition task. In other words, no consciously accessible or verbal information is conveyed in the analytical task that can be applied to the intuition task and elicit an information shift - a shift in the weight given to different information used for the decision.

An additional possibility is that analytical thinking may distract one from recognizing the source of their affect. As described earlier, Topolinski and Strack (2008)

found that intuition-based performance can worsen when another explanation for one's affect is provided (e.g., background music). However, this appears to be an unlikely explanation for the present set of results because no additional explicit source is provided to which one might misattribute affect.

A more plausible argument, and the one that will be advanced here, is that analytical thinking may diminish one's confidence in the usefulness of the affect that is associated with their intuition. Perhaps as analytical thinking increases, one is less likely to trust emotion as a reliable source. Participants begin to over-think about the affect and increase their doubt, thus lowering their intuition. If this is the case, then the ratings of liking of correct grammar strings should not differ between a group that has been induced into an analytical mindset and a group that has not, whereas feelings of confidence toward correct grammar strings should be reduced when analytical thinking has been induced. There are three hypotheses. The first hypothesis states that ratings based upon confidence for correct grammar strings will be significantly higher in the non-counterfactual (control) condition than in the counterfactual (analytic mind-set) condition. The second hypothesis states that the difference in ratings of confidence between the correct grammar strings and incorrect grammar strings will be significantly higher for the non-counterfactual condition than for the counterfactual condition. The third hypothesis states that liking ratings for correct grammar strings will not differ between the non-counterfactual and counterfactual conditions.

Method

Participants

Sixty participants who are undergraduates from Ohio University will complete the experiment in exchange for course credit.

Procedure

Participants completed the implicit learning task, read a vignette, the intuition task and either assessed their liking or confidence regarding grammar strings. They then completed the PANAS.

Scenario condition. Participants were randomly assigned to one of two conditions. Participants assigned to the "counterfactual" condition read the downward counterfactual version of the Jane vignette employed in Study 2 and were asked to list their thoughts, whereas those assigned to the "non-counterfactual" condition read the win version of the Jane vignette and were asked to list their thoughts.

Intuition Task. The intuition task employed in the first three studies was used again, with the exception that participants were asked to either rate their liking of each grammar string on a 1 ("not at all") - 6 ("very much") scale, or rate their confidence that the grammar string is correct on a 1 ("not at all") - 6 ("very much") scale.

Following completion of the PANAS, participants were debriefed and thanked for their participation.

Results

Manipulation Check

Fifteen participants were removed for failing the manipulation or failing to follow the instructions for the counterfactual task. The confidence counterfactual group excluded 1 participant; the confidence control group excluded 6 participants; the liking counterfactual group excluded 3 participants; the liking control group excluded 5 participants. This left 77 participants.

PANAS

After running a factor analysis, two components emerged that represented positive emotions (attentive, active, proud, excited, strong, enthusiastic, alert, inspired, and determined) and negative emotions (afraid, nervous, scared, and distressed). A One-Way ANOVA measured each component against the conditions and found that the positive emotion component was marginally significant, F (3, 73) = 2,43, p = .072, and the negative emotion component was insignificant, F (3, 73) = .612, p = 0.62. Planned contrasts comparing the counterfactual against the non-counterfactual condition were run for confidence and affect. Results revealed that confidence showed no significant difference in affect, t (73) = 1.656, p = .102, but there was a significant difference in affect where participants in the counterfactual condition showed higher affect (M = 3.02, SD = .956) than the non counterfactual condition (M = 2.4, SD = .785), t (73) = 2.206, p = .037)

Intuition Task

A Between-Group ANOVA was run for the mean rating of correct grammar strings; mean ratings for false grammar strings; and difference rating between correct and incorrect grammar strings. The means are displayed below in table 5. The mean ratings for false grammar strings were not significantly different, F (3, 73) = .713, p = .55. There were significant differences between groups in mean rating of correct grammar strings, F(3, 73) = 3.0, p = .036, and marginal significance in the discrimination rating between correct and incorrect grammar strings, F(3, 73) = 2.37, p = .078. T-tests were conducted in order to compare the discrimination scores from 0. The bigger discrepancy between correct and incorrect grammar strings, larger the discrimination score is from 0. A discrimination score that is significantly different from 0 suggests that correct grammar strings had a significantly different rating than the incorrect grammar strings. In Table 5 the mean discrimination scores are displayed. The results of the t-tests indicated that the confidence control condition had a highly significant discrimination rating, t (19) = 3.094, p <.001. The affect counterfactual condition was marginally significant, t (21) = 1.972, p < .06. Neither the affect counterfactual condition nor the affect control were significant, t (17)= .664, p > .10; t (15) = 1.103, p > .10.

Table 4

Mean Ratings of Grammar Strings

Condition	N	Correct Strings	Incorrect Strings	Difference
Confidence Counterfactual	18	3.31	3.33	-.023
Confidence Control	20	3.90	3.4	.46
Liking Control	22	3.97	3.67	.29
Liking Control	17	3.45	3.45	00

Two planned contrasts were performed that (1) compared the confidence ratings between the counterfactual and non-counterfactual groups and (2) compared the likeability ratings between counterfactual and non-counterfactual groups. The first planned contrast found a significant difference in the mean confidence ratings of correct grammar strings, $t(73)= -2.30$, $p<.03$, and a significant difference in the discrimination of correct from incorrect grammar strings, $t(72)= -2.24$, $p<.03$, where in both cases the control condition had a significantly higher correct string rating and significantly higher discrimination rating. These results, which can be seen in Table 5, support the first hypothesis that states ratings based upon confidence for correct grammar strings will be significantly higher in the non-counterfactual (control) condition than in the counterfactual (analytic mind-set) condition. The significant difference in the discrimination ratings supports the second hypothesis that states the difference in ratings

of confidence between the correct grammar strings and incorrect grammar strings will be significantly higher for the non-counterfactual condition than for the counterfactual condition.

Results of the second planned comparison revealed a marginally significant difference in likeability ratings of the correct grammar strings between the control and counterfactual condition, t (73)=1.937, $p < .06$, where the counterfactual condition had the higher rating of correct grammar strings, as seen below in Table 5. This finding does not support the 3rd hypothesis that stated there would be no significant difference in affect ratings between the non-counterfactual and counterfactual conditions. Neither the ratings of incorrect grammar strings nor the discrimination ratings between correct and incorrect grammars strings were significantly different between the counterfactual and non-counterfactual conditions, when looking at the affect ratings. There is an interaction in liking and confidence between counterfactual and control groups. As shown in Figure 1, control groups had higher confidence ratings and lower affect ratings and counterfactual groups had higher affect ratings and lower confidence ratings. And as stated earlier, the difference in confidence ratings of correct grammar strings between the counterfactual and control conditions is significant (p<.03) and the affect ratings between these two conditions is marginally significant (p<.06).

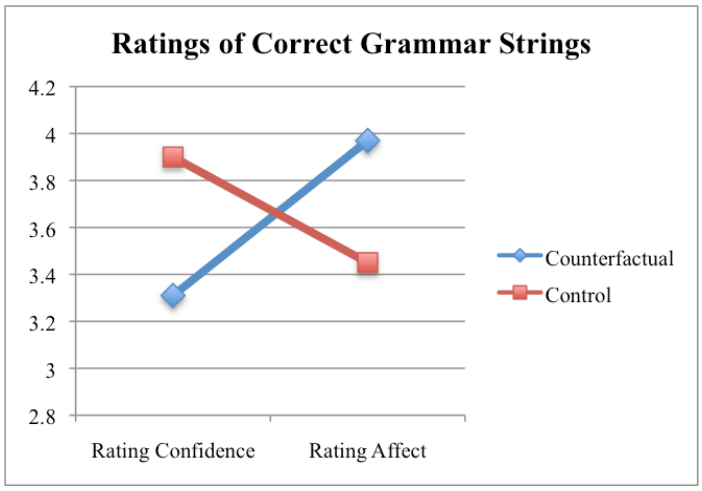

Figure 1. Graph of correct grammar string ratings from study 4.

GENERAL DISCUSSION

Overall, we believe these studies support the notion that an analytical mindset can worsen intuition-based performance. In the first three tasks, participants induced into an analytical mindset could not perform better than chance at an intuition-based task even when this subsequent task was unrelated. Whether participants were induced into an analytical mindset through the use of math problems or counterfactual vignettes, they were not able to perform significantly better than chance at classifying correct grammar strings. Control conditions were able to significantly perform better than chance at classifying correct grammar strings. The fourth task tried to uncover the mechanism that could be influenced by an analytical mindset resulting in the worsened intuition. The first two hypotheses were confirmed, where the confidence control condition rated correct grammar strings higher than the confidence counterfactual condition and the discrimination scores were significantly higher for the confidence control condition than the confidence counterfactual condition. Because the confidence control condition performed better than all other conditions, especially the confidence counterfactual condition, confidence could be another important key in accurate intuition—in addition to what has been identified in past research. An analytical mindset causes one to over-think problems; in this context one may try to over-think the intuitive affect and thus, have increased doubt towards this affect. This lowered confidence will lower the influence of intuition on the decision. The affect may still be reaching the conscious but if one has no confidence in this affect or overly thinks about it, it is probably less likely to be used.

Another interesting result was the performance of the affect counterfactual task, which also performed fairly well. Though not expected, this was a slightly anticipated possibility. Past research has found a relation between positive affect and intuition-based performance (Bolte, Goschke, and Kuhl, 2003). Also, counterfactual mindsets have been known to cause "emotion amplification" (Kahneman & Miller, 1986; Markman et al., 1993). As such, the amplification of positive affect from the counterfactual task could also carry-over and have an additive effect with the positive affect incited by the grammar strings, which would explain the difference in positive affect between the affect control condition and affect counterfactual condition. Such a consequence could increase the positive affect towards incorrect grammar strings as well, as indicated by the higher affect means for both string types.

The poor performance of the affect control condition in the fourth study was concerning. It was expected that this condition would perform better at discriminating between correct and incorrect grammar strings. If emotion amplification did improve the results of the affect counterfactual group and participants were able to perform marginally better at discriminating correct and incorrect grammar strings as a result then it is possible that the results of the control affect group accurately reflect the performance of affect alone. However, past research has found differences in affect scores for control conditions; therefore this explanation appears unsettling (Gordon & Holyoak, 1983).

Methodology could be another cause for these results. Gordon and Holyoak (1983) had a slightly different methodology when they found a strong association between liking and grammar string ratings. In the first study, participants rated their

liking for the grammar strings directly after rating their confidence that the string is grammatical. This could create a bias response in affect ratings if participants are first being influenced by their confidence ratings. In the second study, the participants rated liking without being told prior that there was a structure that the strings followed. Perhaps, it is important that the participants not know about the grammar structure before rating their likeability of the grammar strings. This knowledge may also cause participants to overly focus on the structure of the test strings, possibly once again increasing doubt. In the 4th study, the instructions were kept identical between the confidence and affect conditions to increase their comparability as much as possible. Therefore all conditions knew about the grammar structure before rating the new strings. Though small differences, these slight alterations could have decreased the magnitude of the difference between the liking of correct and incorrect grammar strings. Either way, further research may need to be conducted in order to better understand why these results found for the affect control condition deviate from past research.

Future Directions

If analytical mindsets worsen intuition via confidence, then it should be possible to repair this effect. Future studies could look at the effects of boosting one's confidence over their intuitive ability. This may repair the effect of analytical thinking as well as improve intuition in other contexts. Also there may be individual differences in intuition-based performances that may moderate the damage caused by an analytical mindset. For example, the rationality-experiential inventory did not produce significant results in earlier studies, but maybe people who score very high on the "faith in intuition scale" or

low on the “need for cognition scale” will not be as influenced by the effects of an analytical mindset on one’s intuitive abilities (Epstein et al, 1996).

Further research should be done to test confidence as the mediator in this relationship between analytical mindsets and intuition. In the fourth study, confidence was measured for both the counterfactual groups and control groups. This study was trying to understand why the control groups would be performing better, as shown in the first three studies. therefore, performance wasn’t measured independently of confidence in the fourth study. As discussed by Baron and Kenny (1986), a mediator variable will help explain why or how an effect will occur. This can be done by analyzing three pathways, a) the relationship between the independent variable and the mediator, b) the relationship between the mediator and the performance variable, and c) the relationship between the performance variable and the independent variable after both relationships with the mediator are held constant. The first three studies have shown that there is a relationship between analytical verses non-analytical mindsets and intuition-based performance, where analytical mindsets could not perform better than chance on an intuition-based task. The fourth study found that there was a relationship between analytical verse non-analytical mindsets and confidence in the same direction, where analytical mindsets showed lower levels of confidence towards questions from the same intuition-based task. Unfortunately, because the fourth study didn’t measure performance on the intuition task (grammar identification) separately from the confidence experienced during the intuition task, the relationship between the performance variable and the independent variable when confidence is accounted for could not be measured. More

research would have to be done to test whether confidence is the mediator that is influencing the relationship between analytical mindsets and intuition performance.

Many avenues may open up for intuition research based upon these findings. If the importance of analytical mindsets is now realized, efforts can be made to combat its negative effects, while the importance of confidence and intuition can be further explored. Allwood et al. (2000) stated that there was overconfidence in intuition that was based on realistic outcomes. If confidence is an important component to intuition, future research could test the specifics of this relationship.

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