Texas A&M University-San Antonio

Digital Commons @ Texas A&M University- San Antonio

Psychology Faculty Publications

College of Arts and Sciences

4-2011

The Effects of Explicit and Implicit Cognitive Factors on the Learning Patterns in the Iowa Gambling Task

Melissa J. Hawthorne
Texas A&M University-Commerce

Dawn R. Weatherford
Texas A&M University-San Antonio, dawn.weatherford@tamusa.edu

Karin Tochkov
Texas A&M University-Commerce

AMERICAN JOURNAL OF

PSYCHOLOGICAL RESEARCH

Volume 7, Number 1
Submitted: March 11, 2011
Revisions: April 2, 2011
Accepted: April 4, 2011
Published: April 6, 2011

The Effects of Explicit and Implicit Cognitive Factors on the Learning Patterns in the Iowa Gambling Task

Melissa J. Hawthorne, Dawn R. Weatherford, and Karin Tochkov

Texas A&M University – Commerce

E-mail: Karin_Tochkov@tamu-commerce.edu

ABSTRACT

The Iowa Gambling Task (IGT) has become a standard tool in the area of decision making, but recent studies have indicated that cognitive factors might distort the implicit learning expected from the original design of the task. This paper examines the effects of cognitive factors on the performance and learning outcomes of the IGT along two dimensions. First, the instructions for the task are manipulated to test whether more detailed information is conducive to adopting a winning strategy in the IGT. Second, procedural priming's role is investigated by administering a pattern recognition task ahead of the IGT. The results indicate that instructional variation did not have a significant effect on learning patterns. Furthermore, the priming did not yield better results in the IGT compared to the control group. These findings suggest that the IGT is not driven by cognitive awareness of the nature of the task.

Keywords: Iowa Gambling Task, priming, cognitive factors, learning patterns

INTRODUCTION

Bechara, Damasio, Damasio, and Anderson (1994) developed the Iowa Gambling Task (IGT) as an assessment for patients who had suffered damage to the ventromedial frontal lobes of the brain. This task, which is based on a complex schedule of rewards and punishments, gained popularity as a means of studying decision making under conditions of uncertainty. In the task, participants are presented with four decks of cards and instructed to make a series of choices with the goal of maximizing gains and minimizing losses. The decks are designed so that two of the decks have small gains but smaller losses resulting in an overall gain. The other decks have greater gains but even greater losses resulting in an overall loss.

In repeated studies, normal participants began making more advantageous decisions even before they are able to articulate a reason for their decisions. Additionally, participants tend to show higher skin conductive responses (SCR) before choosing from a bad deck, again prior to being able to articulate a reason for their responses. In contrast, participants who had bilateral damage to the ventromedial prefrontal cortex, an area of the brain thought to be linked to emotion processing, did not produce SCRs. Furthermore, they continued to choose from the disadvantageous decks even after knowing the correct strategy. Bechara et al. (1994) concluded that in the normal players, unconscious affective biases guided behavior before the players acquired declarative knowledge that the decks were biased. Based on these findings, Bechara et al. hypothesized that there was a form of implicit or emotion-based learning driving participants' decisions.

Although much of the research into the concept of emotion-based learning and decision making has supported Bechara and Damasio's theory (e.g., Persaud, McLeod, & Cowey, 2007; Whitney, Hinson, Wirick, & Holben, 2007), not everyone is convinced that the IGT actually measures emotional learning. Maia and McClelland (2004) argued that the questions used in IGT research were insufficient to accurately gauge participants' conceptual knowledge about the task. Cella, Dymond, Cooper, and Turnbull (2007) furthered the idea of the IGT as being cognitively penetrable by demonstrating that time pressure affected learning on the task.

Further research supported the idea that cognitive variables influence IGT performance. Balodis, MacDonald, and Olmstead (2006) found that giving shortened instructions to participants prior to the IGT prevented the expected pattern of learning. However, when the researchers expanded the instructions to include information regarding the existence of good and bad decks, the pattern emerged in the typical order. Thus, Balodis, et al. hypothesized that cue salience may be an important contributor to the development of emotional learning.

Likewise, Fernie and Tunney (2006) conducted a study examining the impact of differential instructions on IGT performance. The researchers used two versions of task instructions so that one version contained a hint about the good and bad decks, whereas the other version did not provide any hints. The results revealed no main effect of instruction type for the participants' net scores on the IGT. Fernie and Tunney then calculated the learning rates of both groups and assessed the difference between the hint and no-hint instructions. Again, there was no main effect of instruction. However, in a second session that occurred 48 hours later, main effects of instruction were found for both net gain and learning rate, with the Hint group benefiting most from the second session.

Although Fernie and Tunney's initial findings contradicted those of Balodis, MacDonald, and Olmstead (2006), the second session produced similar results. One possible explanation for this discrepancy is the version of the IGT used by Fernie and

Tunney. This version of the task added two features not present in the standard task. When participants made a card draw in which they gained money, the computer responded with a voice saying "Yippee" and a large yellow smiling face appeared on the computer screen. When participants made a losing draw, they received a frowning yellow face and a "Doh" response. Additionally, gains were presented in green font whereas losses were presented in red font. These stronger indicators of gain or loss may have caused stronger emotional responses that overrode any difference that might have been caused by the instructional variations.

When the participants returned for the second session, they were specifically instructed to read the instructions again and to be sure that they were familiar with them. This emphasis placed on reading and understanding the instructions may have caused participants to pay greater heed to the provided hint. Thus, participants in the Hint condition were able to utilize both the emotional learning of the first session with the renewed cognitive knowledge in the second session. Consequently, the impact of instructional variation on emotional learning is still undetermined. The present study corrects for the potential confound of the extra emotional elements of Fernie and Tunney's version of the IGT. This study also further explores the impact of varying the amount of help given in the instructions on IGT performance.

IGT and Priming

If IGT performance depends on cognitive operations in addition to emotional and somatic reactions, then performance should also be influenced by cognitive priming. According to Smith and Branscombe (1987) an experience can leave a memory trace that can influence later information processing (i.e., priming). Hinson, Whitney, Holben and

Wirick (2006) demonstrated that IGT performance is susceptible to emotional priming. In this study, the decks were labeled with words in addition to the numbers. For half the participants, the emotional valence of the words (i.e., positive or negative) was congruent with the deck status (i.e., good or bad). For the other half, the emotional valence was incongruent. Hinson et al. found that participants in the congruent condition had a very rapid rate of learning, whereas participants in the incongruent condition had slower rates of learning. However, when the decks were all labeled with neutral words, participants showed the normal pattern of learning.

In contrast to emotional priming, procedural priming involves the frequent or recent use of a cognitive strategy to increase the likelihood that a procedure will be used on a subsequent task (Smith & Branscombe, 1987). In later research, Kirmani, Lee and Yoon (2004) applied the idea of procedural priming to the spontaneous use of a relationship or rule. In the facilitative prime condition, the participants were given a scenario in which a person gave a larger donation to one charity than she normally gave to other charities. No reason was given for the larger donation, and participants were expected to infer that the donor truly believed in this charity. In the suppressive prime condition, the implied reason was a self-serving one (i.e. impressing a man). Participants in the control condition did not see a description of the charity.

Following these scenarios, participants read a description of a particular brand of bottled water and saw an example of a print ad for the product. Participants then rated the quality of the product and the effort the company put into promoting it. The results demonstrated that participants who received the facilitative prime did use the cost-quality rule, whereas participants in the other conditions did not. Thus, procedural priming of a relationship influences later spontaneous use of that relationship.

If IGT performance is driven by cognitive knowledge rather than being a measure of emotional learning, performance should be influenced by a procedural priming of the relationship or rule needed to be successful on the task. Because the IGT involves the recognition of a pattern of gains and losses in relationship to the decks chosen, we used a pattern identification task to prime the recognition of patterns. If success on the IGT is predicated on cognitively identifying the pattern of deck rewards and losses then this prime should facilitate the recognition of the pattern causing quicker learning and greater gains.

METHOD

Participants

Eighty eight undergraduate students recruited from a subject pool at a large public university participated for partial course credit. The average age of participants in the subject pool is 22.79, with females representing 64%.

Design

We used a 2x3 experimental design, whereby participants' responses on the IGT were recorded and coded by prime (i.e., implicit or explicit) and instructions (i.e., minimum, intermediate, or maximum detail). The data were divided into five blocks of twenty responses per block and net gain was analyzed using a series of repeated measures ANOVAs. Participants were randomly selected so that there were an equal number of participants per condition.

Procedure

After giving informed consent, the participants performed one of two tasks. In the control condition, participants completed an unrelated task that lasted 15 minutes. In the experimental condition, participants completed pattern recognition problems for 15 minutes. Participants then completed the computerized IGT programmed in the PEBL experiment building language (Mueller, 2010). The instructions for the IGT task varied from being vague to providing many details as to how participants could "win" the game (materials available upon request). Upon completing the IGT, participants were debriefed as to the purpose of the study and thanked for their time.

RESULTS

The first mixed ANOVA used Block (the block of scores on the IGT) as the within subjects variable and Condition (prime * instruction) as the between-subjects variable (N = 70). The results showed a significant difference in scores across Block, $F(1, 57) = 33.08$, $p < .001$, $\eta^2_p = .37$. There was no interaction of Condition and Block, $F(5, 57) = 1.14$, $p = .309$, $\eta^2_p = .09$. However, the sample size per condition was small (N = 10), thus the absence of a main effect of condition and of an interaction could be caused by a lack of power.

To explore this possibility, we collapsed the conditions into two variables, Instruction and Prime. We then analyzed the data using Block as the within subjects variable and Instruction as the between-subjects variable (N = 84). Results showed a significant difference across Block, $F(1, 73) = 44.43$, $p < .001$, $\eta^2_p = .38$. There was no interaction of Instruction and Block, $F(2, 73) = 1.21$, $p = .293$, $\eta^2_p = .03$. A separate ANOVA was used to analyze the data using Block as the within-subjects variable and Prime as the between-subjects variable (N = 35). The results showed a significant difference in scores across Block, $F(1, 32) = 39.43$, $p < .001$, $\eta^2_p = .37$. There was no interaction of Prime and Block, $F(3, 32) = .602$, $p = .662$, $\eta^2_p = .003$.

Pairwise comparisons revealed an intriguing phenomenon for both conditions. Although blocks 3-5 showed a somewhat typical learning pattern (i.e., increasing net gains), Block 2 showed a substantial loss of money (see Figure 1 & 2).

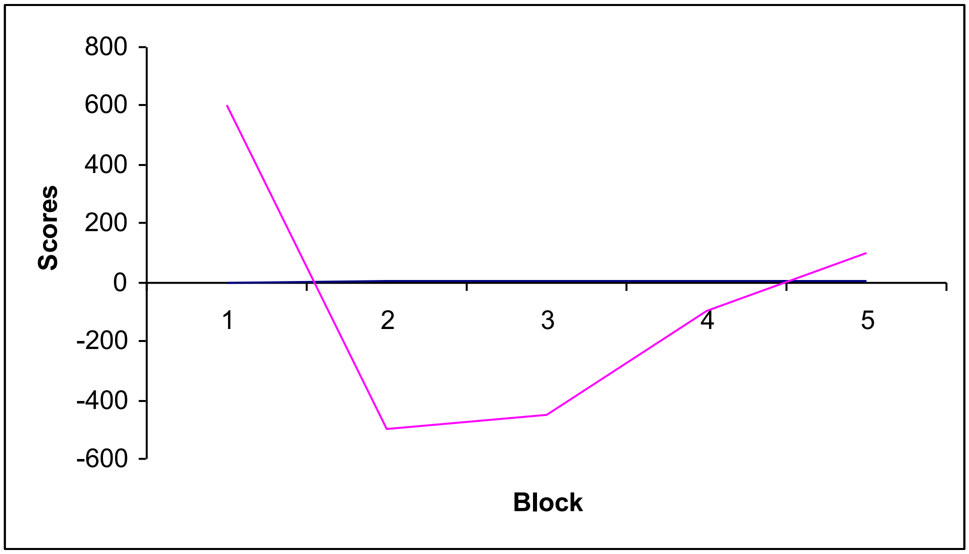

Figure 1. Iowa Gambling Task performance in net gains: Instruction

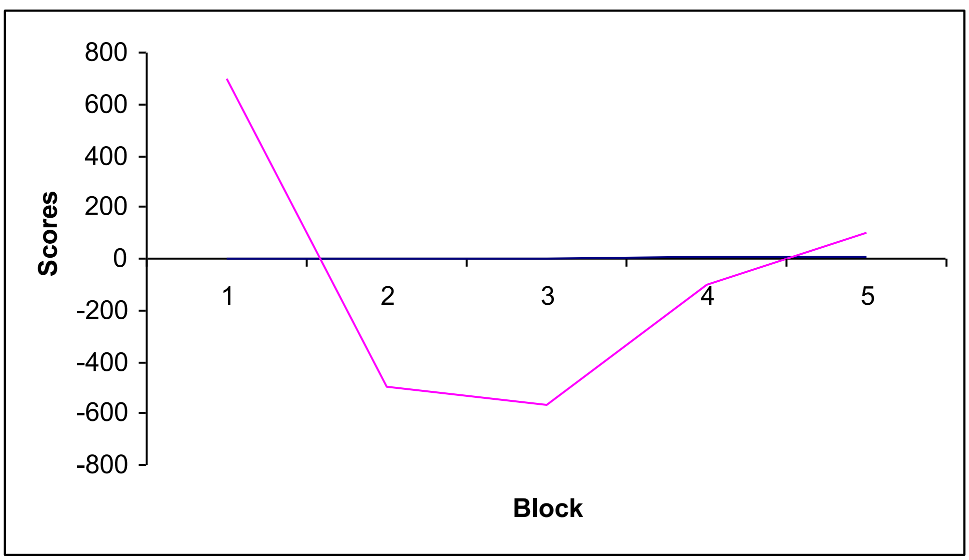

Figure 2. Iowa Gambling Task performance in net gains: Prime

To further explore this pattern, the number of times participants drew from each deck in each block was calculated. The same three ANOVA designs were conducted. The analysis revealed a main effect of Block, $F(4, 328) = 10.77$, $p < .001$, $\eta^2_p = .12$, but no interaction of Block and Condition, $F(20, 328) = 1.11$, $p = .39$, $\eta^2_p = .06$. Further examination revealed that the number of selections from good decks followed the typical IGT learning pattern. For Instruction, there was a main effect of Block, $F(4, 8) = 10.99$, $p < .001$, $\eta^2_p = .11$, but no interaction of Block and Instruction, $F(8, 340) = 1.08$, $p = .38$, $\eta^2_p = .03$ Similarly, for Prime there was a main effect of Block, $F(4, 344) = 11.83$, $p < .001$, $\eta^2_p = .12$, but no interaction of Block and Prime, $F(4, 344) = 1.71$, $p = .14$, $\eta^2_p = .02$. Again, for both conditions the typical learning pattern emerged with participants increasing the number of cards drawn from good decks in Blocks 2 and 3.

These results presented an intriguing contradiction. Although participants began drawing more frequently from the “good” decks, they still showed a dramatic decrease in their gains in block 2. In an effort to explain these conflicting findings, we examined how often participants drew from each deck. The resulting pattern showed that participants drew most from deck B ($M = 32.48$) and least from deck A ($M = 14.78$). The number of cards drawn from decks C and D were only slightly less than from deck B ($M = 27.12$) and ($M = 25.65$) respectively.

However, the most telling patterns emerged when we examined the number of cards drawn from each deck by block and compared them to the IGT reward schedule. The greatest cost (i.e., $1250) was typically not encountered in Blocks 1 and 5 but was hit in Blocks 2, 3, and 4. Concurrently, the number of cards drawn from deck A decreased across the blocks and the number of draws from decks C and D increased. This pattern explains the discrepant findings detailed earlier. The largest penalty was avoided in the first block and hit almost immediately in the second block. This accounts for the sudden decrease in participants' gains. The number of cards drawn from deck B remained fairly constant across the blocks at the same time that the number of draws from decks C and D were increasing and thereby allowing participants to begin making gains in their net score (see Figures 3-6).

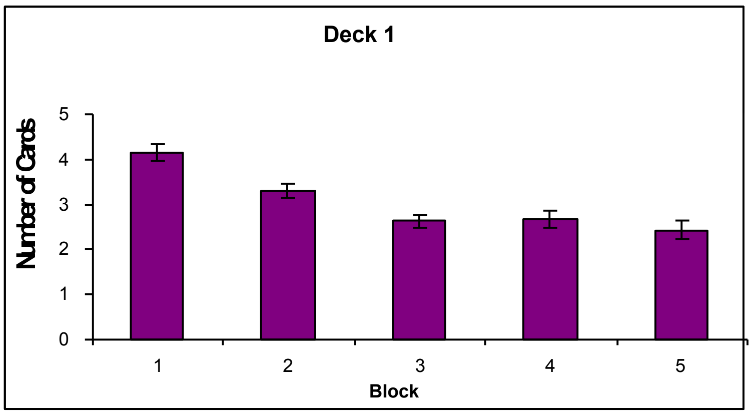

Figure 3. Mean number of cards drawn from Deck 1.

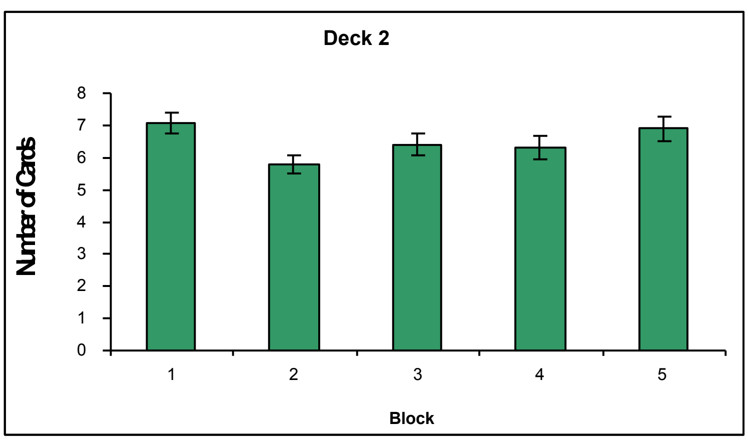

Figure 4. Mean number of cards drawn from Deck 2.

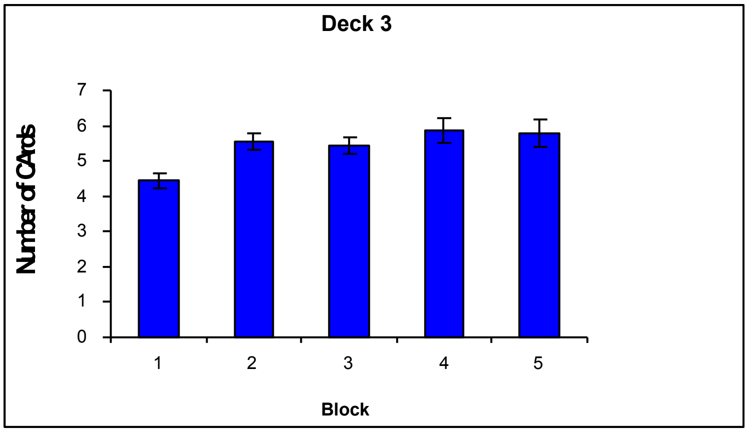

Figure 5. Mean number of cards drawn from Deck 3.

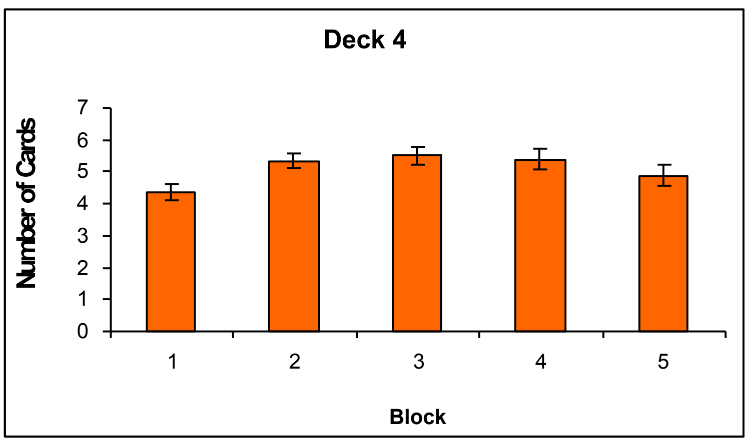

Figure 6. Mean number of cards drawn from Deck 4.

DISCUSSION

This study examined the effects of explicit factors (i.e., detail of instruction) and implicit cognitive factors (i.e., priming) on IGT performance. In prior research, Balodis, MacDonald, and Olmstead (2006) found that a less detailed version of the traditional IGT instructions wiped out the typical leaning pattern associated with the task. Therefore, this research attempted to replicate this finding and to explore what level of detailed instruction is necessary to achieve typical performance patterns. However, results failed to replicate Baldois et al.'s findings. Instead, the learning pattern was established in all three instructional conditions. These findings are in line with Fernie and Tunney's (2006) results that instruction did not influence IGT performance.

Furthermore, this study examined the effect of introducing a cognitive prime (i.e., a pattern recognition task) prior to completing the IGT. If the IGT is cognitively penetrable then introduction of a procedural prime should cause faster learning on the IGT task. According to Smith and Branscombe (1987), repeated use of a cognitive procedure or strategy should increase the likelihood that strategy will be used on a subsequent task. Additionally, Kirmani, Lee and Yoon (2004) demonstrated that procedural priming increases the spontaneous use of a rule or relationship in later tasks. Therefore, participants in the prime condition were expected to show an increased rate of learning on the IGT. Instead, the use of a cognitive prime had no effect on IGT performance. Moreover, the combination of instruction type and prime likewise had no effect on IGT performance. These results provide further evidence that the IGT is driven by emotional reactions rather than by cognitive awareness of the nature of the task.

Perhaps the most intriguing findings of this study came from examining the changes that took place within the course of playing the IGT. Lin, Chiu, Lee and Hsieh (2007) noted that studies using the IGT typically use an advantageous-disadvantageous comparison that may be masking some important dynamics that occur as participants proceed through the task. Indeed, research has found that, contrary to expectation, deck B (disadvantageous) is chosen most often (Lin et al., 2007) while deck C (advantageous) is often avoided (Chiu & Lin, 2007). Our results support the "prominent deck B phenomenon" (Lin et al., 2007, p.23.) but are inconsistent with the "sunken deck C phenomenon" (Chiu & Lin, 2007, p.42). In the present study, participants did choose deck B more often than any other deck, but deck C (advantageous) was also frequently chosen. Additionally, deck A (disadvantageous) was the sunken deck. However, these results also indicate that to fully understand the nature of IGT performance, the patterns of choices within the task need to be more carefully studied.

In summary, this study examined the effects of both a cognitive prime and variation in the level of detail given in the instructions on IGT performance. The results indicated that the cognitive manipulations had no impact on the overall IGT performance. Although these findings support the concept of the IGT as a measure of implicit emotional learning, further analysis of learning patterns within the task supported Lin, Chiu, Lee and Hsieh's (2007) contention that there is more to the IGT story than first believed. Consequently, more research is needed to understand the true nature of IGT performance.

REFERENCES

Baldois, I. M., MacDonald, T. K., & Olmstead, M. C. (2006). Instructional cues modify performance on the Iowa Gambling Task. *Brain and Cognition, 60,* 109-117. doi:10.1016/j.bandc.2005.05.007

Bechara, A., & Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50,* 7-15. doi:10.1016/0010-0277(94)90018-3

Chui, Y-C., & Lin, C-H. (2007). Is deck C an advantageous deck in the Iowa Gambling Task? *Behavioral and Brain Functions, 3,* 37-48. doi:10.1186/1744-9081-3-37

Cella, M., Dymond, S., Cooper, A., & Trunbull, O. (2007). Effects of decision-phase time constraints on emotion-based learning in the Iowa Gambling Task. *Brain and Cognition, 64,* 164-169. doi:10.1016/j.bandc.2007.02.003

Fernie, E., & Tunney, R. J. (2006). Some decks are better than others: The effect of reinforcer type and task instructions on the Iowa Gambling Task. *Brain and Cognition, 60,* 94-102. doi:10.1016/j.bandc.2005.09.011

Hinson, J. M., Whitney, P., Holben, H., & Wirick, (2006). Affective biasing of choices in gambling task decision making. *Cognitive, Affective, & Behavioral Neuroscience, 6*, 190 200. doi: 10.3758/CABN.6.3.190

Kirmani, A., Lee, M. P., & Yoon, P. (2004). Procedural priming effects on spontaneous inference formation. *Journal of Economic Psychology, 25,* 859-875. doi: 10.1016/j.joep.2003.09.003

Lin, C-H, Chui, Y-C, Lee, P-L, & Hsieh, J-C. (2007). Is deck B a disadvantageous deck in the Iowa Gambling Task? *Behavioral and Brain Functions, 3,* 16-26. doi:10.1186/1744-9081-3-16

Maia, T. V., & McClelland, J. L. (2004). A reexamination of the evidence for the somatic marker hypothesis: What participants really know in the Iowa Gambling Task. *Proceedings of the National Academy of Science, 101*(48)*,* 16075-16080. doi:10.1073/pnas.0407200101

Mueller, S. T. (2010). A partial implementation of the BICA cognitive decathlon using the Psychology Experiment Building Language (PEBL). *International Journal of Machine Consciousness, 2*, 273-288. doi: 10.1142/S1793843010000497

Persaud, N., McLeod, P., & Cowey, A. (2007). Post-decision wagering objectively measures awareness. *Nature Neuroscience, 10,* 257-261. doi:10.1038/nn1840

Smith, E. R., & Branscombe, N. R. (1987). Procedurally mediated social inferences: The case of category accessibility effects. *Journal of Experimental Social Psychology, 23*, 361-382. doi:10.1016/0022-1031(87)90036-9

Whitney, P., Hinson, J. M., Wirick, A., & Holben, H. (2007). Somatic responses in behavioral inhibition. *Cognitive, Affective, & Behavioral Neuroscience, 7,* 37-43. doi: 10.3758/CABN.7.1.37