SENSITIVITY TO GAIN AND LOSS AS DETERMINANTS OF PERFORMANCE IN THE IOWA GAMBLING TASK

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THESIS ABSTRACT

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Emotions have been theorized to be a source of information when making decisions. The Behavior Inhibition System (BIS) and the Behavior Approach System (BAS) are body signals that are activated when gains or losses occur and are hypothesized to be a source of information for decision making. It is hypothesized that people sensitive to BIS or BAS would have these systems activate at a lower threshold of losses or gains than people who are insensitive. The IGT simulated decision making in real life with a gambling task which required the participants to make card selections from four decks, and either gain or lose points depending on the card turned. The goal was to determine which two decks had an overall gain in points for the participants. This study sought to examine how the information gained from BIS/BAS might impact decision making when there is little information using the Iowa Gambling Task (IGT). An Alternate Iowa Gambling Task (AIGT) was also designed which limited the impact of the overall gains and losses that the participants might experience during the task. The study had mixed results, but it found that participants sensitive to BIS would avoid decks with more frequent losses than participants insensitive to BIS on the IGT. After 30 trials, most participants regardless of sensitivity, would move to a strategy in which decks with frequent losses were avoided. The AIGT did not see the same switch occur though, despite the similar set up.

Keywords: Affect, Alternative Iowa Gambling Task, Behavior Inhibition System, Behavior Approach System, Iowa Gambling Task, Somatic Marker Hypothesis

DEDICATION

To Linday, Morgan and Paige Byrnes

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The important role played by emotion in making rational judgments has been documented from a variety of theoretical and empirical perspectives (e.g., Damasio, 1994; Kahneman, 2003; Mellers, 2000; Zajonc, 1980). The goal of the present research was to further our understanding of how this role is moderated by personality factors, such that the effects of emotions on rational judgments differs across individuals. The present study makes a small contribution to this larger goal by focusing on a specific example of rational decision making that has been widely used in both research and clinical practice, the Iowa Gambling Test, and one way of characterizing personality differences that emphasizes the biopsychological aspects of personality, the behavioral approach systems (BAS) and behavioral inhibition systems (BIS) hypothesized by Jeffrey Gray. Thus, the primary research questions of this study are used to determine how performance on the Iowa Gambling Test depends, first, on high or low sensitivity to BAS and BIS, and, second, on either the magnitude of gains and losses or the schedule in which gains, and losses occur.

Role of emotions in decision-making.

The concept that emotions were more than just an after process of reasoning was proposed by Zajonc in 1980. Zajonc (1980) argued that instead of emotions being an outcome of the decision-making process, they followed a parallel process to decision making and could come develop independently of cognitive reasoning. This reasoning stems from the observations that certain decisions about preference have no connection to an advantageous outcome and little or no reasoning (Zajonc, 1980). Whether choosing a particular color for a house or gauging how we feel about a person during first impressions, there is no lengthy cognitive process that comes before emotions, but instead we develop feelings prior to any other cognitive processes (Zajonc, 1980). In many cases, it seems that we rely more on these impressions that come from emotions

rather than judge all the individual criteria that may be applicable (Kahneman, 2003; Quandt, 1956; Zajonc, 1980).

Affect heuristics takes the idea of emotions being independent one step further by arguing that emotions, when associated with ideas, events or things, provide a beneficial service as another source of information for the person (Slovic, Finucane, Peters, & MacGregor, 2007). The benefit of this process is that instead of recalling all aspects of an idea or thing that might be important, emotions allow us to quickly judge and compare the items by the positive or negative emotion we have attached to them (Slovic, et. al., 2007).

The ventromedial prefrontal cortex (vmPFC) is thought to link the memories of past complex situations with bioregulatory states, such as emotions. Damasio (1994; 1996) hypothesized that when decisions are made during uncertainty (that is, without certain information about the outcomes), people use past experiences to judge how events might play out. The recollection of past events also causes people to experience the body states, including the emotions, associated with those events. Damasio (1994; 1996) argued that these re-activated emotions are a new source of information to allow the brain to make quick decisions without a long-drawn-out process of weighing the benefits and costs. This proposal is his 'Somatic Marker Hypothesis' (SHM). These emotions work as a sign on a road telling the body to prepare for certain outcomes that may come along. Without this information, every time a person approached a situation with multiple outcomes, they would have to consider all options equally, even if they have experienced similar situations before and knew that certain outcomes would lead to tragedy. This would not only require the person to spend a lot of time on even the most inconsequential decisions, but without emotional feedback, all the outcomes would be equally valid, even those that might have negative consequences, and/or few benefits to the person (Damasio, 1994; 1996; 1998).

Somatic Marker Hypothesis.

According to the Somatic Marker Hypothesis, memories of past outcomes/events recreate the emotions associated with those memories (Damasio, 1996). This somatosensory pattern, as Damasio (1996) calls it, is the body state that is either created by the emotional response to an event or recreates the emotional response directly in the person when recalling the event. The change that is generated in the body and then interpreted by the mind, is known as the 'body loop' (Damasio, 1994; 1996). The change in the body's state may be quite overt, such as the anxiety experienced before taking a test, in which the professor is known to grade harshly, warning you to be extra careful while taking the test (Damasio, 1996). Conversely, it can be covert, such as predisposing an individual to avoid certain types of food when with in-laws because of past experience with the food (Damasio, 1996).

Since emotions are, arguably, bioregulatory states of the body that have been interpreted by the mind as part of the 'body loop', Damasio (1996) has suggested that Skin Conductivity Response's (SCR) can be used to measure changes in emotion related to the IGT. Several studies (Bechara et. al., 1996, Damasio, 1996; Wagar & Dixon, 2006) have found that to be the case. Sometime after the start of the IGT, SCRs spike before the participants chose from decks with an overall loss; Decks A and B. This was interpreted to be a warning for the participants, who during the same time period began choosing primarily from decks with an overall gain: decks C and D (Damasio, 1996; Wagar & Dixon, 2006). Moreover, these spikes in SCR would usually occur before the participant showed conscious knowledge of which decks were beneficial to the participant (Bechara, Tranel, Damasio & Damasio; 1996; Stocco & Fum, 2008). This finding suggests that the emotional guidance precedes cognition, which is one of the key claims of the Somatic Marker Hypothesis.

Background of the Iowa Gambling Test.

The Iowa Gambling Task (IGT) was originally designed to investigate the Somatic Marker Hypothesis (SMH) proposed by Damasio and his colleagues (e.g. Bechara, Damasio, Damasio & Anderson, 1995; Bechara, et, al, 1996; Damasio 1994; 1996; 1998) as an explanation for why patients with damage to the orbitomedial prefrontal cortex (OMPFC) show deficiencies in judgment and decision-making. Damasio (1994) found that some of these patients scored within the normal range on intelligence tests, despite the damage to regions of the brain, but were still prone to making decisions that carried a lot of risk or were unable to make decisions, sometimes going to great lengths weighing the benefits and costs of even minute decisions. This led Damasio (1994) to argue that something other than reasoning and intelligence guided the decision-making process. Since the OMPFC is part of the brain linked with emotions, Damasio reasoned that emotions played a prominent role in the decision-making process and developed the IGT to study how people made decisions with risk when faced with uncertainty or lacking information (Damasio, 1996; De Vries, Holland, & Witteman, 2008).

Personality as a moderator of performance on IGT.

Many studies using the IGT also use the Behavioral Inhibition System/Behavioral Approach System (BIS/BAS) scale alongside it (Desmeules, Bechara & Dube, 2008; Franken & Muris, 2005; Suhr & Tsanadis, 2006). BIS/BAS scale was designed by Carver and White (1994) and is used in many studies because of the hypothesized influence of how the approach system or inhibition system may be activated by the IGT. The reasoning in using the BIS/BAS in conjunction with the IGT is to examine how personality traits might affect the pattern of choices (Desmeules, et. al., 2008; Franken & Muris, 2005; Suhr & Tsanadis, 2006). Gray's Reinforcement Sensitivity Theory (RST) predicts that the Behavioral Inhibition System activates at times of potential punishment while the Behavioral Activation System would activate in times of reward or goal-oriented activities (Gray, 1991). The IGT is thought to activate both the BAS

and BIS since participants are rewarded with card turns and are punished every few intervals. The BIS/BAS scale measures a participant's sensitivity to the two systems, and it has been argued that participants that score high on the BIS section of the scale might be influenced more by the losses from the decks and may move to avoid certain decks earlier in the IGT than other participants (Desmeules, et. al., 2008; Franken & Muris, 2005; Suhr & Tsanadis, 2006). On that same note, participants that scored low in sensitivity on BAS might be more prone to make a preference for decks with high wins earlier in the task, which would be detrimental to the task of earning as much as possible (Desmeules, et. al., 2008; Franken & Muris, 2005; Suhr & Tsanadis, 2006). BIS sensitivity is associated with anxiety-related measurements. Carver and White (1994) looked at how participants reacted to the prospect of exposure to an unpleasant stimulus. The study was set up so that participants were asked to guess the 6th digit in a sequence of five-digits (Carver & White, 1994). These digits were all random but seemed to have a pattern of some sort. Participants then had their hands placed in ice cold water and were told that at the midpoint of the study, their hands would again be placed in ice cold water although with varying amount of ice depending on how well the participant did (Carver & White, 1994). They (Carver & White 1994) measured for nervousness right before the hand dunk in the beginning of the study and at the midpoint of the study, and found that BIS scale correlated strongly with the participants nervousness (between .41 and .43, which was found to be significantly greater than chance value, $p < .01$). It is important to note that scoring low on the any of the scales developed by Carver and White indicates high sensitivity to that trait being measured. Balconi, Falbo and Brambilla (2009) conducted a study on effect of BIS/BAS on skin conductivity response, (SCR) electrocardiogram, (EKG) and electromyogram (EMG) when presented with pleasant and unpleasant stimuli of differing arousal levels. The study found that SCRs increased more when participants were shown unpleasant stimuli of differing arousal levels compared to positive stimuli which goes along with the results of the IGT (Bechara, et. al., 1995) (getting higher SCR scores before decks A and C which are risky and prone to losses). Participants that scored higher

on the BIS scale also had higher SCRs when presented with unpleasant stimuli (Balconi et. al., 2009). It should be noted that the three sub scales of the Behavioral Approach System scale only moderately correlated with each other, and that the majority of studies use the 3 sub scales of BAS instead of a single score for BAS (Franken & Muris 2005; Suhr & Tsanadis, 2006).

Objectives

This study investigates the influence of BIS/BAS personality traits on the decision-making process, using the Iowa Gambling Task and a variant, termed the Alternative Iowa Gambling Task (AIGT) as the task for evaluating decision making. The principal question of interest was whether scores on the BIS/BAS scale predict preferences on the IGT and the AIGT.

In the Iowa Gambling Task, participants try to win as much money as possible by selecting a card from one of four decks that are turned face over, so that the information on the card is revealed only when the card is chosen. With each card turn, the participant is rewarded with either 50 or 100 dollars, but certain cards in each deck also penalize the participant by the loss of money (Bechara, et. al., 1995). The task is designed so that the two decks with the higher pay-off of $100 on each selection (Decks A and B) also have higher losses in the penalty amounts, producing an overall loss of $250 after choices of 10 from those decks (Appendix A has payment/punishment schedule). In contrast, the two decks with the lower pay-off of $50 dollars on each selection (Decks C and D) also have much smaller losses in the penalty amounts, producing an overall gain of $250 dollars after choices of 10 cards from those decks.

Participants come to the task with no knowledge of which decks will have the best outcome and must make selections to find the better outcome. After spending some time with the task, normal participants come to select cards from Decks C and D regularly and avoid selecting cards from Decks A and B. These participants experience a negative feeling about those decks that have a higher regular pay out but an overall loss (usually decks A and B) while having positive emotions about the other two decks (usually decks C and D), as expressed by the

participants when questioned. Participants with damage to the OPMFC do not show this change in selection behavior, however, and continue to select from Decks A and B, resulting in losses. Damasio's interpreted this result to mean that patients with damage to the OPMFC are unable to connect past experiences with the emotions that stem from them and are therefore unable to use past emotional responses as a guiding force in their decision-making process (Damasio, 1994; 1996; 1998).

Alternative interpretations of performance on the IGT.

Damasio's interpretation of performance on the IGT has been challenged on several grounds (e.g. Dunn, Dalgleish & Lawrence, 2006; Maia & McClelland, 2004). Four concerns were relevant to the design of the present research, namely, the role of conscious strategies, the basis for enhanced SCRs to Decks A and B, and the nature of the gain/loss schedule, and the role of sensitivity to loss and reward. Role of conscious strategies vs implicit tendencies

Damasio claimed that participants had little conscious knowledge of what the most advantageous decks were, and that emotions guided them to avoid certain decks despite not knowing the reason why (Damasio, 1994; Bechara et, al., 1995). Maia and McClelland (2004) attempted to replicate Bechara et. al., (1995) but asked more probing questions every 10 card turns, starting on the 20th card turn (questions found in Appendix B). They found that participants started acquiring conscious knowledge of the rules of the game far earlier than claimed by Bechara et., al., leading them to conclude that conscious knowledge was involved in making good choices on the IGT. A possible problem with using more probing questions about awareness is the questions might generate an awareness that would not be present without the questionnaire. Wagar and Dixon (2006) addressed this in a study with two groups, one using the questionnaire while the other group did not. They found that there was no difference between the two groups when comparing card preferences, showing that the questionnaire did not have a significant impact on the study overall. Wagar and Dixon also found that, on average,

participants usually started using an optimum strategy for card selection (primarily choosing C and D) between trial 40 and 50, whether given the Maia and McClelland Questionnaire or not. Interestingly, they found that participants started having higher SCR values on average during Block 4 (card selections 31-40) before the majority of participants had conscious knowledge of the optimal strategy, which occurred in Block 5 (card selections 41-50). Stocco and Fum (2008) performed an experiment to see whether there was an emotional bias that was separate from conscious knowledge. In the experiment, participants were asked to do 20 card turns of the IGT 'blind', or without feedback (Stocco & Fum, 2008). The participants were assigned to do 40 trials, 60 trials, or 80 trials of the IGT before being asked to perform the IGT 'blind' (Stocco & Fum, 2008). Half the participants were told to choose the best cards based on past experience (called the Shallow Group), while the other half of the participants were told that the decks had switched, and those decks (C and D) that were advantageous became now disadvantageous, while those decks (A and B) that were disadvantageous became advantageous (called the Reverse Group) (Stocco & Fum, 2008). All the groups performed at above chance level and avoided the disadvantageous decks before entering the 'blind' or 2nd phase of the study (Stocco & Fum, 2008). Stocco and Fum (2008) found that all the groups performed similarly regardless of how many cards turns (40, 60, or 80) each participant went through before being asked to do the IGT 'blind' during the 2nd phase. Stocco and Fum (2008) found no differences or interactions were caused by the duration of the IGT prior to the 2nd phase of the study, leading them to conclude that participants picked up the strategy for the IGT as early as the 40th card turn. The second and possibly more interesting finding of the study was that participants in the Reverse Group did not switch strategies when informed during the 2nd phase that conditions of the decks had been reversed (Stocco & Fum, 2008). Participants in the Reverse Group continued to choose from the decks they had preferred despite being told that the advantageous decks had been switched with the disadvantageous decks (Stocco & Fum, 2008). It was also found that the participants in the Reverse Group were just as confident of their selection as participants in the

Shallow Group, despite the fact they had preferred the newly designated disadvantageous decks (2008). This seemed to indicate to Stocco and Fum (2008) that the participants were not explicitly aware of the bias in their decision making. Stocco and Fum (2008) suggested that, if the participants had conscious knowledge of the decks, they should be able to switch strategies when they found out that the conditions of the decks had switched or indicate that the new reversed condition was much more difficult than the shallow condition. Since they didn't switch strategies, Stocco and Fum (2008) argued, in keeping with the SMH, something other than conscious knowledge was implicitly biasing the participants in favor of decks C and D. In sum, although there is some evidence that participant's selections on the IGT are not entirely based on conscious awareness of contingencies (Stocco & Fum, 2008), there is good reason to believe that normal participants are more aware of the contingencies guiding their choices than Damasio and colleagues initially claimed.

Another flaw of the IGT stems from the use of SCR, which was argued by Damasio (1996) to be an early warning system before making bad decisions. Tomb, Hauser, Deldin and Caramazza (2002) presented participants with a modified version of the IGT, with the key difference being a change to the gain/loss schedule of each of the decks in an effort to separate the variance of gains and losses from the overall outcome. In the modified version, decks A and B had an expected value of 750 dollars every 10 card turns, while C and D had an expected value of -500 dollars (Tomb, et. al., 2002). When picking 10 cards from either Deck A or B, the average gain would be 2,250, while the average losses equaled 1,500 dollars (Tomb, et. al, 2002). In comparison, picking 10 cards from Deck C or D, the average gain was only 250 dollars, with the losses from punishment cards equaling 750 dollars (Tomb, et. al, 2002). Decks A and B became the advantageous decks in this modified version of the IGT, but still retained the higher variance of winnings and losings as it had in the original IGT, meaning that winnings were larger than those of decks C and D, but so were losses when a punishment card was drawn (Tomb, et. al., 2002).

SCRs were recorded while taking the modified IGT, and it was found that significantly higher SCRs were still recorded before participants chose from decks A and B despite the fact that they were beneficial and the preferred decks of the participants (Tomb et. al., 2002). Before this study, it was predicted that SCRs came before making detrimental decisions and would steer people away from those decision, but in this case, they occurred before the beneficial decks (Bechara, et. al., 1995; Dunn, et. al., 2006; Tomb et. al., 2002). Tomb and his associates (2002) believed this to signify that SCRs signaled that a risky decision was being made, one with a high variance as to the outcome, but not necessarily a detrimental decision.

Other research has been conducted with patients with amnesia, who should be unable to acquire the conscious knowledge to guide their decision but are still able to learn tasks that didn't require conscious knowledge (Gutbrod, Krouzel, Hofer, Müri, Perrig & Ptak, 2006). It was found that certain participants did have high SCR spikes prior to picking from one of the four decks, but they failed to acquire a clear preference for any of the decks, good or bad, and performed at chance level when choosing decks (Gutbrod et. al., 2006). This would seem to indicate that the SCRs or the body reactions by themselves are not the factor that contributes to how we are making decisions to avoid one or more of the decks, but that explicit knowledge may be a factor in order to successfully complete the IGT, as argued by Maia and McClelland (Gutbord et. al., 2006).

Role of gain and loss schedule.

Several investigators have questioned whether there is something about particular schedules of gains and losses that are responsible for performance on the IGT. Looking at Damasio's gain/loss schedule, it is easy to see that deck A and C have 5 losses and 5 gains during every 10 card turns, while decks B and D have only 1 loss and 9 gains during 10 card turns. Several studies (Chiu & Lin, 2007; Chiu, Lin, Huang, Lin, Lee & Hsieh, 2008; Chiu, Lee & Hsieh, 2007; van den Bos, Houx & Spruijt, 2006) have focused on how participants may not be

influenced by the overall outcomes as was predicted originally for the IGT (Bechara et. al., 1995; Damasio 1994; 1996; 1998; Dunn et. al., 2006) but instead looked at how the gain/loss ratio might be influencing the participants. In these studies, it was found that participants preferred deck B when participants did not have conscious knowledge of the IGT (level 1 on Maia & McClelland's scale) then they had continued to have a preference for deck B, arguing against the idea that participants would have preferences based on overall outcomes (Lin et. al., 2007).

This is further emphasized when you compare the decks to each other individually, rather than as group A & B and group C & D. Lin and associates took disassembled the IGT and presented participants with either four decks made up of two deck A's and two deck C's or four decks made up two deck B's and two deck D's (Lin et. al., 2007). In the former set up it played out just as expected on the IGT, with participants shifting from the A decks to the C decks around the 20th card turn, but in the later design, they found that the participants didn't shift over to the D decks and kept choosing from the B decks (Lin et. al., 2007). Even when doubling the duration of the study from 100 card turns to 200 card turns, participants kept choosing from the B decks, even when experiencing the severe losses that comes with it, leading the researchers to dub this the 'prominent deck B' phenomenon (Lin et. al., 2007).

Lin et. al. (2007) argued that the shift that happened was caused not by overall outcome of a particular deck, but instead was caused by the number of times that participants experienced a loss from a particular deck. When confronted with two deck B's and two deck D's, the participant experienced an equal number of losses from each deck, and even though the magnitude of the losses were greater for deck B, the gains were greater for that deck than that of deck D (Lin, et. al., 2007). The gain/loss explanation can also be applied to why participants did make the shift when given a choice from two deck A's and two deck C's (Lin et. al., 2007). In deck C, the participants win 50 dollars per card turn, but when they are punished, loose between 25 and 75 dollars. This translates to the participants not experiencing 5 losses in 10 card turns, as in the case of deck A, but instead only 1 loss on average per 10 card turns and 4 punishment card

turns that either end with the participant losing nothing or gaining 25 dollars instead of the usual 50 dollars (Lin et. al., 2007). If you were to use the number of times you gained or lost as a guiding thought rather than the total amount of money gained or lost, you would still prefer deck C to deck A. The end result would be that if participants choose equally from B and D, but prefer deck C to deck A, they would end up having a net gain in the IGT, despite not using overall outcome as predicted by Damasio (Bechara, et. al., 1995).

In a follow-up study, researchers looked at a modified version of the IGT in which the amount of a card turn was doubled (decks A and B give 200 dollars per turn, while C and D give 100 dollars per turn, instead of 100 and 50 respectively) (Chiu & Lin, 2007). This study found that participants did not have an overall tendency to choose from deck C during the 'hunch' stage, but instead preferred decks B and D to it (Chiu & Lin, 2007). The preference for B and D during the 'hunch' stage meant that participants would still prefer deck B even when they start to realize that decks C and D probably the better decks overall (Chiu & Lin, 2007). Again, it was argued that the gain/loss frequency was the cause of the switch, since in the original IGT deck C didn't have any real losses, but instead had 5 card turns in which the loss and the gain canceled each other out, leaving the participant with no money lost or gained (Chiu & Lin, 2007; van den Bos, et. al., 2004). Instead of the overall outcome influencing the participants, Chiu and Lin (2007) put forth the idea that lack of loss in the original IGT didn't inhibit them from choosing that deck. In a similar study done by van den Bos and associates (2004) it was found that as the ratio of amount won between advantageous and disadvantageous deck changed, from 100:50 to 200:50 or 300:50, the greater the likelihood that participants would prefer the disadvantageous decks, especially deck B, despite the expected values of the decks staying the same (decks A and B had an expected value of -500 dollars, while decks C and D had an expected value of 500 dollars). Sensitivity to the amount won or lost seems to have a strong influence over how participants choose cards in the IGT and may have a stronger role than overall outcome as predicted by Damasio (1994; 1996) and Bechara and his colleagues (1995).

There is contradictory evidence when comparing a participants' scores on BIS/BAS and the IGT (Franken & Muris, 2005; Suhr & Tsanadis, 2006). A study designed by Franken and Muris (2005) which included 44 psychology students, found that a participant's score on BAS reward responsiveness scale correlated with how well the participant did on the IGT. Students that scored high on the BAS, meaning they were insensitive to reward did better on IGT. It should be noted that participants in Franken and Muris' study (2005) overall did poorly, usually ending the game with fewer dollars than they started with on the IGT, although this is given two explanations; one is that higher education seems to correlate poorly with IGT performance, and the second is that they used a modified version of the IGT in which rewards and punishment schedule was altered so that the magnitude and frequency of the rewards and punishments were altered.

In contrast to this, Suhr and Tsanadis (2006) found that BAS reward responsiveness and fun seeking had a negative correlation with how well the 87 participants did on the IGT, showing that high sensitivity to fun and reward meant better overall outcome, which they argue is more in keeping with the theory that relates both subscales with impulsiveness, and thus participants insensitive to reward would choose the decks with the larger initial reward, but overall loss (decks A and B) since small rewards would not activate the BAS. In an alternative comparison, Suhr and Tsanadis (2006) divided the participants into three groups, participants with low scores on all the BAS scales, participants with high scores on the reward and the drive scale but low fun seeking, and participants that scored high on each of the BAS scales. They found that participants that scored low on all the BAS scales (considered to have high sensitivity to BAS) did significantly better than the other two groups on the IGT and that the groups that scored high on fun seeking scale did the worst overall on the IGT (Suhr & Tsanadis, 2006). This is because participant's sensitive to reward have the BAS activated when the participant wins 50 dollars, while participants insensitive to BAS might only experience the Behavioral Approach System

activation those participants choose from decks A or B with its 100-dollar reward (Desmeules et. al., 2008).

In a modified version of the IGT in which the amount gained on a card turn was not always the same, but instead followed a range of rewards (decks A and C paid between 50 and 150 dollars, while decks B and D paid between 150 and 250 dollars), Peters and Slovic (2000) found that participants that scored higher on the BIS scale also preferred deck D, which had an overall gain, over deck B which had an overall loss. The study also seemed to indicate that participants that scored high on BIS (insensitive to loss or punishment) also were less likely to choose the deck with the largest losses, although no significant correlation was found (Peters and Slovic, 2000). It should be noted that because of the modifications made to the IGT, including the reward and punishment schedule, it is difficult to compare how BIS/BAS predict the results if participants were using an unaltered version of the IGT.

Besides the contradictory evidence on the relationship between BIS/BAS and the IGT, two other studies found no significant correlations between them (Desmeules et. al., 2008; Franken, Georgieva & Muris, 2006).

However, Desmeules and associates (2008) did divide the 126 adult women that were participants by their BIS/BAS scores into four categories, that of high BIS/high BAS, high BIS/low BAS, low BIS/ high BAS and low BIS/low BAS. The study found that despite the lack of correlations between the BIS/BAS and IGT, there was a significant difference between how the 4 groups performed and found that low BIS/ low BAS did better than the other 3 groups while participants that scored high on both BIS and BAS did the worst of the 4 groups (Desmeules, et. al., 2008).

Desmeules and her fellow researchers (2008) were looking at whether BIS/BAS made participants more sensitive to the amount gained or lost or less sensitive. The scalar multiplication hypothesis states that higher sensitivity to BAS (or BIS) meant that the person would experience greater amount of arousal at rewards (or punishments) than persons that were

less sensitive to BAS (or BIS) (Desmeules, et. al., 2008). This would mean that they would feel a greater amount of excitement at the prospect of winning (or losing) than the average person. The scope insensitivity hypothesis states that instead of a greater feeling about a greater reward, the BAS (or BIS) would be activated at a lower reward (or punishment) point for a person sensitive to BAS (or BIS) than the average point. An example would be that a person with high sensitivity to BIS would feel equally bad over losing 50 dollars as they would over 100 dollars, where the average person might not feel bad about losing 50 dollars but would feel bad at 100 dollars lost.

The results found by Desmeules and colleagues (2008) seemed to support the scope insensitivity hypothesis over the scalar multiplication hypothesis since participants with a high BIS seemed to do on average worse, because they weren't able to distinguish between the greater losses of deck A and B and the losses of deck C and D. Also, the high BAS scores made participants insensitive to the amount won, making decks A and B with their 100 dollars per card turn less attractive than decks C and D with their 50 dollars per card turn, allowing them to make the switch sooner (Desmeules, et. al., 2008). Of course, this seems to indicate that individual card turns have more strength over the participants than the overall results.

In the second part of the study, Desmeules and associates created a reversed IGT with the turn of the cards causing a consistent loss, with every few card turns resulting in a gain, they found that BIS/BAS scores had the opposite effect, with high BIS scores being associated with a better overall outcome, while a high BAS was associated with worse overall outcome (Desmeules et. al, 2008).

Bowman and Turnbull's (2003) study tested whether the level of motivation that money has on the participants by having two groups, one that was offered 1 English pound per thousand dollars earned in the IGT and started with 2 Pounds of real cash, while the other was offered no compensation, but used only facsimile money, similar to monopoly money. It was found that there was no significant difference between the two groups (Bowman & Turnbull, 2003).

As shown, the setup of the study can affect how well participants do, depending on their BIS/BAS sensitivity. The failure occurs where participants do learn through the trials and tailoring their choices in the game to get the best overall outcome. This study proposes an alternative IGT in which all decks have an equal, although marginal gain, allowing the researchers to overcome the confounding variable that outcomes may have on the participants' deck preference.

This study proposes several hypotheses. First that participants' sensitive to BIS will prefer decks with fewer loss events, even if the overall loss is greater. The second is that participants insensitive to BAS will prefer decks with greater individual return, even if the decks have an overall loss. Third is that conscious knowledge of the decks outcome will influence the participants' strategy as they take part in the trial and prefer decks with overall positive gains.

Methods

The experiment had 90 participants ranging from 18 to 40, (34 males, 46 females, and 10 that indicated no response) took part in the study, all of whom were students at Rutgers Camden and came from the Rutgers-Camden Subject Pool and received course credit for participating. Students signed up for the study utilizing Experimentrix at www.experimetrix2.com/rutcmdn. The data gathered from 21 students was deemed unusable because their work couldn't be identified accurately across all three stages of the experiment.

Materials

The study used methods that have been used previously in IGT studies (Bechara et. al., 1995; Bowman & Turnbull, 2003; Chui & Lin, 2007; Franken & Murris, 2005; Maia & McClelland, 2004) and the BIS/BAS scale (Carver & White, 1994). There were three parts to the study; the Carver and White questionnaire (1994), located in the appendices, with the Maia and McClelland questionnaire (2004), the Iowa Gambling Task, and the Alternative Iowa Gambling

Task created for the study. Both the IGT and AIGT were administered on a computer using E-Prime. The Maia and McClelland questionnaire were given separately on paper along with the Carver and White BIS/BAS scale.

Procedure

Participants registered for sessions posted online. These sessions were set up in 1-hour blocks and participants received 1 credit for participating in the study. Each session had space for up to 6 participants.

Upon entering the lab, each participant was direct to a computer. After all the participants were present and seated, each participant was assigned a five-digit number taken from a list of randomly generated numbers. The five-digit number started with either a 1 or a 2. A 1 indicated that the participant would start with the IGT, while a 2 indicated that they would start with the AIGT, other than this, there were no other differences between the two groups. This five-digit number was not linked in anyway with the participants name or identity and was only used in order to link the participants IGT, AIGT and BIS/BAS scorers together.

The computers that the participants utilized had the E-Prime program, with either the AIGT or IGT active. The participants were asked to type in their five-digit code before beginning the task. Participants whose random five-digit number started with a 1 began with the IGT, while participants whose random five-digit number started with a 2 started with the AIGT. Participants were given paper questionnaires which accompanied the AIGT and IGT and were asked to put their five-digit number on the questionnaire so that it could be linked to the files created by E-Prime. The instructions were read to the participants before they began the exercise.

Both the IGT and the AIGT were presented on E-Prime. Each participant was asked to select one of four 'decks' (each of the 'decks' were actual icons that resembled a deck of cards). After the selection, the participant viewed two sets of numbers. The first set indicated how much money was gained while the second set showed the amount of money lost. The participant could

monitor their overall score in the corner of the screen. After 30 trials the participant completed the Maia and McClelland Questionnaire for that section of the task. They then returned to E-Prime to continue with the IGT or the AIGT. At the end of the 50th, 70th and 90th trials the participants were asked to fill out a new Maia and McClelland Questionnaire for each of those sections.

When all four sections of the IGT or the AIGT were completed, the participants were given further instructions by the researcher to complete the BIS/BAS questionnaire. This questionnaire contained 24 questions (found in appendices). After all the participants had completed the BIS/BAS questionnaire, they were then instructed to complete their final task; either the AIGT if they had started with the IGT or the IGT if they had started with the AIGT. The task had the exact same instructions and procedures as the first section, with 30 trials of either IGT or AIGT on the computer followed by the questionnaire in the appropriate folder. Exactly as the first section, after they finished with the questionnaire, they continued with E-Prime. Each section of 20 trials would be followed by the questionnaire from Maia and McClelland's (2004) study.

Participants were given a debriefing at the end of the study and given an opportunity to ask questions.

Data Analysis

The study used several derived measures for the data analysis. Participant scores were added up within each of the scales to derive an overall score for the BIS, the BAS Drive, the BAS Reward Response and the BAS Fun Seeking measures. The category scale of possible responses for each of the questions ranged from very True for Me (1) to Very False for me (4). To get a score for the BAS, scores for each of the three individual sub-scales of the BAS were added together. This allowed the assignment of a score to each of the participants that completed the BIS/BAS questionnaire from Carver and White (1994).

On each of the scales, participants were divided into low and high sensitivity groups using a median split. Because of the reverse scoring used for the BIS/B AS scales, scores higher than the median were placed in the low sensitivity group, and scores lower than the median were placed in the high sensitivity group. The mean, median and mode were computed for each set of scores, reflecting the following results in table 1.

Table 1

Average Ratings on the BIS/BAS Scale of participants

Scale	Mean	Median	Mode
BIS	14.46	15	15
BAS Drive	8.86	9	9
BAS Reward Response	7.39	7	6
BAS Fun Seeking	8.29	8	10
BAS	24.54	24	24

Measures for the IGT and AIGT were obtained as follows: The program tracked the number of times the participants selected from each of the four decks during both the IGT and the AIGT and when they made these selections. The research from Wagar and Dixon (2006) was employed to estimate when participants usually became more sophisticated in their deck selection.

The participants' selections during the first 30 trials, the last 60 trials, and the selections made during the entire task were given extra scrutiny.

Three sets of analyses were completed for both the IGT and AIGT. For each analysis, the participants were classified into either low or high BIS and BAS (19 participants were sensitive to both, 15 participants were sensitive to BAS, 14 participants sensitive to BIS and 11 participants that were not sensitive). In each analysis, we compared the percentage of times the participants selected from the various decks during the first 30 trials versus the last 60 trials.

The first analysis compared the participants selection from each of the decks individual in a 4x2x2x2 ANOVA, again using the same additional 3 factors.

The second analysis compared the participants selection from decks with high gain events versus low gain event (Decks A and B versus Decks C and D) in a 2x2x2x2 ANOVA, using the timing, and the participants BIS and BAS sensitive as the other 3 factors.

The third analysis compared the participants selection from decks with few loss events versus many loss events (Decks B and D versus Decks A and C) in a similar 2x2x2x2 ANOVA, using the same three additional factors.

Each analysis was completed twice, once for the IGT and once for the AIGT.

A correlational analysis between the participants BAS/BIS scores and the frequency of a participant's selections from each deck and between all the decks was also performed, but there were no significant findings.

Measures for the Maia-McClelland questionnaire proved unworkable, because of excessive subject error in completing the questionnaires by the participants. For purposes of this report, therefore, these data were not analyzed further.

Results

Table 2 - *Descriptive Statistics of All Deck Selection during the IGT*, breaks down the individual mean percentages of often participants made selection from each deck, and further breaks it down by BIS and BAS sensitive, and the different stages (either the first 30 or last 60 trials). The analysis of the individual decks for the Iowa Gambling Task indicated that there was a significant difference between how often participants made a selection from all four decks $F(3, 165) = 14.657$, $p < .05$, not taking into account whether the selections occurred during the first 30 trials or the last 60.

Further analysis shows that BIS was also found to be a significant factor in how participants selected decks, $F(3, 165) = 2.82$, $p < .05$. Neither BAS, nor the combination of BAS and BIS was found to have a significate impact on how participants selected decks during the task though.

The combination of the timing of the trials (first 30 vs final 60) and the four different decks also influenced the participants selection strategy during the task, $F(3, 165) = 5.442$ $p < .05$ but no combination of Timing, Decks, BIS and/or BAS were found to be significant.

Several one-way ANOVAs were performed as a follow up, with the results found in tables 6 through 8 in the Appendix. The ANOVAs compared either the participants selection in an individual deck, or combination of deck by either BIS sensitivity or BAS sensitivity during the first 30 trials (Table 6), last 60 trials (Table 7) and all 90 trials (Table 8) in the IGT.

As illustrated in Table 6, *First 30 Trials of the IGT* only BIS sensitivity had a significant impact during the first 30 trial, and was limited to Deck A $F(1, 58) = 4.13$, $p < .05$, and the combination of decks with fewer individual loss events (decks B and D), $F(1, 58) = 6.436$, $p < .05$. Deck A was preferred by participants not sensitive to BIS, while the combination of deck B and D was preferred by participants sensitive to BIS.

The last 60 trials had sensitivity not impacting participants preferences for any deck.

Reviewing all 90 trials, the combination of decks with fewer individual loss events (decks B and D), $F(1, 58) = 6.439$, $p < .05$ was preferred by participants sensitive to BIS.

Further 2x2 ANOVAs were set up comparing participants first 30 and last 60 deck selection with BIS or BAS since Timing was found to be significant. Tables 12 through 17 breaks down the results per deck, showing the impact of time under the Repeated results, and the impact of either BAS or BIS next.

Overall, there was shown as change in preferences due to the timing for three sets, Deck A $F(1, 57) = 12.114$, $p < .05$, Deck C $F(1, 57) = 4.17$, $p < .05$ and the Decks with High Gains (Decks A and B) $F(1, 57) = 7.438$, $p < .05$. It was found that Deck A and the Decks with High Gains were avoided in later stages, while Deck C was preferred in later stages.

As with the 4x2x2x2 ANOVA, neither BIS nor BAS were found to have a significant influence on how the participants strategy changed or did not change.

Table 3 - *Descriptive Statistics of Decks AB vs CD and BD vs AC during the IGT,* breaks down mean and standard deviation of the 4 different combination of decks (High Gain Decks, Low Gain Decks, Decks with Few Losses, Decks with Many Losses) as they were compared to each other.

Comparing the combination of High Gain Decks (Decks A and B) versus Low Gain Decks (Decks C and D) showed no significant difference between how often the decks were selected overall. Neither BIS sensitivity nor BAS sensitivity had a significant impact on the outcome either.

Comparing the two sets of decks during the first 30 trials and the last 60 trials does show a significant change, $F(1, 55) = 6.439$, $p < .05$. Although neither BIS sensitivity nor BAS sensitivity were found to be significant individually, it was found the combined factors of BIS and BAS sensitivity, did have a marginally significant impact on how participants made deck selections during the first 30 and last 60 trials $F(1, 55) = 4.002$, $p = .05$.

Comparing the combination of Decks with Few Losses (Decks B and D) versus Decks with Many Losses (Decks A and C) showed a significant difference between how often the participant made selections from those decks, $F(1, 55) = 47.447$, $p < .05$.

Although BIS sensitivity did have a significant impact how participants made selections during the IGT $F(1, 55) = 8.687$, $p < .05$, neither BAS sensitivity nor the combination of BIS and BAS sensitivity had a significant impact on the participants strategy.

Table 5, *Descriptive Statistics of All Deck Selection during the AIGT* shows a similar break down of the mean and standard deviation of the AIGT as Table 2 did for the IGT. Unlike with the IGT, the AIGT had no significant differences between the decks alone, nor did the factors of BIS or BAS sensitivity place a significant role when excluding the timing of the deck selection.

When timing (the first 30 trials versus the last 60 trials) was factored in though, there was a significant difference between participants preference for the four decks, $F(3, 165) = 3.588$, p

<.05. BIS Sensitivity was also a significant factor when taken into consideration with the timing $F(3, 165) = 2.751$, $p < .05$, although neither BAS sensitivity nor the combination of BIS and BAS sensitivity played a significant role.

As with the IGT, further 2x1 ANOVAs were completed (Tables 9 through 11). No significant differences were present in the first 30 trials, nor the overall trials, but there were results for deck C in the last 60 trials, $F(1, 58) = 6.447$ $p < .05$, with participants sensitive to BIS preferring it compared to participants not sensitive to BIS.

Tables 18 through 23 shows a more in-depth 2x2 ANOVA, comparing either BIS or BAS sensitivity with the first 30 trials and the last 60 trials of the AIGT. These analyses revealed a shift in how frequently participants made selections from Deck A, with participants avoiding it in later stages of the task, $F(1, 57) = 10.104$ $p < .05$. A similar shift occurred for High Gain decks, $F(1, 57) = 4.332$ $p < .05$. Neither were impacted by the participants' BIS or BAS sensitivity.

Participants sensitive to BIS did have a significant preference for Deck C in later stages of the task $F(1, 57) = 5.28$ $p < .05$ although there was no overall change in that decks preference. Participants sensitive to BIS also shifted away from Decks with Few Loss Events $F(1, 57) = 5.173$ $p < .05$, again without seeing an overall shift in preference.

As with the AIGT, am analysis comparing the High Gain Decks to Gain Decks was completed using a 2x2x2x2 ANOVA. Table 5 *Descriptive Statistics of Decks AB vs CD and BD vs AC during the AIGT,* breaks down mean and standard deviation of the 4 different combination of decks (High Gain Decks, Low Gain Decks, Decks with Few Losses, Decks with Many Losses).

The analysis comparing the High Gain Decks with the Low Gain deck show a lack of significant difference. The added factor of BIS sensitivity has some marginally significant impact on the participants strategy, $F(1, 55) = 3.746$, $p = .058$, but the neither BAS sensitivity nor the combination of BIS and BAS sensitivity have a significant impact on how participants make selections from the 2 sets of decks.

When the factor of time (the first 30 trials versus the last 60 trials) is included, there is a significant difference on how often selections are made from the two decks, $F(1, 55) = 4.395$, $p = .05$, with participants avoiding decks with High Gains in the last 60 trials. Neither BAS nor BIS sensitivity have a significant impact on the participants preferences though.

The analysis comparing the Decks with Few Losses versus Decks with Many Losses also show a lack of significant difference. The factors of BIS and BAS sensitive also have no significant impact on participants make selections from either set of decks.

By itself, timing is also not a significant factor, but there is a significant difference in how participants make selections from the decks during the first 30 trials and the last 60 trials when BIS sensitive is factored in, $F(1, 55) = 5.045$, $p = .058$.

Discussion

The goal of the study was three-fold; first it was to observe whether participants that are sensitive to BIS would avoid outcomes that had a high probability of punishing the participants, even if those punishments were relatively minor, the second was to observe whether participants that were insensitive to BAS would prefer outcomes that had larger rewards, even if the chance for it was relatively small and third to test whether participants, when they have explicit conscious knowledge of the outcomes, would make choices influenced by their prior preferences or would be more inclined to make selections based on the optimal outcome.

The Iowa Gambling Task was designed to mimic real life decision making by giving the participants limited information, and that there is uncertainty on whether the outcome would be beneficial or not. Participants would learn about the task and the different task by going through multiple trials, similar to how past experiences can be used to inform future decision making in real life.

The first hypothesis had been observed before. Desmeules and his colleagues (2008) had observed that participants' sensitive to BIS seemed to prefer decks that had fewer punishment

outcomes, even if those punishments were of a larger scale. The study argued that BIS sensitivity made the participants insensitive to the scope of a bad outcome, so participants would react to a punishment in the same fashion, regardless of the level of outcome.

Looking at the overall results of the Iowa Gambling task, it is evident that participants that were more sensitive to BIS were significantly more likely to make selections from Decks with fewer loss events (Decks B and D), than participants who were less sensitive to BIS ($p < .05$). This would support the argument that was made by Desmeules and her colleagues and our hypothesis that participants sensitive to BIS would avoid decks with more negative outcomes and prefer decks with more positive outcomes.

This small preference for decks with fewer loss events supports the argument by Desmeules and his colleagues that people are insensitive to the scope of punishments and losses, but instead influenced by the number of such events, if they meet a certain threshold of severity for the individual (2008). More importantly, this study found evidence that participants sensitive to BIS would have a lower threshold to register an event as negative than participants less sensitive to BIS.

Although the study did find that decks with fewer loss events were preferred by participants with BIS sensitive, there were no significant findings that of BIS sensitivity might affect a participants' preference any individual deck over the course of the task. I only saw an effect when the two decks were taken together.

During the first 30 trials of the IGT, where the research indicates that explicit conscious knowledge of the task is least likely, and has the least amount influence (Dunn, et. al., 2006; Maia & McClelland, 2004; Stocco & Fum, 2008; Wagar & Dixon, 2006), the study found that participants who were insensitive to BIS had a significant preference for deck A ($p < .05$). Participants who were sensitive to BIS may prefer deck D although these results were only marginally significant ($p<.10$). The direction of the results would agree with Scope Insensitivity Hypothesis (Desmeules, et. al., 2008) that decks with fewer loss events are preferred by

participants' sensitive to BIS and that participants insensitive to BIS might not be as impacted by the losses in deck A as participants that are sensitive.

The last 60 trials show no significant impact of BAS or BIS. Based on past research, such as by Wagar and Dixon (2006), it was predicted that participants would start preferring the optimal decks, regardless of whether they had a set predilection to one or more decks in the past. This is based on the understanding that participant had a more concrete understanding of the 4 decks by this point and would realize that deck C and D were preferred. The fact that there were no significant results is in keeping with the past studies which argued that conscious knowledge played a role in the final 60 trials and overcame the influence of the participants individual preferences (Dunn, et. al., 2006; Maia & McClelland, 2004; Stocco & Fum, 2008; Wagar & Dixon, 2006).

Unfortunately, the research didn't fully support the hypothesis that participants sensitive to BIS would prefer deck B. Since deck B has few loss events, we hypothesized that participants sensitive to BIS would be drawn to it. There was some marginal significant impact of sensitivity to BIS, where participants sensitive to BIS would be more likely to avoid A and C overall ($p < .10$) during the course of all the trials. This find is in agreement with the work of Desmeules, et. al., (2008) that participants sensitive to BIS would avoid decks with losses, even if the outcomes were overall beneficial.

The second hypothesis was that participants' sensitive to BAS would be Scope Insensitive to rewards, so that they would not have any preferences for an individual deck since all decks had some positive gain events which would activate Behavior Approach System. Instead, participants insensitive to BAS would prefer decks with larger gains even if the overall outcome of the decks were not beneficial, since a large reward would be necessary to active the participants BAS.

Reviewing the results of the first 30 trials of the task, there was some significant evidence that participants' sensitive to BAS preferred deck C compared to participants' insensitive to BAS

($p < .05$) . This would go along with the hypothesis that, much like BIS, Scope Insensitivity played a role with the Behavior Approach System response. Participants insensitive to BAS would avoid deck C since it had lower individual gains then decks A and B.

Neither the final 60 trials of the task nor the overall deck section showed BAS having a significant impact on participant made selections. It might be that BAS has a smaller impact on participant deck selection then BIS.

In consideration of the last question, whether explicit conscious knowledge overcomes the participants' sensitivity to BIS and BAS, this study analyzed whether a significant difference between the first 30 trials of the IGT and the last 60 trials could be demonstrated. This would indicate that a participants' conscious knowledge played a role in how deck selections were made and whether either BIS or BAS sensitive could be attributed to how participants' selection might change over the course of the task.

If Maia and McClelland (2004) were correct in their hypothesis, during the IGT, participants would all gain conscious knowledge of the task and the gain/loss schedule as they progressed and that participants would realize that A and B had significant losses, despite the high individual gains and so move away from making selections from those two decks, regardless of their preference for high earning decks.

A significant change in how participants made selections would support the hypothesis that conscious knowledge plays a role in how participants select, especially if participants move away from deck A and B, and towards decks C and D, which had a more beneficial outcome for the participants.

The analysis of deck A showed that participants made an overwhelming shift away from deck A, regardless of whether they were sensitive to BIS or BAS. As the loss events were far greater than what was gained, participants with conscious knowledge of the task would move away from that deck to decks with better gain/loss outcome. This shift was not significantly

impacted by either BIS or BAS sensitivity, supporting the hypothesis that explicit conscious knowledge played a leading role in participants shift away from deck A.

Conversely, deck B selections would also result in more losses than gains in the IGT, but no significant change in participants' preference for that deck could be found, as the frequency of selection from deck B stayed consistent. Much like Lin and colleagues found (2007), participants were observed to prefer deck B throughout the study regardless of the participants' sensitivity to BIS or BAS. Lin et. al.'s rationale was that the number of losses had a more significant impact on the participants deck preferences than the participants overall gains or losses and that B was not viewed as a negative deck (Chiu, Lin, et. al., 2007).

Participants were shown to have a shift in preferences for Deck C. Deck C has similar characteristics to deck A, but during the task, selecting from deck C would result in an overall gain for the participants, compared to deck A. Per the hypothesis, as participants gain conscious knowledge of the task, they would prefer it since it has a positive outcome. Unlike the previous decks though, the change was not uniform, as participants insensitive to BAS were initially less likely to select from deck C than participants sensitive to BAS, but during the last 60 trials, this preference was reversed. This same switch was not observed when comparing participants who were BIS sensitive, as both groups were observed to make greater selections from deck C during the last 60 trials.

Finally, deck D, much like deck B, demonstrated little change, and none that can be attributed to BIS or BAS. Again, it seems that participants were comfortable with this deck, regardless of the overall outcome.

For decks with High Gains, much like deck A, there was a shift away from those decks. This is likely what was seen by Damasio in his research using the IGT, seeing a shift away from the High Gain decks toward the safer Low Gain decks. It is likely that this shift was primarily caused by deck A since we did not observe any significant change in deck B.

At the same time, decks with few loss events (B and D) were relatively stable in selection by participant. Much like previous studies have shown (Chiu & Lin, 2007), B and D selection was constant throughout the task, while A and C did go through some changes. This likely indicates that even with conscious knowledge of the events, the participants did not recognize a need make a change in strategy to maximize their gains and that participants are not explicitly aware that deck B will result in an overall loss to the participant.

Outside of deck C, the impact of BIS and BAS was not significant. That indicates that participants uniformly move away from deck A and towards deck C, and this was likely caused by conscious knowledge of the task, such as the observation by participants that deck C had a better overall outcome than deck A. Decks B and D, with their rare loss events, appear more difficult for the participants to determine what the overall outcomes of each and so participants are less likely to move away from them, or even make more selections from them then they initial did.

Since participants seem to be moving from deck A to deck C, instead of moving from decks A and B to decks C and D, as Damasio believed, it does bring up the question of the role of Skin Conductive Response (SCR) that many studies had measured prior to selections from deck A and B (Bechara et. al., 1996, Damasio, 1996; Wagar & Dixon, 2006). It was argued by Damasio (1996) and Wagar and Dixon (2006) that SCR occurs as a warning system to participants prior to conscious knowledge, but it doesn't seem to impact participants selections from deck B. This would argue that something other than, or in addition to SCR's is providing the participants with data, at least before they have achieved conscious knowledge of the event.

The Alternative Iowa Gambling Task was constructed so that individual decks had equal outcomes. Since explicit conscious knowledge of the IGT should lead participants to prefer certain decks because of their better outcome, removing the notion of better decks should lead to participants selecting more frequently from decks they preferred.

Comparing the AIGT to the IGT setup, the AIGT demonstrated two distinctions. First the AIGT's gain schedule, unlike the IGT, is not a single consistent gain. Pilot testing indicated that consistent gains allowed participants to realize that none of the decks had better outcomes and therefore the participant would be less likely to move beyond random selection. Therefore, decks A and B were designed to have large gains interspersed with instances of no gains at all, while decks C and D has smaller gains, but few instances where the gains were set to 0. In addition, the gains were no uniform, but varied over time, to make it more difficult for the participants to discover the overall outcomes of all four decks.

Losses were also more randomized in the AIGT task, with one effect being that smaller, but more frequent loss events in decks A and C meant that sometimes deck C would have a loss and gain of equal value (something that came up infrequently in the IGT, but more frequently in the AIGT). This may have caused participants sensitive to BIS to be more comfortable with the deck C because several loss events may not have triggered the BIS because the loss events were equal to or less than the gains. If participants did not make a distinction between the loss result and the gains, and instead considered only the over loss or gain of a card turn in aggregate, then deck C would seem to have far fewer loss events than the schedule indicates.

In contrast, the losses of B and D were fewer, but larger, and when they did occur, would more likely be greater than the gains, while deck A's larger rewards and many losses might trigger the BIS more often, and trigger BAS less often, leading to fewer participants to prefer it (Gray 1991).

The results of the AIGT turned out to differ from the results of the IGT. Deck C, which, like the IGT, consisted of many small loss events, and smaller gains, was preferred by participant's sensitive to BIS, in contrast to the original hypothesis. Participant's sensitive to BIS leaned towards low gain decks, although; further analysis would indicate that this was due to deck C alone.

During the first 30 trials, neither BIS nor BAS had a significant impact on deck selection in contrast to the IGT. There was as shift in the last 60 trials though, has BIS sensitivity had a significant impact on deck A selection ($p < .05$), with participants sensitive to BIS preferring the deck. There were also a few marginal results involving BIS ($p < .10$), with participants sensitive to BIS having a slight preference for log gain decks (C and D) and avoiding decks with few losses (B and D). These results were likely driven by the participants preference for deck C though. That trend of deck C's preference can also be seen in the overall deck selection as well ($p < .05$).

Oddly enough, despite not having any decks with a preferred outcome, some shifts in how participants made selections in the decks were exhibited, and in some cases a causal effect linked to BIS or BAS sensitivity may have been demonstrated.

Participants' preferences for deck A did lessen overtime, much like in the IGT. Although there isn't a clear explanation, this might be due to deck A having large gains initially, and the loss events usually being smaller than the gain events, but as time progresses, the pattern shows that the gain events are few (4/10 turns will have a gain event) while the loss events, though small, happen much more frequently (8/10 turns have a loss event). This would support the hypothesis of Scope Insensitivity, as the number of small losses seem to have more impact than fewer larger gains (Desmeules, et. al., 2008). The continued shift from deck A to deck C, regardless of the over outcome falls in line with the with much of the prior research that shows that participants may not be explicitly cognizant of the overall gains of decks, but actually seeking to avoid losses (Chiu & Lin, 2007; Chiu, et. al., 2008; Chiu, Lee & Hsieh, 2007; van den Bos, Houx & Spruijt, 2004).

Much like the IGT, deck B stayed relatively stable, with participants selecting from the deck rough a quarter of the time throughout the task.

Deck C did not show an overall shift in preference, except for participants' sensitive to BIS. Participants sensitive to BIS select more from the deck in the last 60 trials, while those less sensitive to BIS shift away from it. BAS does not demonstrate a significant influence on this, and

the overall percentage of selection does not change significantly. As argued before, one hypothesis is that the relative frequency of loss events that are equal to or less than the gain events made them more palatable to participants' sensitive to loss.

As in the IGT, I did not see participants shift away from decks with less frequent but higher gains (decks A and B). Since these decks originally had a slightly greater percentage of selections in the first 30 trials, it may be an indication that participants realized those decks had no real advantage and were looking for a more optimized strategy or realized that random selection would have the same outcome. As with the works by Damasio (1996, 1998), this move was mainly pushed by participants moving away from deck A rather than deck B, which had fewer, but larger losses. As with the IGT, this move away was not attributed significantly to either BAS or BIS sensitivity, but instead a move made by almost all participants.

Participants started selecting less frequently from decks A, and more often from deck C just as in the IGT. Although the sensitivity to BAS or BIS did not make a significant difference in participants moving away from deck A, it was found that participants sensitive to BIS would be more likely to make selections from deck C during the last 60 trials.

Although the AIGT did not have the outcomes that were hypothesized, there are some conclusions that can be drawn from it. It is likely that participants do not independently track loss events and gain events in the task, but instead look at the overall outcome of a task. In the IGT, there were only a few instances where a loss event was less than the gain event, and so it was easy for the participants to distinguish when loss events occurred. In the AIGT this was more blurred, since loss amounts, as well as gain amounts seemed to be more randomized to the participants. This made it likely that individual loss events may not have been characterized by the participants' as loss events, especially in deck C, were on occasion the loss event was less than the actual gain event. This lack of a true 'loss' event might not trigger the participants' sensitive to BIS and make deck C a more attractive deck.

The AIGT did have at least one deck fall out of favor as the event progressed, much like in the IGT. Although the wins and losses in the game were marginal and the outcomes were held steady, participants still moved away from deck A. Since deck A on the AIGT, like the IGT, had many smaller losses, this could be attributed to participants wanting to avoid frequent loss events, regardless of the size of the loss. Again, this supports the argument that multiple losses, if large enough, has a great impact on how participants make decisions (Desmeules, et. al., 2008).

One final note that contrasts the IGT and the AIGT is that the role of both BIS and BAS seemed to be larger on the IGT in the first 30 rounds, where BIS has a significant impact on selections from deck A, and the aggregate of decks with fewer losses (deck B and D), and a marginal impact on deck D. In addition, BAS has a significant impact on selections made from deck C during the first 30 trials as well. The last 60 trials would show BAS and BIS having little or no influence on deck selection.

In contrast, the AIGT shows little direct influence on deck selection caused by BIS or BAS with a participant's sensitivity not making much of an impact during the first 30 trials. This changes somewhat during the last 60 trials, when BIS has a significant (although unexpected) impact on selection from deck C, and a marginal impact on selections from the aggregate of decks C and D, and decks B and D.

It could be that the since both gains and losses were subject to different schedules in the AIGT that participants, whether consciously or not, explicitly or not, had more trouble differentiating the decks during the first 30 trials compared to the IGT. That could explain why the role of BIS and BAS was greater during the last 60 trials, since knowledge of the decks, both explicit and implicit would arrive later.

The end results of the study did not match up with several of the hypotheses laid out, but it did open several questions for future research. The research also revealed several shorting comings of the methods themselves that could be addressed in future research.

As can be seen, the impact of BIS sensitive (and to a lesser extent BAS sensitive) can cause participant to shy away from certain options, even if those options have the same outcome. The likelihood of a detrimental event, even a small one, can cause people sensitive to BIS to avoid options, even if, the other options had harsher but less frequent outcomes for people (such as comparing Deck B versus Deck C on the IGT). People insensitive to losses may only consider the very worst outcomes, even if the accumulation of small losses would have a worse impact overall.

Sensitivity to BIS may cause people to avoid risky but ultimately beneficial choices, even if the risks are general minor. It could also cause them to give up sooner on tasks, as multiple minor set backs might be internalized sooner than for people insensitive to BIS, who may not take losses or failure as harshly.

Depending on the position and the goals of a person, sensitivity to BIS may be of benefit though. People sensitive to BIS may sooner realize when something is generally a losing strategy, such as procrastination, gambling or doing activities to excess. In those situations, BIS would activate sooner and be helpful in avoid bad outcomes.

Future research should continue to focus on different versions of the Alternative Iowa Gambling Task. The one provided showed interesting results, deck C was shown to confound participants. Rather than show an outcome with multiple small losses and small gains, the end results to participants seemed to perceive only a few loss events because the gains were greater. This led participants to react to deck C in a similar fashion as participants reacted to deck D on the Iowa Gambling Task. Future version of the AIGT should be more in line with the IGT by having all the loss events be equal to or greater than the gain events, should both occur.

In addition, although prior research showed that conscious knowledge of the task occurred after 30 trials, allowing the participants to take the Maia and McClelland (2004) questionnaire in the IGT and AIGT itself instead of on a separate paper might reduce the error rate on the survey, and allow the study to incorporate the questionnaire directly.

Finally, several of the analyses did show marginal results that are listed in the table. Although these are significant, a larger sample size might show that BIS and BAS have a slightly larger impact than the current study shows.

Appendices

Appendix A – Results

Table 2

Descriptive Statistics of All Deck Selection during the IGT

Deck	Sample Size	BAS Sensitivity	BIS Sensitivity	Mean	Std. Deviation	Deck	Mean	Std. Deviation
IGT30A	19	High	High	0.2070	0.0690	IGT60A	0.1640	0.0667
	15		Low	0.2378	0.0815		0.1922	0.0669
	34		Total	0.2206	0.0752		0.1765	0.0673
	14	Low	High	0.2095	0.0862		0.1643	0.0584
	11		Low	0.3273	0.2430		0.1424	0.0979
	25		Total	0.2613	0.1794		0.1547	0.0772
	33	Total	H	0.2081	0.0755		0.1641	0.0624
	26		L	0.2756	0.1714		0.1712	0.0835
	59		Total	0.2379	0.1302		0.1672	0.0719
IGT30B	19	High	H	0.2825	0.0670	IGT60B	0.2737	0.1214
	15		L	0.2889	0.0544		0.3033	0.1170
	34		Total	0.2853	0.0610		0.2868	0.1186
	14	Low	H	0.3262	0.1514		0.3440	0.1796
	11		L	0.2909	0.1193		0.2409	0.1296
	25		Total	0.3107	0.1367		0.2987	0.1649
	33	Total	H	0.3010	0.1110		0.3035	0.1504
	26		L	0.2897	0.0858		0.2769	0.1240
	59		Total	0.2960	0.1000		0.2918	0.1389
IGT30C	19	High	H	0.2000	0.0484	IGT60C	0.1991	0.1240
	15		L	0.2156	0.0844		0.2178	0.0674
	34		Total	0.2069	0.0660		0.2074	0.1020
	14	Low	H	0.1595	0.0682		0.1893	0.0802
	11		L	0.1727	0.0952		0.2909	0.1440
	25		Total	0.1653	0.0796		0.2340	0.1216
	33	Total	H	0.1828	0.0602		0.1949	0.1063
	26		L	0.1974	0.0899		0.2487	0.1104
	59		Total	0.1893	0.0744		0.2186	0.1105
IGT30D	19	High	H	0.3105	0.1111	IGT60D	0.3632	0.2276
	15		L	0.2578	0.0801		0.2867	0.0972
	34		Total	0.2873	0.1008		0.3294	0.1837
	14	Low	H	0.3048	0.2226		0.3024	0.1469
	11		L	0.2091	0.1165		0.3258	0.1294
	25		Total	0.2627	0.1867		0.3127	0.1371
	33	Total	H	0.3081	0.1646		0.3374	0.1971
	26		L	0.2372	0.0981		0.3032	0.1113
	59		Total	0.2768	0.1427		0.3223	0.1645

Appendix A – Results (Continued)

Table 3

Descriptive *Statistics of Decks AB vs CD and BD vs AC during the IGT*

Deck	BAS Sensitivity	BIS Sensitivity	Sample Size	Mean	Std. Deviation	Deck	Mean	Std. Deviation
IGT30AB	High	High	19	0.4895	0.0994	IGT30BD	0.5930	0.0966
		Low	15	0.5267	0.0961		0.5467	0.0853
		Total	34	0.5059	0.0983		0.5725	0.0934
	Low	High	14	0.5357	0.1883		0.6310	0.1423
		Low	11	0.6182	0.1980		0.5000	0.1764
		Total	25	0.5720	0.1931		0.5733	0.1683
	Total	High	33	0.5091	0.1432		0.6091	0.1176
		Low	26	0.5654	0.1516		0.5269	0.1306
		Total	59	0.5339	0.1484		0.5729	0.1292
IGT60AB	High	High	19	0.4377	0.1642	IGT60BD	0.6368	0.1647
		Low	15	0.4956	0.1150		0.5900	0.1039
		Total	34	0.4632	0.1455		0.6162	0.1412
	Low	High	14	0.5083	0.1821		0.6464	0.1030
		Low	11	0.3833	0.1700		0.5667	0.1406
		Total	25	0.4533	0.1844		0.6113	0.1250
	Total	High	33	0.4677	0.1729		0.6409	0.1399
		Low	26	0.4481	0.1489		0.5801	0.1187
		Total	59	0.4590	0.1617		0.6141	0.1334
IGT30CD	High	High	19	0.5105	0.0994	IGT30AC	0.4070	0.0966
		Low	15	0.4733	0.0961		0.4533	0.0853
		Total	34	0.4941	0.0983		0.4275	0.0934
	Low	High	14	0.4643	0.1883		0.3690	0.1423
		Low	11	0.3818	0.1980		0.5000	0.1764
		Total	25	0.4280	0.1931		0.4267	0.1683
	Total	High	33	0.4909	0.1432		0.3909	0.1176
		Low	26	0.4346	0.1516		0.4731	0.1306
		Total	59	0.4661	0.1484		0.4271	0.1292
IGT60CD	High	High	19	0.5623	0.1642	IGT60AC	0.3632	0.1647
		Low	15	0.5044	0.1150		0.4100	0.1039
		Total	34	0.5368	0.1455		0.3838	0.1412
	Low	High	14	0.4917	0.1821		0.3536	0.1030
		Low	11	0.6167	0.1700		0.4333	0.1406
		Total	25	0.5467	0.1844		0.3887	0.1250
	Total	High	33	0.5323	0.1729		0.3591	0.1399
		Low	26	0.5519	0.1489		0.4199	0.1187
		Total	59	0.5410	0.1617		0.3859	0.1334

Appendix A – Results (Continued)

Table 4

Descriptive Statistics of All Deck Selection during the AIGT

Deck	Sample Size	BAS Sensitivity	BIS Sensitivity	Mean	Std. Deviation	Deck	Mean	Std. Deviation
AIGT30A	19	High	High	0.2579	0.0760	AIGT60A	0.2246	0.0810
	15		Low	0.2733	0.1304		0.2267	0.0548
	34		Total	0.2647	0.1021		0.2255	0.0697
	14	Low	High	0.2714	0.0866		0.1869	0.1030
	11		Low	0.2970	0.1303		0.2379	0.0898
	25		Total	0.2827	0.1063		0.2093	0.0988
	33	High	High	0.2636	0.0797		0.2086	0.0914
	26		Low	0.2833	0.1283		0.2314	0.0703
	59		Total	0.2723	0.1034		0.2186	0.0829
AIGT30B	19	Low	High	0.2333	0.0484	AIGT60B	0.2237	0.0804
	15		Low	0.2533	0.0451		0.2511	0.0674
	34		Total	0.2422	0.0474		0.2358	0.0751
	14	High	High	0.2762	0.0709		0.2286	0.0720
	11		Low	0.2273	0.0647		0.3182	0.2391
	25		Total	0.2547	0.0713		0.2680	0.1694
	33	Low	High	0.2515	0.0619		0.2258	0.0758
	26		Low	0.2423	0.0546		0.2795	0.1630
	59		Total	0.2475	0.0585		0.2494	0.1239
AIGT30C	19	High	High	0.2351	0.0490	AIGT60C	0.2904	0.1631
	15		Low	0.2489	0.0502		0.2411	0.0742
	34		Total	0.2412	0.0493		0.2686	0.1322
	14	Low	High	0.2310	0.0673		0.3167	0.1288
	11		Low	0.2152	0.0545		0.1864	0.1008
	25		Total	0.2240	0.0613		0.2593	0.1326
	33	High	High	0.2333	0.0565		0.3015	0.1479
	26		Low	0.2346	0.0537		0.2179	0.0889
	59		Total	0.2339	0.0548		0.2647	0.1313
AIGT30D	19	Low	High	0.2737	0.0528	AIGT60D	0.2614	0.1003
	15		Low	0.2244	0.0597		0.2811	0.0906
	34		Total	0.2520	0.0604		0.2701	0.0952
	14	High	High	0.2214	0.0464		0.2679	0.0826
	11		Low	0.2606	0.0880		0.2576	0.1761
	25		Total	0.2387	0.0692		0.2633	0.1290
	33	Low	High	0.2515	0.0560		0.2641	0.0919
	26		Low	0.2397	0.0736		0.2712	0.1309
	59		Total	0.2463	0.0640		0.2672	0.1098

Appendix A – Results (Continued)

Table 5

Descriptive Statistics of Decks AB vs CD and BD vs AC during the AIGT

Deck	BAS Sensitivity	BIS Sensitivity	Sample Size	Mean	Std. Deviation	Deck	Mean	Std. Deviation
AIGT30AB	High	High	19	0.4912	0.0576	AIGT30BD	0.5070	0.0733
		Low	15	0.5267	0.1033		0.4778	0.0879
		Total	34	0.5069	0.0816		0.4941	0.0802
	Low	High	14	0.5476	0.0894		0.4976	0.0779
		Low	11	0.5242	0.0932		0.4879	0.1148
		Total	25	0.5373	0.0899		0.4933	0.0938
	High	High	33	0.5152	0.0769		0.5030	0.0742
		Low	26	0.5256	0.0972		0.4821	0.0981
		Total	59	0.5198	0.0858		0.4938	0.0854
AIGT60AB	Low	High	19	0.4482	0.1188	AIGT60BD	0.4851	0.1482
		Low	15	0.4778	0.0938		0.5322	0.0837
		Total	34	0.4613	0.1079		0.5059	0.1246
	High	High	14	0.4155	0.1452		0.4964	0.1028
		Low	11	0.5561	0.2520		0.5758	0.1277
		Total	25	0.4773	0.2073		0.5313	0.1189
	Low	High	33	0.4343	0.1295		0.4899	0.1292
		Low	26	0.5109	0.1786		0.5506	0.1045
		Total	59	0.4681	0.1564		0.5167	0.1218
AIGT30CD	High	High	19	0.5088	0.0576	AIGT30AC	0.4930	0.0733
		Low	15	0.4733	0.1033		0.5222	0.0879
		Total	34	0.4931	0.0816		0.5059	0.0802
	Low	High	14	0.4524	0.0894		0.5024	0.0779
		Low	11	0.4758	0.0932		0.5121	0.1148
		Total	25	0.4627	0.0899		0.5067	0.0938
	High	High	33	0.4848	0.0769		0.4970	0.0742
		Low	26	0.4744	0.0972		0.5179	0.0981
		Total	59	0.4802	0.0858		0.5062	0.0854
AIGT60CD	Low	High	19	0.5518	0.1188	AIGT60AC	0.5149	0.1482
		Low	15	0.5222	0.0938		0.4678	0.0837
		Total	34	0.5387	0.1079		0.4941	0.1246
	High	High	14	0.5845	0.1452		0.5036	0.1028
		Low	11	0.4439	0.2520		0.4242	0.1277
		Total	25	0.5227	0.2073		0.4687	0.1189
	Low	High	33	0.5657	0.1295		0.5101	0.1292
		Low	26	0.4891	0.1786		0.4494	0.1045
		Total	59	0.5319	0.1564		0.4833	0.1218

Appendix A – Results (Continued)

Table 6

First 30 Trials of the IGT

Decks		Deck A		Deck B		Deck C		Deck D		LG Decks (C+D)		FL Decks (B+D)	
BIS/BAS Sensitivity	Sample Size	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low BIS	26	0.28	0.17	0.29	0.09	0.20	0.09	0.24	0.10	0.43	0.15	0.53	0.13
High BIS	33	0.21	0.08	0.30	0.11	0.18	0.06	0.31	0.16	0.49	0.14	0.61	0.12
Low BAS	25	0.26	0.18	0.31	0.14	0.17	0.08	0.26	0.19	0.43	0.19	0.57	0.17
High BAS	34	0.22	0.08	0.29	0.06	0.21	0.07	0.29	0.10	0.49	0.10	0.57	0.09
Total	59	0.24	0.13	0.30	0.10	0.19	0.07	0.28	0.14	0.47	0.15	0.57	0.13
Test	df	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.
BIS Levels	1	4.13	0.047**	0.182	0.67	0.556	0.459	3.763	0.057*	2.135	0.149	6.436	0.014**
BAS Levels	1	1.421	0.238	0.926	0.34	4783	0.033**	0.424	0.518	2.958	0.091	0.001	0.917

Table 7

Last 60 Trials of the IGT

Decks		Deck A		Deck B		Deck C		Deck D		LG Decks (C+D)		FL Decks (B+D)	
BIS/BAS Sensitivity	Sample Size	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low BIS	26	0.17	0.08	0.28	0.12	0.25	0.11	0.30	0.11	0.55	0.15	0.58	0.12
High BIS	33	0.16	0.06	0.30	0.15	0.19	0.11	0.34	0.20	0.53	0.17	0.64	0.14
Low BAS	25	0.15	0.08	0.30	0.16	0.23	0.12	0.31	0.14	0.55	0.18	0.61	0.13
High BAS	34	0.18	0.07	0.29	0.12	0.21	0.10	0.33	0.18	0.54	0.15	0.62	0.14
Total	59	0.17	0.07	0.29	0.14	0.22	0.11	0.32	0.16	0.54	0.16	0.61	0.13
Test	df	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.
BIS Levels	1	0.136	0.0713	0.529	0.47	0.3596	0.063*	0.623	0.433	0.211	0.648	3.128	0.082
BAS Levels	1	1.694	0.198	0.012	0.91	0.1239	0.271	0.601	0.806	0.243	0.624	0.038	0.846

Appendix A – Results (Continued)

Table 8

All trials of the IGT

Decks		Deck A		Deck B		Deck C		Deck D		LG Decks (C+D)		FL Decks (B+D)	
BIS/BAS Sensitivity	Sample Size	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low BIS	26	0.21	0.05	0.28	0.08	0.23	0.08	0.28	0.07	0.51	0.09	0.56	0.08
High BIS	33	0.18	0.06	0.30	0.12	0.19	0.08	0.33	0.15	0.52	0.13	0.63	0.12
Low BAS	25	0.19	0.06	0.30	0.12	0.21	0.09	0.30	0.11	0.51	0.13	0.60	0.10
High BAS	34	0.19	0.06	0.29	0.09	0.21	0.08	0.32	0.14	0.52	0.11	0.60	0.11
Total	59	0.19	0.06	0.29	0.10	0.21	0.08	0.31	0.13	0.32	0.12	0.60	0.11
Test	df	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.
BIS Levels	1	0.3611	0.062*	0.635	0.43	3.688	0.060*	2.041	0.159	0.34	0.855	6.439	0.014**
BAS Levels	1	0.004	0.949	0.364	0.55	0.032	0.859	0.342	0.561	0.248	0.621	0.011	0.917

Table 9

First 30 trials of the AIGT

Decks		Deck A		Deck B		Deck C		Deck D		LG Decks (C+D)		FL Decks (B+D)	
BIS/BAS Sensitivity	Sample Size	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low BIS	26	0.28	0.13	0.24	0.05	0.23	0.05	0.24	0.07	0.47	0.10	0.48	0.10
High BIS	33	0.26	0.08	0.25	0.06	0.23	0.06	0.25	0.06	0.48	0.08	0.50	0.07
Low BAS	25	0.28	0.11	0.25	0.07	0.22	0.06	0.24	0.07	0.46	0.09	0.49	0.09
High BAS	34	0.26	0.10	0.24	0.07	0.24	0.05	0.25	0.06	0.49	0.08	0.49	0.08
Total	59	0.27	0.10	0.25	0.06	0.23	0.05	0.25	0.06	0.52	0.09	0.49	0.09
Test	df	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.
BIS Levels	1	0.523	0.472	0.357	0.55	0.008	0.93	0.487	0.488	0.214	0.645	0.875	0.353
BAS Levels	1	0.43	0.515	0.656	0.42	1.424	0.238	0.617	0.435	1.844	0.18	0.001	0.973

Appendix A – Results (Continued)

Table 10

Last 60 Trials of the AIGT

Decks		Deck A		Deck B		Deck C		Deck D		LG Decks (C+D)		FL Decks (B+D)	
BIS/BAS Sensitivity	Sample Size	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low BIS	26	0.23	0.07	0.28	0.16	0.22	0.09	0.27	0.13	0.50	0.18	0.55	0.10
High BIS	33	0.21	0.09	0.23	0.08	0.30	0.15	0.26	0.09	0.57	0.13	0.49	0.13
Low BAS	25	0.21	0.10	0.27	0.17	0.26	0.13	0.26	0.13	0.52	0.21	0.53	0.12
High BAS	34	0.23	0.07	0.24	0.08	0.27	0.13	0.27	0.10	0.54	0.11	0.51	0.12
Total	59	0.22	0.08	0.25	0.12	0.26	0.13	0.27	0.11	0.53	0.16	0.52	0.12
Test	df	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.
BIS Levels	1	1.105	0.298	2.822	0.1	6.447	0.014**	0.058	0.81	3.642	0.061*	3.79	0.056*
BAS Levels	1	0.543	0.464	0.974	0.33	0.071	0.791	0.054	0.817	0.15	0.7	0.625	0.433

Table 11

All Trials of the AIGT

Decks		Deck A		Deck B		Deck C		Deck D		LG Decks (C+D)		FL Decks (B+D)	
BIS/BAS Sensitivity	Sample Size	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low BIS	26	0.25	0.06	0.27	0.11	0.22	0.06	0.26	0.09	0.48	0.13	0.53	0.08
High BIS	33	0.23	0.07	0.23	0.06	0.28	0.10	0.26	0.07	0.54	0.09	0.49	0.09
Low BAS	25	0.21	0.10	0.27	0.17	0.26	0.13	0.26	0.13	0.52	0.21	0.53	0.12
High BAS	34	0.23	0.07	0.24	0.08	0.27	0.13	0.27	0.10	0.54	0.11	0.51	0.12
Total	59	0.22	0.08	0.25	0.12	0.26	0.13	0.27	0.11	0.53	0.16	0.52	0.12
Test	df	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.	F Score	Sig.
BIS Levels	1	1.531	0.221	2.284	0.14	6.246	0.015**	0.001	0.972	3.8235	0.055*	2.119	0.151
BAS Levels	1	0.071	0.79	1.366	0.025	0.261	0.612	0.178	0.675	0.526	0.471	0.508	0.479

Appendix A – Results (Continued)

Table 12

Analysis of IGT Deck A

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.28	0.17	0.17	0.08
High BIS	33	0.21	0.08	0.16	0.06
Low BAS	25	0.26	0.18	0.15	0.08
High BAS	34	0.22	0.08	0.18	0.07
Total	59	0.24	0.13	0.17	0.07
Test	df	F-Score (Within)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	12.114	0.001*	2.016	0.161
BAS Levels	1	12.411	0.001*	2.136	0.149

Table 13

Analysis of IGT Deck B

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.29	0.09	0.28	0.12
High BIS	33	0.3	0.11	0.3	0.15
Low BAS	25	0.31	0.14	0.3	0.16
High BAS	34	0.29	0.06	0.29	0.12
Total	59	0.3	0.1	0.29	0.14
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	0.059	0.808	0.132	0.718
BAS Levels	1	0.062	0.805	0.101	0.752

Appendix A – Results (Continued)

Table 14

Analysis of IGT Deck C

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.20	0.09	0.25	0.11
High BIS	33	0.18	0.06	0.19	0.11
Low BAS	25	0.17	0.08	0.23	0.12
High BAS	34	0.21	0.07	0.21	0.1
Total	59	0.19	0.07	0.22	0.11
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	4.17	0.046*	1.591	0.212
BAS Levels	1	5.207	0.026*	5.06	0.028*

Table 15

Analysis of IGT Deck D

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.24	0.1	0.30	0.11
High BIS	33	0.31	0.16	0.34	0.20
Low BAS	25	0.26	0.19	0.31	0.14
High BAS	34	0.29	0.10	0.33	0.18
Total	59	0.28	0.14	0.32	0.16
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	3.163	0.081	0.47	0.496
BAS Levels	1	2.906	0.094	0.021	0.885

Appendix A – Results (Continued)

Table 16

Analysis of IGT High Gain Decks

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.57	0.15	0.45	0.15
High BIS	33	0.51	0.14	0.47	0.17
Low BAS	25	0.57	0.19	0.45	0.18
High BAS	34	0.51	0.10	0.46	0.15
Total	59	0.53	0.15	0.45	16.00
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	7.438	0.008*	1.701	0.197
BAS Levels	1	7.61	0.008*	1.67	0.199

Table 17

Analysis of IGT Few Loss Event Decks

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.53	0.13	0.58	0.12
High BIS	33	0.61	0.12	0.64	0.14
Low BAS	25	0.57	0.17	0.61	0.13
High BAS	34	0.57	0.09	0.62	0.14
Total	59	0.57	0.13	0.61	0.13
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	3.818	0.56	0.242	0.625
BAS Levels	1	3.472	0.068	0.017	0.898

Appendix A – Results (Continued)

Table 18

Analysis of AIGT Deck A

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.28	0.13	0.23	0.07
High BIS	33	0.26	0.08	0.21	0.09
Low BAS	25	0.28	0.11	0.21	0.10
High BAS	34	0.26	0.10	0.23	0.07
Total	59	0.27	0.10	0.22	0.08
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	10.104	0.002*	0.009	0.926
BAS Levels	1	11.28	0.001*	1.037	0.313

Table 19

Analysis of AIGT Deck B

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.24	0.05	0.28	0.16
High BIS	33	0.25	0.06	0.23	0.08
Low BAS	25	0.25	0.07	0.27	0.17
High BAS	34	0.24	0.05	0.24	0.08
Total	59	0.25	0.06	0.25	0.12
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	0.099	0.754	3.019	0.088
BAS Levels	1	0.035	0.852	0.28	5.99

Appendix A – Results (Continued)

Table 20

Analysis of AIGT Deck C

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.23	0.05	0.22	0.09
High BIS	33	0.23	0.06	0.30	0.15
Low BAS	25	0.22	0.06	0.26	0.13
High BAS	34	0.24	0.05	0.27	0.13
Total	59	0.23	0.05	0.26	0.13
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	1.946	0.168	5.28	0.025*
BAS Levels	1	2.623	0.111	0.041	0.84

Table 21

Analysis of AIGT Deck D

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.24	0.07	0.27	0.13
High BIS	33	0.25	0.06	0.26	0.09
Low BAS	25	0.24	0.07	0.26	0.13
High BAS	34	0.25	0.06	0.27	0.10
Total	59	0.25	0.06	0.27	0.11
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	2.059	0.157	0.375	0.543
BAS Levels	1	1.916	0.172	0.045	0.834

Appendix A – Results (Continued)

Table 22

Analysis of AIGT High Gain Decks

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.53	0.10	0.51	0.18
High BIS	33	0.52	0.08	0.43	0.13
Low BAS	25	0.54	0.09	0.48	0.21
High BAS	34	0.53	0.08	0.46	0.11
Total	59	0.52	0.09	0.47	0.16
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	4.332	0.042*	2.071	0.156
BAS Levels	1	5.065	0.028*	0.094	0.76

Table 23

Analysis of AIGT Few Loss Event Decks

BIS/BAS Sensitivity	Sample Size	First 30 Mean	First 30 SD	Last 60 Mean	Last 60 SD
Low BIS	26	0.48	0.10	0.55	0.10
High BIS	33	0.50	0.07	0.49	0.13
Low BAS	25	0.49	0.09	0.53	0.12
High BAS	34	0.49	0.08	0.51	0.12
Total	59	0.49	0.09	0.52	0.12
Test	df	F-Score (Repeated)	Sig.	F-Score (Repeated and Between)	Sig.
BIS Levels	1	2.383	0.128	5.173	0.027*
BAS Levels	1	1.757	0.19	0.488	0.487

Appendix B – Gain Loss Schedule of the Iowa Gambling Task

Table 24

First 20 Trials of the IGT

Deck	A		B		C		D	
Trials	Gains	Losses	Gains	Losses	Gains	Losses	Gains	Losses
1	100	0	100	0	50	0	50	0
2	100	0	100	0	50	0	50	0
3	100	-150	100	0	50	-50	50	0
4	100	0	100	0	50	0	50	0
5	100	-300	100	0	50	-50	50	0
6	100	0	100	0	50	0	50	0
7	100	-200	100	0	50	-50	50	0
8	100	0	100	0	50	0	50	0
9	100	-250	100	-1250	50	-50	50	0
10	100	-350	100	0	50	-50	50	-250
Average	1000	-1250	1000	-1250	500	-250	500	-250
11	100	0	100	0	50	0	50	0
12	100	-350	100	0	50	-25	50	0
13	100	0	100	0	50	-75	50	0
14	100	-250	100	-1250	50	0	50	0
15	100	-200	100	0	50	0	50	0
16	100	0	100	0	50	0	50	0
17	100	-300	100	0	50	-25	50	0
18	100	-150	100	0	50	-75	50	0
19	100	0	100	0	50	0	50	0
20	100	0	100	0	50	-50	50	-250
Average	1000	-1250	1000	-1250	500	-250	500	-250

Appendix B Iowa Gambling Gain/Loss Schedule (Continued)

Table 25

Second 20 Trials of the IGT

Deck	A		B		C		D	
Trials	Gains	Losses	Gains	Losses	Gains	Losses	Gains	Losses
21	100	0	100	-1250	50	0	50	0
22	100	-300	100	0	50	0	50	0
23	100	0	100	0	50	0	50	0
24	100	-350	100	0	50	-50	50	0
25	100	0	100	0	50	-25	50	0
26	100	-200	100	0	50	-50	50	0
27	100	-250	100	0	50	0	50	0
28	100	-150	100	0	50	0	50	0
29	100	0	100	0	50	-75	50	-250
30	100	0	100	0	50	-50	50	0
Average	1000	-1250	1000	-1250	500	-250	500	-250
31	100	-350	100	0	50	0	50	0
32	100	-200	100	-1250	50	0	50	0
33	100	-250	100	0	50	0	50	0
34	100	0	100	0	50	-25	50	0
35	100	0	100	0	50	-25	50	-250
36	100	0	100	0	50	0	50	0
37	100	-150	100	0	50	-75	50	0
38	100	-300	100	0	50	0	50	0
39	100	0	100	0	50	-50	50	0
40	100	0	100	0	50	-75	50	0
Average	1000	-1250	1000	-1250	500	-250	500	-250
Net	4000	-5000	4000	-5000	2000	1000	2000	1000

Appendix C – Gain/Loss Schedule of the Alternative Iowa Gambling Task

Table 26

First 20 Trials of the AIGT

Deck	A		B		C		D	
Trials	Gains	Losses	Gains	Losses	Gains	Losses	Gains	Losses
1	300	0	300	0	150	0	150	0
2	0	-150	0	-200	100	-150	100	-200
3	250	-75	250	0	125	-75	125	0
4	0	-100	0	0	0	-100	0	0
5	0	-125	0	-250	100	-125	100	-250
6	200	-75	200	-250	125	-75	125	-250
7	0	-125	0	0	150	-125	150	0
8	250	-100	250	0	100	-100	100	0
9	0	0	0	0	0	0	0	0
10	0	-150	0	-200	150	-150	150	-200
Average	1000	-900	1000	-900	1000	-900	1000	-900
11	275	-125	275	-225	150	-125	150	-225
12	0	-150	0	0	0	-150	0	0
13	0	0	0	-250	150	0	150	-250
14	225	-75	225	0	150	-75	150	0
15	0	-75	0	0	0	-75	0	0
16	0	-125	0	-225	100	-125	100	-225
17	300	0	300	0	100	0	100	0
18	0	-100	0	0	125	-100	125	0
19	200	-100	200	-200	100	-100	100	-200
20	0	-150	0	0	125	-150	125	0
Average	1000	-900	1000	-900	1000	-900	1000	-900

Appendix C – Gain/Loss Schedule of the Alternative Iowa Gambling Task (Continued)

Table 27

Second 20 Trials of the AIGT

Deck	A		B		C		D	
Trials	Gains	Losses	Gains	Losses	Gains	Losses	Gains	Losses
21	0	-75	0	-300	125	-75	125	-300
22	0	-150	0	0	100	-150	100	0
23	325	-100	325	0	175	-100	175	0
24	250	0	250	-200	100	0	100	-200
25	0	0	0	0	0	0	0	0
26	0	-75	0	-200	125	-75	125	-200
27	0	-150	0	0	100	-150	100	0
28	225	-125	225	0	175	-125	175	0
29	0	-75	0	-200	0	-75	0	-200
30	200	-150	200	0	100	-150	100	0
Average	1000	-900	1000	-900	100	-900	100	-900
31	250	-100	250	0	150	-100	150	0
32	0	-75	0	-225	125	-75	125	-225
33	0	0	0	-225	0	0	0	-225
34	225	-175	225	0	100	-175	100	0
35	275	-100	275	-225	125	-100	125	-225
36	0	-75	0	0	175	-75	175	0
37	0	0	0	0	100	0	100	0
38	0	-150	0	-225	0	-150	0	-225
39	0	-75	0	0	125	-75	125	0
40	250	-150	250	0	100	-150	100	0
Average	1000	-900	1000	-900	1000	-900	1000	-900
Net	4000	-3600	4000	-3600	4000	-3600	4000	-3600

Appendix D – Maia and McClelland Questionnaire (2004)

Conscious Knowledge of the IGT and AIGT

The operational definition of conscious knowledge: Knowledge that can be reported verbally and identified to be at one of the following three levels.

Level 0: The participant does not have any conscious knowledge specifying a preference for one of the two best decks.

Level 1: The participant has conscious knowledge specifying a preference for one of the two best decks but does not have conscious knowledge about the outcomes of the decks that could provide a basis for that preference.

Level 2: The participant has conscious knowledge specifying a preference for one of the two best decks and has conscious knowledge about the outcomes of the decks that could provide a basis for that preference.

The level of a participant is determined by answer the following questions after the 20 trials, and then ever 10 trials after that, for a grand total of 9 times during the Iowa Gambling Task.

Appendix D (Continued)

Questions for Deck A

Question 1: Rate on a scale of -10 to +10, how good or bad you think deck A is, where -10 means that it is terrible and +10 means it is excellent.

Question 2: Okay, why did you rate deck A with...?

Question 3: In answering the questions that follow, consider the following definitions. Your "winning amount" for a trial is the amount you won on that trial. Your "loss" on a trial is the amount you lost on that trial. Your "net result" for a trial is the amount you won minus the amount you lost on that trial. Do you understand these definitions and the differences between the three terms? [If not, explain again using examples}

Okay, now suppose you were to select 10 cards from deck A.

Question 3.1: What would you expect your average net result to be?

Question 3.2: What would you expect your average winning amount to be?

Question 3.3.: In how many of the 10 trials would you expect to get a loss (not necessarily a net loss)?

Question 3.4: For those trials in which you would get a loss, what would you expect the average loss to be?

Appendix D (Continued)

Questions for Deck B

Question 1: Rate on a scale of -10 to +10, how good or bad you think deck B is, where -10 means that it is terrible and +10 means it is excellent.

Question 2: Okay, why did you rate deck B with...?

Question 3: In answering the questions that follow, consider the following definitions. Your "winning amount" for a trial is the amount you won on that trial. Your "loss" on a trial is the amount you lost on that trial. Your "net result" for a trial is the amount you won minus the amount you lost on that trial. Do you understand these definitions and the differences between the three terms? [If not, explain again using examples}

Okay, now suppose you were to select 10 cards from deck B.

Question 3.1: What would you expect your average net result to be?

Question 3.2: What would you expect your average winning amount to be?

Question 3.3.: In how many of the 10 trials would you expect to get a loss (not necessarily a net loss)?

Question 3.4: For those trials in which you would get a loss, what would you expect the average loss to be?

Appendix D (Continued)

Questions for Deck C

Question 1: Rate on a scale of -10 to +10, how good or bad you think deck C is, where -10 means that it is terrible and +10 means it is excellent.

Question 2: Okay, why did you rate deck C with...?

Question 3: In answering the questions that follow, consider the following definitions. Your "winning amount" for a trial is the amount you won on that trial. Your "loss" on a trial is the amount you lost on that trial. Your "net result" for a trial is the amount you won minus the amount you lost on that trial. Do you understand these definitions and the differences between the three terms? [If not, explain again using examples

Okay, now suppose you were to select 10 cards from deck C.

Question 3.1: What would you expect your average net result to be?

Question 3.2: What would you expect your average winning amount to be?

Question 3.3.: In how many of the 10 trials would you expect to get a loss (not necessarily a net loss)?

Question 3.4: For those trials in which you would get a loss, what would you expect the average loss to be?

Appendix D (Continued)

Questions for Deck D

Question 1: Rate on a scale of -10 to +10, how good or bad you think deck D is, where -10 means that it is terrible and +10 means it is excellent.

Question 2: Okay, why did you rate deck D with...?

Question 3: In answering the questions that follow, consider the following definitions. Your "winning amount" for a trial is the amount you won on that trial. Your "loss" on a trial is the amount you lost on that trial. Your "net result" for a trial is the amount you won minus the amount you lost on that trial. Do you understand these definitions and the differences between the three terms? [If not, explain again using examples}

Okay, now suppose you were to select 10 cards from deck D.

Question 3.1: What would you expect your average net result to be?

Question 3.2: What would you expect your average winning amount to be?

Question 3.3.: In how many of the 10 trials would you expect to get a loss (not necessarily a net loss)?

Question 3.4: For those trials in which you would get a loss, what would you expect the average loss to be?

Appendix D (Continued)

Questions for all of the Decks.

Question 4. Okay, now tell me, on a scale of 0 to 100, how much you think that you know what you should do in this game in order to win as much money as possible (or, if you can't win, to avoid losing money as much as possible). 0 means that you have no idea of what you should do and feel that you still need to explore the game more and 100 means that you know exactly what you should do and have no doubts that that would be the best strategy.

Question 5. Now suppose I told you that you could only select cards from one of the decks until the end of the game, but that you were allowed to choose now the deck from which you would draw your cards. Which of the four decks would you pick?

Appendix E - Behavioral Inhibition System/Behavioral Approach System (BIS/BAS) Scale as developed by Carver and White (1994)

Each individual scale is scored separately by adding up the number circled by the participants.

Table 28

Behavioral Inhibition System Scale

#	Question	Score			
1	Even if something bad happens to me, I rarely experience fear or nervousness. (Reverse Coded)	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
2	Criticism or scolding hurts me quite a bit.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
3	I feel pretty worried or upset when I think or know somebody is angry at me.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
4	If I think something unpleasant is going to happen I usually get pretty "worked up."	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
5	I feel worried when I think I have done poorly at something important.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
6	I have few fears compared to my friends. (Reverse Coded).	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
7	I worry about making mistakes.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me

Appendix E (Continued)

Table 29

Behavioral Approach System, Drive Scale

#	Question	Score			
1	I go out of my way to get the things I want.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
2	When I want something I usually go all-out to get it.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
3	If I see a chance for something I want I move on it right away.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
4	When I go after something I use a “no holds barred approach.”	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me

Table 30

Behavioral Approach System, Fun Seeking Scale

#	Question	Score			
1	I'm always willing to try something new if I think it will be fun.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
2	I will often do things for no other reason than they might be fun.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
3	I often act on the spur of the moment.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
4	I crave excitement and new sensations	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me

Appendix E (Continued)

Table 31

Behavioral Approach System, Reward Responsiveness Scale

#	Question	Score			
1	When I am doing well at something I love to keep at it.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
2	When I get something I want, I feel excited and energized.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
3	When I see an opportunity for something I like I get excited right away.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
4	When good things happen to me, they affect me strongly	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
5	It would excite me to win a contest.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me

Table 32

Filler Questions

#	Question	Score			
1	A person's family is the most important thing in life.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
2	How I dress is important to me.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
3	It's hard for me to find the time to do things like get a haircut.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me
4	I often wonder why people act the way they do.	1. Very True For Me	2. Some What True For Me	3. Some What False For Me	4. Very False For Me

Appendix F

Instructions for the "Gambling with Uncertainty"

1. In front of you on the screen are four decks: A, B, C and D.
2. I want you select to one card at a time, by clicking on the card, from any deck you choose.
3. Each time you select a card from a deck, there is a chance you will win some money. The amount won will not be known until after you have chosen a card. This amount won will be added to your total score, which you will see after you have chosen.
4. Each time you select a card from a deck, there is a chance you will lose some money. The amount you lose will not be known to you until after you have chosen a card. The amount lost will be subtracted from your total score, which you will see after you have chosen.
5. You are free to switch from one deck to another any time you wish.
6. The goal of the game is to win as much money as possible. If you feel you are unable to win, make sure you avoid losing money as much as possible.
7. I can't tell you how long the game will continue. You must keep on playing until the computer stops.
8. You will get a $2000 credit to start the game. At the end, we will see how much you have won or lost.
9. It is important to know that the computer does not make you lose money at random. However, there is no way to figure out when the computer will make you lose money. All I can say is that you may find yourself losing money on all decks, but some decks will make you lose more than others. You can win if you stay away from the worst decks.

Do Not Turn the Page until you are instructed to do so by the Experimenter or the Computer. Continue on with the Computer Section. You may refer back to this page if necessary!

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