Personality characteristics and state mood influence individual deck selections on the Iowa Gambling Task

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The Iowa Gambling Task (IGT) is commonly used to assess risky decision making in clinical and non-clinical populations, and negative mood and various personality characteristics have been shown to affect the number of advantageous and disadvantageous selections on this task. Recent research has suggested that IGT data should be analyzed at the individual deck level due to differences in frequency and magnitude of losses, and the present study examined how personality characteristics and state mood may affect deck level selections on this task. Participants were 91 undergraduate students (38 male) who completed measures of impulsivity and sensation seeking, behavioral activation and inhibition, state mood, and the computerized IGT. Results indicated that negative mood, drive, impulsivity, and sensation seeking were all positively correlated with Deck B selections, but negatively correlated with Deck D selections. No differences emerged in correlations between Decks A and B or Decks A and D. Results indicate that mood and personality characteristics differentially relate to selections from the individual decks on the IGT. Results have implications for the assessment of decision making, as personality and fluctuations in state-dependent mood could mimic pathological risk-taking if analysis is conducted on the combined decks.

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1. Introduction

1.1. Background

The Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) was created to assess decision making deficits in adults with prefrontal cortex damage but who showed little impairment on measures of executive functions. On the IGT, individuals select 100 cards from one of four decks of cards: A, B, C, or D. Decks A and B yield an average profit of $100 per selection, and Decks C and D yield an average profit of $50 per selection (Bechara, 2008). Participants also experience losses. After ten selections from Decks A or B, individuals incur a net loss of $250, whereas 10 selections from Decks C or D result in a net gain of $250. Thus, Decks A and B have been termed “disadvantageous” and Decks C and D “advantageous” (Bechara et al., 1994). Risky decision making, in that individuals continue to select from the disadvantageous decks even after the risks are made apparent, is seen across multiple clinical populations (for a review, see Buelow & Suhr, 2009). For example, individuals with damage to the ventromedial prefrontal cortex or amygdala, at younger and older age ranges, abuse of or dependence on single or multiple substances, or diagnoses of schizophrenia or Attention-Deficit/Hyperactivity Disorder have shown riskier performance on the task.

However, research also suggests it is not just clinical populations that play in a risky manner on the IGT. Using non-clinical samples, researchers have examined whether personality characteristics and mood affect IGT performance. Among children, high levels of sensation seeking/disinhibition were associated with riskier IGT performance (Crone, Vendel, & van der Molen, 2003). Riskier performance on the IGT is also associated with high behavioral activation (BAS) and low behavioral inhibition (BIS) (Franken & Muris, 2005; Suhr & Tsanadis, 2007; van Honk, Hermans, Putman, Montagne, & Schulter, 2002). Studies examining negative mood and anxiety are mixed, with some studies showing riskier (de Vries, Holland, & Wittman, 2008; Miu, Heilmann, & Houser, 2008; Must et al., 2006; Suhr & Tsanadis, 2007) and others improved performance (Smoski et al., 2008; Werner, Duschek, & Schandry, 2009). Impulsivity has also shown an inconsistent relationship with the IGT (Davis, Patte, Tweed, & Curtis, 2007; Franken, van Strien, Nijs, & Muris, 2008; Perales, Verdejo-Garcia, Moya, Lozano, & Peres-Garcia, 2009; Upton, Bishara, Ahn, & Stout, 2011; Zermatten, van der Linden, d’Acremont, Jermain, & Bechara, 2009). For example, individuals with damage to the ventromedial prefrontal cortex or amygdala, at younger and older age ranges, abuse of or dependence on single or multiple substances, or diagnoses of schizophrenia or Attention-Deficit/Hyperactivity Disorder have shown riskier performance on the task.
Collectively, these results indicate personality and mood can impact IGT performance, yet inconsistencies remain unexplained. One factor potentially contributing to inconsistent findings is the method of assessing IGT performance. Originally, IGT performance was calculated by subtracting the advantageous minus disadvantageous selections, resulting in one total score across all 100 trials (Bechara et al., 1994). Eventually, research indicated not all trials are equal (Brand, Recknor, Grabenhorst, & Bechara, 2007), and performance should instead be examined by 20-card blocks of trials, with early trials indicating decision making under ambiguity and later trials decision making under risk. Studies utilizing block analyses may result in different findings than when a total score is used. In addition, concerns have been raised about inequalities between the decks. For example, although Decks A and B result in long-term negative outcomes, selections from Deck B are penalized on 10% of trials but Deck A selections are penalized 50% of the time (Bechara, 2008). The immediate losses on Deck B are also larger than those in Deck A. Similar differences are seen between Decks C (50% losses) and D (10% losses). The IGT manual indicates that, while avoiding Deck B is considered a good decision, Deck A should be avoided by most “neurologically intact” individuals (Bechara, 2008). No indication was made regarding differences in Deck C and D preferences. A general preference for Deck B has been found in clinical and nonclinical samples (Overman et al., 2004; Ritter, Meador-Woodruff, & Dalack, 2004; Sevy et al., 2007), providing evidence that participants may not weigh selections from Decks A and B consistently. To date, no research has been conducted on whether personality characteristics and state affect relate differently to Deck B (“normal” risk-taking) versus Deck A (“pathological” risk-taking).

Differences in choices at the individual deck level may be due to the frequency of wins and losses, rather than the long-term outcomes. Utilizing adapted versions of the IGT, controls have shown a preference for decks with a high frequency of wins over decks with a low frequency of wins, even when this results in long-term negative outcomes (Caroselli, Hiscock, Scheibell, & Ingram, 2006; Chiu et al., 2008; Lin, Chiu, & Huang, 2009; Lin, Chiu, Lee, & Hsieh, 2007). Although these studies provide evidence that decision making among healthy control individuals may be guided by the frequency of wins/losses, we still do not know why an individual chooses Deck B over Deck D, or even Deck A over Deck C.

BAS and BIS systems, stemming from Gray’s (1987) theory of personality, have been consistently associated with IGT performance. BAS systems activate in response to threats/risk, leading to increased risk-avoidant behavior (Carver & White, 1994), whereas BAS systems create approach behaviors in response to reward cues (Carver, 2004). Newer conceptualizations of BAS/BIS focus on BAS resolving goal conflicts by activating or de-activating BAS (Bijttebier, Beck, Claes, & Vandereycken, 2009). It is likely that those high in BAS focus on rewards from decks with high immediate gains. Depending on how individuals make decisions, Decks A and B or Decks B and D could provide those immediate rewards. In addition, other personality characteristics such as impulsivity and sensation seeking have been associated with IGT performance and may affect individual deck selections.

State mood may also influence selections on the IGT. State negative mood may result in a tendency to carefully analyze information, whereas state positive mood may result in a tendency to use intuition and “gut feelings” instead (Bolte, Gschke, & Kuhl, 2003). In addition, positive state mood has been linked with higher BAS-type reactivity (i.e., increased loss aversion), with the frequency of expected losses playing a role as well (Arkes, Herren, & Isen, 1988; Nygren, 1998; Nygren, Isen, Taylor, & Dulin, 1996). As the IGT relies on more “hot,” affective decision making than “cold,” calculated decision making (Bechara, 2008), it would follow that current mood could impact performance. However, data are again inconsistent, with evidence of both decreased (Smoksi et al., 2008) and increased risky decision making (de Vries et al., 2008; Must et al., 2006; Suhr & Tsanadis, 2007) as a function of negative mood. It is possible that these inconsistent findings are due to combining Decks A and B into one composite disadvantageous score, which would hide any differences in the advantages/disadvantages of each deck. Individuals in a negative mood who are carefully analyzing information may determine that Deck B is not as disadvantageous as Deck A. In addition, positive mood could affect decision making if individuals focus on the frequencies of losses.

1.2. Objectives and hypotheses

We investigated whether BIS/BAS, impulsivity, sensation seeking, and state mood are related to individual deck selections on the later, decision making under risk trials of the IGT. We hypothesized that positive mood, negative mood, impulsivity, sensation seeking, BAS, and BIS would relate differently to individual deck selections on the IGT. Specifically, we hypothesized that positive mood, negative mood, impulsivity, sensation seeking, and BAS would be related to either greater Deck A or greater Deck B selections, depending on whether individuals focused on the magnitude of the rewards or the frequency of rewards. Similarly, these characteristics, as well as BIS (due to the loss aversion associated with this characteristic), would be associated with either Deck B or Deck D selections, depending on whether individuals focus on immediate or long-term gains/losses. It was also hypothesized that state positive and negative mood will differentially relate to selections from Decks A and D, as previous research has indicated that positive mood may result in riskier decision making than negative mood. Finally, we examined whether BIS related differently to selections from Decks C and D, as the high frequency of losses in Deck C may be aversive to individuals high in BIS, resulting in greater selections from Deck D.

2. Methods

2.1. Participants

Participants were 91 undergraduate students (38 male), ages 18–28 (mean age 19.04 [SD = 1.49]) enrolled in psychology courses at Ohio University who received course credit and $20 for participation. The sample was 90% Caucasian, and participants reported no history of prior head injury, substance abuse, or psychiatric diagnoses.

2.2. Measures

The 24-item BIS/BAS scale (Carver & White, 1994) was used to assess level of behavioral activation and inhibition. Total summed scores were calculated separately for each of the BIS/BAS subscales: BIS, BAS-Reward Responsiveness, BAS-Drive, and BAS-Fun Seeking, with higher scores indicating greater levels of BIS and BAS. Internal consistency of the subscales in our study was moderate to high (α = .73–.85).

The 19-item Impulsive Sensation Seeking subscale of the Zuckerman-Kuhlman Personality Questionnaire (ImpSS; Zuckerman, Kuhlman, Joreman, Teta, & Kraft, 1993) was used to assess individual differences in impulsivity and sensation seeking. The average summed scores for the 8 impulsivity and 11 sensation seeking items were calculated separately, with higher scores indicating higher levels of these characteristics. Internal consistency in our sample was moderate to high (α = .67–.79).

Reference:
The 20-item Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) assessed participants’ current mood. Average summed scores for the 10 positive and 10 negative mood items were calculated separately, with higher scores indicating greater positive (or negative) state mood. Internal consistency for the immediate scale was high (α = .86 for both scales).

The standard computerized version of the IGT was administered (Bechara, 2008, based on Bechara et al., 1994). At the start of the IGT, participants do not have any information about the relative advantages/disadvantages of each deck. Therefore, the first approximately 40 selections are termed decision making under ambiguity, whereas the final 40–60 trials are decision making under risk (Brand et al., 2007; Ko et al., 2010; Noel, Bechara, Dan, Hanak, & Verbanck, 2007) as participants have had time to learn the relative costs and benefits of each deck. To compare effects of mood and personality on risky decision making, we utilized the last 40 trials only (Ko et al., 2010; Noel et al., 2007). Performance was broken into the percentage of selections from each of the four individual decks (A, B, C, D).

2.3. Procedure

All participants provided written informed consent. Participants first completed the BIS/BAS, ImpSS, and PANAS as part of a larger study, then the IGT. State mood was assessed at several times during the study session, and only those mood ratings immediately prior to the IGT are presented here.

2.4. Data analysis

First, differences between percentages of selections on the IGT decks were calculated using a repeated measures ANOVA. Next, Pearson correlations between study variables were calculated. To address study hypotheses regarding personality and state mood affecting individual deck selections, specific pairs of correlations were compared using Fisher’s r to z calculations (Cohen, Cohen, West, & Aiken, 2003).

3. Results

IGT deck selection percentages were as follows: Deck A 13.51%, Deck B 31.83%, Deck C 22.30%, and Deck D 32.36%. Repeated measures ANOVA (F(3,264) = 18.382, p < .001, partial eta-squared = .173) indicated participants generally avoided Deck A (p < .001) and preferred Decks B and D (p = .006) to Deck C. No differences were found between selections from Decks B and D (p = .883).

Correlations between IGT decks and personality/mood variables are displayed in Table 1. Fisher’s r to z transformations indicated that there were significant differences between Decks B and D with regard to their relationship to mood and personality variables. Specifically, negative mood was positively correlated with Deck B selections but negatively correlated with Deck D selections, z = 2.52, p = .012. In addition, BAS-drive, z = 2.46, p = .014, impulsivity, z = 2.27, p = .023, and sensation seeking, z = 2.39, p = .017, were all positively correlated with Deck B selections but negatively correlated with Deck D selections. All other hypothesized comparisons of correlations of personality characteristics and state mood with Decks A and B, Decks A and D, and Decks C and D (for BIS only) were not significant (p > .20).

4. Conclusions

The present study examined the influence of personality characteristics and state mood on IGT deck selections during decision making under risk trials. We found that participants generally avoided Deck A and preferred Decks B and D, consistent with previous research (Adida et al., 2008; Bechara, 2008; Cella, Dymond, & Cooper, 2010; Overman et al., 2004; Ritter et al., 2004; Sevy et al., 2007; Wilder, Weinberger, & Goldberg, 1998). This finding suggests that combining Decks A and B and Decks C and D into disadvantageous and advantageous decks may disguise individual deck level preferences.

We hypothesized that personality characteristics would differentially relate to selections from Decks A and B, Decks B and D, and Decks A and D, depending on whether participants focused on frequency of wins/losses or overall outcomes. Our results suggest that the relationship of personality characteristics to individual deck selections did vary. Specifically, greater Deck B selections and fewer Deck D selections were seen among individuals high in sensation seeking and impulsivity, in part consistent with previous findings of riskier decisions (examining the long-term outcomes) as a function of these characteristics (Crone et al., 2003; Davis et al., 2007; Franken et al., 2008). In addition, higher levels of BAS-drive were associated with greater Deck B but fewer Deck D selections, consistent with previous research indicating higher levels of BAS were associated with riskier decisions on the IGT (Franken & Muris, 2005; Suhr & Tsanadis, 2007; van Honk et al., 2002).

Of note, BIS was not associated with any deck selections in the present study. Although three BAS subscales have been found, allowing for more specific analyses of the construct’s components, no such revision has been made to the BIS scale. As BIS items encompass both inhibition and fear, assessment of these individual BIS components in future research may help elucidate the relationship of BIS characteristics to IGT performance.

We also predicted that state positive and negative mood would be related to selections from Decks A, B, and D. No results emerged for positive mood, despite previous research linking positive mood with increased loss aversion (Arkes et al., 1988; Nygren, 1998; Nygren et al., 1996). However, individuals in a highly negative mood during the IGT selected more from Deck B and less from Deck D. No differences emerged between Decks A and D or Decks A and B. Our results are in keeping with previous results indicating riskier decision making on the IGT as a function of negative mood de Vries et al., 2008; Miu et al., 2008; Must et al., 2006; Suhr & Tsanadis, 2007), as participants in a more negative mood selected less advantageously in the long-run.

The present findings indicate differences in individual deck preferences during decision making under risk on the IGT. Given
that our differences in relationships with personality characteristics emerged in comparisons between Decks B and D, the results provide preliminary evidence that individuals expressing high levels of drive, impulsivity, and sensation seeking, as well as a negative mood, may not focus as much on long-term positive outcomes when deciding which deck to choose from on the later trials of the IGT. Because the only difference between Decks B and D is the magnitude of immediate rewards, our participants are likely focusing on the higher immediate gains in Deck B than on frequency of losses or long-term gains.

It is interesting that no differences emerged in the comparisons between Decks A and B, as previous researchers theorized that individuals who make less risky decisions may prefer Deck B to Deck A, based on the lower frequency of losses (Carosselli et al., 2006; Chiu et al., 2008). In addition, no differences emerged in the correlations of personality characteristics and mood to selections from Decks A (the riskiest deck) and D (the least risky deck). It is possible that no differences emerged in personality and mood correlates of Deck A selections due to the limited number of selections made from Deck A in our non-clinical sample. Further follow-up of the influence of personality characteristics and state mood on individual deck selections among clinical populations, such as individuals with ventromedial prefrontal cortex lesions, amygdala lesions, substance abuse/dependence, and schizophrenia, is warranted in order to assess how these characteristics affect individuals known to exhibit impairment on the IGT.

The present results have implications for real-world decision making as well as the appropriate assessment of decision making. Given previous inconsistent findings and our present results, the direct relationship between IGT performance and real-world risky decision making is likely more complex than originally thought. Our focus on the individual deck selections may help to explain some of the inconsistent findings in studies of personality/mood and the IGT. In particular, the current pattern of grouping Decks A and B into one “risky” score should be reconsidered. Deck B is a disadvantageous deck due to its long-term losses (Bechara, 2008); however, due to the low frequency of losses in Deck B, pathological risky decision making may be more linked to Deck A selections than to selections from Decks A and B combined (Bechara, 2008). In addition, our findings suggest that state and trait characteristics both play a role in individual deck selections during early and later trials of the IGT, indicating the need to further examine deck-level preferences on this task. Using a deck-level analysis would allow clinicians and researchers to determine which deck is preferred, which may lead to different conclusions. A preference for Deck A may lead to a conclusion of significant decision making impairment, whereas a preference for Deck B may lead to a conclusion that the individual focuses more on the frequency of wins/losses than final outcomes and is less indicative of frank decision making impairment.

Several limitations may have affected the results of this study. The sample consisted of undergraduate student volunteers. It is possible that students who chose to volunteer for this study were somehow different from the general population of undergraduate students, limiting generalizability of findings to this age group. In addition, the present study utilized a self-report measure of current mood. As no direct manipulation of mood was made, we have to rely on participants’ accurate self-reporting of current mood state, which could be inaccurate. A follow-up study in which mood is directly manipulated is currently in progress. Our sample was predominately female and Caucasian, which may limit generalizability to males and non-Caucasian individuals.

Our results provide some intriguing hints into the differential roles of state and trait factors in influencing individual deck selections on the IGT, and provide additional evidence that individuals may not focus entirely on long-term outcomes as the IGT creators intended. Future studies of the IGT should continue to investigate group differences at the individual deck level, as well as include variants of IGT that further alter the potentially important win/loss and gain/loss variables (i.e., Caroselli et al., 2006; Chiu et al., 2008; Lin et al., 2009). The Soochow Gambling Task (Chiu et al., 2008) manipulates the frequency and magnitude of immediate losses, allowing for determination of decision making based on short-versus long-term outcomes. Additionally, studies of risky decision making should utilize multiple lab-based measures of decision making, including the IGT, the Balloon Analogue Risk Task (Lejuez et al., 2002), the Game of Dice (Brand et al., 2005), and the Columbus Card Task (Figner, Mackinlay, Wilkening, & Weber, 2009), as a means of more fully assessing how personality and state mood can influence different aspects of real-world risk-taking and decision making behaviors. Only by fully assessing the construct of decision making, as well as individuals’ state and trait characteristics, can the relationships between mood, personality, and decision making be more fully understood.

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