Risk taking personality traits on affect processing during modified versions of the Iowa Gambling Task

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Abstract

The Iowa Gambling Task (IGT) is widely used to assess the role of emotion in decision making. However, there is only indirect evidence to support that the task measures emotion. There are inconsistencies in performance within in healthy populations who display risk taking traits. Two hundred and fifty participants were assessed for psychopathy, sensation seeking, and impulsiveness. The IGT was compared with modified versions that directly manipulated emotion within in the task by indexing reward and punishment cards with images varying in emotional content. Participants continued to learn to avoid risky decks in all versions of the IGT. The manipulation of emotional content within the task did affect performance: fearful images contributed to greater risky deck selections. Across the tasks, psychopathy showed the strongest relationship to risky deck selections, and lower levels of psychopathy was associated decreased risky deck selections. However, psychopathy did not affect learning in the modified versions. Exploratory analysis on image valance found that negative images (compared to neutral) benefited learning for individuals with higher levels of psychopathy. Discussion will center on the benefits of manipulating emotion directly within the task as a means to assess the validity of the IGT.

Keywords: Iowa Gambling Task; decision making; risk taking; impulsivity; sensation seeking; impulsiveness

Introduction

The Iowa Gambling Task (IGT) is a widely used tool to assess the role of emotion in decision making under conditions of uncertainty. The IGT requires participants to gain as many points as they can by making selections from four decks of cards. While two of the decks provide small but consistent rewards over time, the remaining two decks yield both large rewards but also large punishments. Thus, to do well in the task, participants must learn to avoid selecting from the risky decks. Although it is a lab-based task, performance has been tied to real-life social decision making, risk-taking behaviours, learning, and affect processing (Damasio, 1994; Upton et al., 2011).

Here we examine the role of emotion in risky decision making. We will examine risk taking personality traits of impulsiveness, sensation seeking, and psychopathic traits in an undergraduate sample. The current study will provide a direct manipulation of emotional content within the task and examine whether performance will be differently affected by risk taking traits.

Historical origins

The link between emotion and decision making was initially demonstrated by Damasio (1994), based on studies with patients suffering from lesions to the ventromedial prefrontal cortex (VMPC), an area Damasio stipulated is related to emotion. These patients had intact cognitive processes including intelligence, motor and verbal skills, memory, and reasoning, but were unable to function in their daily lives because they could not make decisions in ambiguous situations. They also displayed poor interpersonal skills, were impulsive, and engaged in inappropriate and risk taking behaviours (Damasio, 1994). Based on these observations, Damasio (1994) proposed that an emotion-related system in the brain provides information about predicted future outcomes useful in long-term decision making. This system creates *somatic markers*, which, broadly speaking, are a form of bodily feedback (physiological responses) that bias some response options over others in ambiguous situations.

Damasio designed the IGT as a means to measure somatic marker system functioning. In the early seminal studies, research consistently demonstrated that healthy controls learn to avoid selecting from the risky decks, while lesion patients do not display this pattern and continue to select from the risky decks (Bechara et al., 1994).

Skin conductance responses (SCR) in healthy controls were also thought to serve as a meaningful index of emotional responses prior to selections from risky decks. This trend has been found to occur even before healthy controls are conscious of the advantageous strategy of avoiding selection from risky decks (Damasio, 1994; Bechara et al., 2000). These results suggest that the anticipatory response prior to selection from risky decks indexes the formation of a somatic marker that acts as a warning signal of high punishment selections from that deck elicited from previous high punishment selections. However, those with lesions to the VMPC perform poorly on the IGT also display attenuated SCR to risky decks when compared to healthy controls (Damasio, 1994). The IGT continues to be used today to study emotion and decision making, as we now describe.

Current IGT research

Some recent studies have continued to focus on clinical populations, such as ones with psychopathy, depression, and schizophrenia. These populations have been established as

having impairments in emotional functioning, and as predicted, yielded poor performance on the IGT (Must et al., 2006; Bark et al., 2005; Mahmut et al., 2008). However, not all studies have produced consistent findings (Dunn et al., 2006), leading some to question the pairing of emotional responses to risky deck selections. In healthy populations, criticisms have been made that anticipatory SCR is the result of conscious knowledge rather than emotion guiding decision making (Maia & McClelland, 2004). Factors contributing to varying performance in healthy populations may include cognitive processes related to reversal learning (Buelow & Suhr, 2009; Stapleton, 2011). There has also been limited manipulations to the task itself. The majority of research supporting the validity of the IGT uses various clinical populations that have their own set of biases that could influence performance.

As stated above, one case where inconsistent IGT findings have occurred is with individuals who exhibit various levels of psychopathy. Psychopathy is a personality disorder marked by emotional deficits that underlies a constellation of characteristics, including sensation seeking, risk taking, inability to make long-term goals, and impaired moral judgment (Blair et al., 2005). These impairments may be rooted in psychopaths' deficit in emotion processing, in particular the specific deficit in decoding amygdalian emotions of fear and sadness (Hastings et al., 2008; Campanella et al., 2010). However, there have been findings that suggests there are no differences in the decoding accuracy of fear, sadness, and disgust (Dolan & Fullam, 2006; Glass & Newman, 2006), while others indicate a specific disgust deficit in psychopaths (Kosson et al., 2002). Thus, this population has emotion deficits that make it suitable for study with the IGT.

Given that psychopathic traits often increase likelihood with encountering the criminal justice system, many IGT studies have relied on prison populations. With these populations, higher levels of psychopathy have been associated with both poor IGT performance (Mitchell et al., 2002; Broom, 2011) and good IGT performance that is analogous to healthy controls (Losel & Schmucker, 2004; Schmitt et al., 1999). A possible explanation for the mixed findings is that some personality traits that are frequently found in criminal populations have been found to impede IGT performance. These include substance abuse disorders (Barry & Petry, 2008), intermittent explosive disorder (marked by aggression and impulsive behaviours; Best et al., 2002), attention-deficit hyperactivity disorder (ADHD; Toplak et al., 2005), personality traits of low inhibition and high behavioural activation (van Honk et al., 2002), and individuals with low intelligence and/or education level (Demaree et al., 2010). If these traits are not carefully controlled for, inconsistent findings may result.

Some other work has examined of psychopathy in a community setting, and here, the findings continue to be inconsistent as well. Balbuena (2010) and Broom (2011) did not find a link between psychopathic traits and IGT performance. In contrast, with university samples (Mahmut et al., 2008; van Honk et al., , 2002) and a sample of boys with behavioural difficulties (Blair et al., 2001), poor IGT performance was positively associated with higher levels of psychopathy. Miranda and colleagues (2009) also found a link between levels of psychopathy and IGT performance, but their analysis subsequently revealed that it was participants' levels of alcohol dependency, impulsiveness, and antisocial traits that were more predictive of poor performance than psychopathy levels (Miranda et al., 2009). Thus, as with prison populations, with sub-clinical psychopathy populations IGT performance may be influenced by various cognitive processes related to learning (i.e., memory and intelligence) and personality traits (i.e., sensation seeking; Buelow & Suhr, 2009).

IGT and healthy populations

Buelow and Suhr (2009) have argued that personality traits independent of clinical disorders may impact performance on the IGT. For example, impulsiveness and sensation seeking are risk-taking traits that can interfere with decision making. Impulsiveness is defined as an unplanned behaviour that results from deficiencies in response inhibition, whereas sensation seeking is the tendency to seek out novel and highly stimulating experiences with the willingness to take risks (Franken & Muris, 2005). These traits are widely found in populations with frontal lobe dysfunction, such as psychopaths and VMPC lesion patients (Damasio, 1994; Blair, Mitchell, & Blair, 2005). Both of these traits have also been found to be associated with poor IGT performance in healthy populations (Crone et al., 2003; Davis et al., 2007; Franken et al., 2008; Upton et al., 2011; Zermatten et al., 2005), although other studies have failed to find that link (Franken & Muris, 2005; Buelow & Suhr, 2013).

The research described thus far has been very limited in not explicitly manipulated factors related to personality traits and emotion during the IGT. Thus, the link between the impact of emotion on IGT performance was indirectly inferred from using populations that were assumed to have certain emotional characteristics. While informative, as described above, these populations may have their own set of biases that could influence performance. In contrast, other studies have manipulated aspects related to emotion, and observed the impact of doing so on IGT performance.

Cella and colleagues (2007) aimed to induce frustration by giving participants time constraints for their deck selections. Participants who had a time constraint of 2 seconds to select a deck made riskier deck selections than participants with 4s time constraint or no time constraints. In contrast, Bowman and colleagues (2005) found that instilling a 6s time constraint did not alter performance.

Hardy (2009) manipulated emotion by integrating positive, negative, and neutral valenced images into the IGT. Five images, which came from the Affective Picture System (IAPS), were displayed for 7s every 10 trials of the IGT. IAPs images were selected based on valence rating and organized into one of the three conditions depending on the

ratings. The authors did not take into account the intensity ratings of IAPs images nor did they use IAPs ratings to proxy point values of the cards. No significant effects on participants' performance were found. However, when participants were primed with disgust and fear inducing video clips *prior* to performing the IGT, they had poorer performance than controls (Heilman et al., 2010). One possibility for the discrepant findings is that negative emotional priming has been found to affect other tasks, which are not reliant on somatic marker functioning, such as the Wisconsin Card Sorting Task (Robinson et al., 2007). The IGT requires somatic markers to form after repeated exposures to reward and punishment cards, in order for participants to learn to avoid risky decks. Thus, evoking an emotional reaction prior to the task may not disrupt somatic marker formation throughout the task.

In general, there is a gap in existing IGT research that directly manipulates emotion within the task, which may shed light on the theoretical pairing between emotional responses and risky deck selections. It is important that the processes underlying IGT performance are well understood in healthy populations, in order to use this tool as a valid measure to assess the deficits of clinical populations.

Current investigation

In the present study, we examined whether directly manipulating emotion in the IGT altered participants' performance and learning to avoid the risky decks, as well as how risk-taking personality traits affected these variables in the IGT. As we previously discussed, existing findings from related studies are not consistent and thus more work is required to address these questions.

We had the following objectives. The first objective was to replicate the consistent finding of IGT research that individuals will exhibit some learning in terms of making fewer selections from the risky decks over time [1].

The second and third objectives targeted impact of affect and personality. Specifically, the second objective was to assess the effect of manipulating emotion in the IGT. We planned to examine participants' performance, corresponding to overall differences in the total number of risky deck selections between IGT emotion conditions but collapsed across time [2a], as well as effect of condition across time by examining differences in learning to avoid the risky decks between the IGT conditions [2b].

The third objective was to investigate the relation between personality, performance and learning in the IGT, and the impact of emotion on that process. We conjectured that IGT versions infused with negatively-valance affect, such as fear or disgust, would show the greatest effects on performance. However, we also predicted that participants with higher levels of psychopathy would show higher rates of learning in the negative-valence conditions. Psychopathy is associated with emotion deficits, especially those relating to threat, fear, and sadness. Those participants with higher levels of psychopathic traits may require more intense displays of negative emotion to evoke an appropriate reaction that may help them learn the advantageous strategy in the IGT.

Method

Participants

The participants were 250 undergraduate students (M_{age} = 21.12 years, *SD* = 3.44) from a medium-sized Canadian university. Sixty-five percent of participants identified as female (*n* = 162). Fifty-nine percent of participants identified as Caucasian (*n* = 147), 11.6% as Middle Eastern (*n* = 29), 10% as *Other* (*n* = 25), and 7.6% of participants did not provide information on their ethnicity (*n* = 19).

Materials

Demographics A web-based three-item demographics scale was used to collect information on age, gender, and ethnicity. Participants were asked to select their ethnicity from a list of six options (including *Other*) in drop-down menu on the webpage.

Self-report psychopathy scale III (SRP; Paulhus, Neumann & Hare, in press**).** The SRP is a 64-item self-report scale used to assess the level of psychopathic traits in a non-clinical sample. Items consisted of a statement that asked participants to rate the degree to which the statement related to themselves on a Likert range from 1 (*Disagree Strongly*) to 5 (*Strongly Agree*). Following the scoring procedures of Paulhus and colleagues (in press), selected items are reverse scored and all items are summed. A higher score on the SRP indicates a greater degree of psychopathic traits with a maximum score of 320.

The SRP demonstrates good reliability and validity in subclinical populations (Neal & Sellbom, 2012; Williams, Paulhus, & Hare, 2007). The SRP has good internal consistency (α = *.79*; Paulhus & Williams, 2002). Williams and colleagues (2003) carried out confirmatory factor analysis on the SRP results of 274 undergraduate students. In terms of convergent validity, the authors found the SRP to correlate with: (1) related measures of psychopathy and antisocial behaviours, including Levenson's Self Report Psychopathy Scale (*r* = *.62*) and the Psychopathic Personality Inventory (*r* = *.34*), and (2) traits similar to psychopathy, such as narcissism (*r* = *.46*).

Barrett impulsiveness scale-11 (BIS-11; Patton et al., 1995). The BIS-11 is a 30 item self-report survey that provides an assessment of trait levels of impulsiveness. Impulsiveness is defined as unplanned behaviour that results from deficiencies in response inhibition (Franken & Muris, 2005). Participants are required to rate 30 statements on a four-point Likert scale from 1 (*rarely/never*) to 4 (*almost always)* relating to their thoughts, behaviour, and/or lifestyle. Following the scoring procedures of Patton and colleagues (1995), selected items are reverse scored and summed, where a greater score indicates a higher level of impulsiveness (highest possible score is 120).

The BIS-11 has good test-retest reliability and internal consistency (α = 0.83; Stanford et al., 2009). The BIS-11

has been found to correlate with similar measures, such as the Eyesneck Impulsiveness Scale, in both undergraduate samples and clinical populations (Lane et al., 2003; Stanford et al., 2009).

Zuckerman's sensation seeking scale (SSS; Zuckerman, Eysenck & Eysenck, 1978)**.** The SSS is a 40-item is a widely-used scale used to assess the trait of sensation seeking, which is the tendency to seek out novel and highly stimulating experiences with the willingness to take risks (Zuckerman, 1979). Participants were asked to select option A or B to a series of statement to the degree each statement relates to themselves. Scores are summed according to the scoring procedures of Zuckerman et al., (1978) with a higher score indicating a greater degree of sensation seeking (maximum score being 40). The SSS demonstrate good internal consistency (α = .86; Zuckerman, 1994).

Standard and modified IGT Both the Standard and Modified Iowa gambling tasks included four decks with 40 cards per deck. During the standard Iowa Gaming task, participants were shown the four card decks on a computer screen and were told to earn as many points as possible. To earn points, they were asked to make selections from these decks - the selections either resulted in a reward or a punishment, in terms of points earned, shown to participants immediately after their selection, referred to as *reward* or *punishment* cards below (Figure 1). Two of the decks provided small rewards in terms of points, but also small punishments (were less risky), while two of the decks had higher-reward cards but also more high-punishment cards (were riskier).

For the modified IGT, we kept the structure of the task the same, but added affect-inducing images to the task, which were shown immediately after making a card selection and before the points earned or lost was shown (Figure 1). The images were drawn from the IAPs (Center for the Study of Emotion and Attention, National Institute of Mental Health, 1999). The images range in content (e.g., animals, food) and have been previously been organized according to normative ratings of, valence (pleasant or unpleasant), arousal (calming or exciting), and discrete emotion categories (i.e., disgust; Bradley & Cuthbert, 2007; Mikels et al., 2005).

We used the IAPS rating system to determine which photographs to show after a given card selection, by mapping (1) the valence and arousal ratings to the point value of a given card and (2) the discrete emotion category of an image to a given IGT condition (as described below, we had four modified IGT conditions, including sadness, disgust, fear and neutral). Table 1 shows details of the mappings between IAP images and conditions. In all conditions reward cards were always followed by an emotionally neutral image (e.g., clocks), followed by the numeric point value of the reward card (Figure 1). Only in the neutral condition, the punishment cards were also followed by an emotionally neutral condition – thus the neutral condition served as the control. It was felt that it was necessary to isolate the punishment cards as the only means of manipulation to gauge participants' ability to avoid these cards, which is why happy images were not attached with reward cards in the current study.

In contrast, for the emotionally-charged conditions, the punishment cards varied their emotional content [photographs meant to induce disgust (e.g., bugs in food) for the disgust condition or photographs meant to induce fear (e.g., shark) for the fear condition]. Higher punishment cards resulted in more negatively valanced and arousing images. Note that as described above, in the neutral condition both the reward and punishment cards were paired with neutral images that were not designed to elicit an emotional response. Thus, this condition is similar to the standard IGT, but allows us to control for any possible stimulation induced by the mere presence of an image.

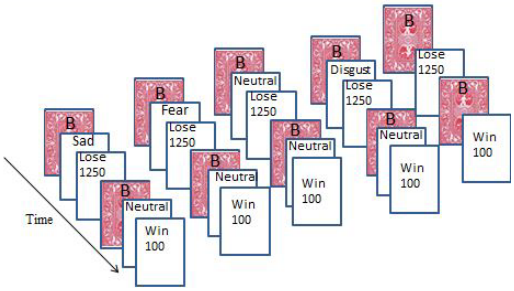

Figure 1. Sample presentation sequence of selecting a reward and punishment card in each condition: sad, fear, neutral, disgust, and the standard IGT

Procedure

Following ethics approval, undergraduate students were recruited via an announcement posted on the university online SONA System. Participants were directed to the study's data collection website through a link provided on the recruitment announcement.

Participants began the study by providing their consent through an informed consent form and then completed three surveys that assessed risk-taking personality traits and collected demographic information. Following completion of the surveys, participants were provided with the following task instructions where they were instructed gain as many points as possible by selecting one card from a deck until the task ends.

Participants were then randomly assigned to one of the five IGT conditions: standard IGT, or one of the modified IGT conditions (fear, disgust, sadness, neutral). Condition was a between-subjects factor, with each participant completing 100 trials of the IGT in their assigned condition. After making a card selection, participants were shown the point value of their selection (*standard IGT* condition), or were shown an affective image for 1s and then the point value of their selection (*modified IGT* conditions). Participants were unaware of which decks were risky or less risky, their condition, or the number of trials. Participants did not take any breaks during the study and had to complete the experiment in a single session, which lasted approximately an hour and a half. Upon task completion, participants were provided with a debriefing form.

Results

Descriptives

Based on the possible ranges of each measure the sample displayed low to moderate levels of baseline psychopathy (*M* = 150.33; *SD* = 31.53), compared to Neal and Selbom (2012)'s SRP-III college sample mean of 121.17. Participants displayed moderate levels of impulsiveness (*M* = 36.3; *SD* = 11.47), and low levels of sensation seeking (*M* = 19.93; *SD* = 5.54) when compared to a normative sample mean of 34.6 and 23.6 (Manuck et al., 2000; Zuckerman & Neeb, 1980). Table 1 provides descriptive information on IGT performance for each condition, collapsed over time.

Table 1

Descriptives of total number risky deck selections collapsed across the conditions and by condition for the 100 trials of the IGT

		N	Risky selections [*M*(*SD*)]
Total		250	52.67 (8.72)
	Standard	67	54.24 (8.45)
	Fear	43	55.19 (6.60)
	Disgust	58	53.97 (8.71)
	Sad	30[1]	47.43 (7.29)
	Neutral	52	50.14 (9.76)

We began by checking for baseline differences between conditions on participants' risk-taking traits. We did not find any differences between conditions on ratings of impulsiveness, $F(4, 244) = .912$, $p = .452$, or sensation seeking, $F(4, 244) = .274$, $p = .895$. However, there was a main effect of psychopathy $F(4, 245) = 2.89$, $p = .023$. Post-hoc analysis using the Bonferroni correction revealed that these differences were present between the sad and neutral conditions (M_{sad} = 133.85 and $M_{neutral}$ = 154.05, respectively; $p = .049$), and the sad and fear conditions (M_{sad} = 133.85 and M_{fear} = 157.16, respectively $p = .018$). Thus, any analysis including these comparisons will have to be interpreted with caution.

Do participants learn to make less risky selections? (Objective 1)

We conducted a repeated measures ANOVA with *time* as the within-subjects factor (i.e., the five blocks of 20 trials each), the five IGT *emotion type* conditions as the between-subjects factor, and the number of points gained per block as the dependent variable. Since the sphericity assumption was violated according Mauchly's test, $\chi^2 (9) = .799$, $p < .001$, we applied the Greenhouse-Geisser correction. This analysis determined that, collapsing across the conditions, there was indeed a significant effect of time, indicating that participants' IGT decisions changed as they progressed through the blocks, $F(3.58, 877.06) = 13.62$, $p < .001$. Figure 2 depicts participants' selections over the five blocks of the IGT. Participants made the riskiest decisions in B1 at the start of the experiment, and the least by the end of the experiment in B5. This was verified by post-hoc tests using the Boneforroni correction: We found that the mean number of risky selections in B1 (M = 11.35) was significantly higher than in B4 (M = 9.93; $p < .001$) and then in B5 (M = 9.30; $p < .001$). Participants also made more risky selections in B2 (M = 10.9) than in B4 (M = 9.93; $p = .033$) and then in B5 (M = 9.30; $p < .001$). Finally, the mean number of risky selections in B3 (M = 10.74) was significantly higher than in B5 (M = 9.30; $p < .001$).

Does manipulating emotional content influence IGT performance (Objective 2a and 2b)

To address this question, as a starting point, we collapsed across the blocks (*time*) to assess participants' performance in each condition. We found support for the hypothesis that manipulating emotion content within the IGT affects performance (overall difference in number of risky selections between conditions, Objective 2a). Specifically, the above-described ANOVA revealed a significant between-subjects effect of condition, indicating that collapsed across time, the number of risky decisions differed between the IGT conditions, $F(4, 245) = 6.02$, $p < .001$.

To examine this effect further, we conducted post-hoc tests using the Bonferroni correction. This analysis revealed that the fear condition had a significantly higher number of risky selections than the neutral condition (M = 10.03; $p = .04$). Moreover, the sad condition had the lowest mean number of risky selections, significantly less than the standard IGT condition (M = 10.89; $p = .003$) and the disgust condition (M = 10.82; $p = .006$). The sad condition also had less risky-decisions than the fear condition (M = 11.04; $p < .001$) but this result has to be interpreted with caution given the baseline differences in psychopathy between these two conditions. Table 2 displays the means and grand means for each block and each condition.

Table 2

Means and grand mean for each block of each condition

	B1	B2	B3	B4	B5	**Grand mean**
Standard	11.6	10.9	11.3	10.7	9.7	**54.2**
Neutral	10.5	10.4	10.2	9.5	9.5	**50.1**
Sad	11.2	10.5	9.4	8.4	7.9	**47.4**
Fear	11.4	11.7	11.6	10.5	10.0	**55.2**
Disgust	12.1	11.1	11.2	10.5	9.2	**54.0**
Grand mean	**11.4**	**10.9**	**10.9**	**10.0**	**9.4**	**52.7**

We did not find support for the possibility that manipulating emotion content within the IGT differentially affects learning over time between the conditions [Objective 2b]. Specifically, the above-described ANOVA did not reveal a significant interaction between *block* and *condition*, $F(14.33, 877.06) = .72$, $p = .76$. Figure 2 depicts the rate of learning over time (five blocks of twenty trials) for each of the five IGT conditions.

[1] The low number of participants is due to a programming error that did not randomize participants into the sad condition when the experiment first began.

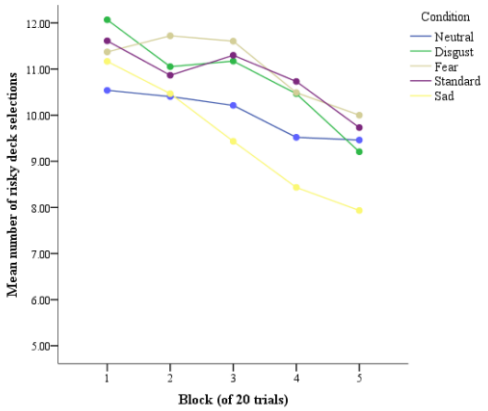

Figure 2. Mean number of risky deck selections for each of the five blocks of twenty IGT trials in each condition

Do personality traits impact performance and how does emotion influence that process? (Objective 3)

As a starting point, to explore the relationship between personality traits and risky decisions in the IGT, as well as personality traits themselves, we conducted correlations between the target variables (Table 3). Collapsed across the conditions, participants who had higher levels of psychopathic traits made more risky decisions, and the same was true for participants with higher levels of impulsiveness – there was also a trend in this direction for sensation seeking traits, but it was marginally significant (p = .08). All risk-taking personality traits had significant and positive associations between themselves: participants who rated high in levels of psychopathy also rated high in levels of impulsiveness and sensation seeking.

Table 3

Pearson correlations of risk taking personality traits and total number of risky deck selections, collapsed across conditions

	SRP	BIS	SSS
SRP	-		
BIS	.626**	-	
SSS	.481**	.353**	-
Risky selection	.307**	.258**	.078

Note. SRP = psychopathy scores from the SRP, *BIS = impulsiveness scores from the BIS-III, SSS, sensation seeking scores from the SSS. N* = 250

**p < .01

Within a given condition, significant correlations between personality and the total number of risky selections existed in the disgust, neutral and standard IGT conditions. Specifically, in the disgust condition, risky selections were associated with higher levels of psychopathy (*r = .39, p =* and higher levels of impulsiveness (*r = .31, p = .02)*. We found a similar pattern in the neutral condition (psychopathy, *r = .40, p = .015*; impulsiveness, *r = 34, p = .004)*; psychopathy was also associated with risky selections in the standard IGT (r = .315, p = .009).

We focused the remainder of the analysis on impulsiveness and psychopathy. In order to understand how these traits interact with condition and/or learning, we cannot simply add it is a covariate to the previous model, given the homogeneity of slopes assumption. First, we used a median split to divide individuals into two groups based on their baseline psychopathy results from the SRP questionnaire – we refer to these groups as the *low-psychopathy* (n = 120; M = 122.9; SD = 15.2) and *high-psychopathy* groups (n = 130; M = 175.7; SD = 19.2), respectively. We then included *psychopathy* as an additional between-subjects factor in the ANOVA (with *condition* as the other between-subjects factor and *block* as the within-subjects factor). Because the sad condition had a lower overall psychopathy mean, we excluded it from the present analysis (but the following results hold if it is included).

As expected given the correlational analysis, collapsed over *block* (i.e., time) and *condition*, the low-psychopathy individuals made fewer risky deck selections as compared to the high-psychopathy group, $F(1, 219) = 13.44$, $p < .001$. We now turn to examining the relation between psychopathy and IGT condition, first checking effects on learning (collapsed over condition) and then performance (collapsed over time).

For the impact of time, the ANOVA revealed a significant main effect of *block*, $F(3.5, 749.3) = 9.45$, $p < .001$, indicating that participants' risky selections changed as they progressed through the blocks, confirming the analysis for Objective 2a that did not take into account psychopathy. Of interest here, there was also a significant *block* x *psychopathy* interaction, $F(3.5, 749.3) = 4.74$, $p = .001$, indicating that level of psychopathy disproportionately affected performance over time. This interaction is shown in Figure 3, which highlights that the disproportionate effect of time is mainly apparent over the first three blocks. In particular, overall, high-psychopathy individuals' risky selections increased slightly at the onset of the experiment (see B2 and 3), and only then begun to decrease. In contrast, low-psychopathy individuals' risky selections decreased steadily across blocks. By the end of five blocks, low-psychopathy participants were making significantly fewer risky selections as compared to the high-psychopathy group (see B5, Figure 3; $t(218) = 3.14$, $p = .002$), even though the low-psychopathy group started off making more risky selections (see B1; $t(218) = 3.53$, $p = .002$).

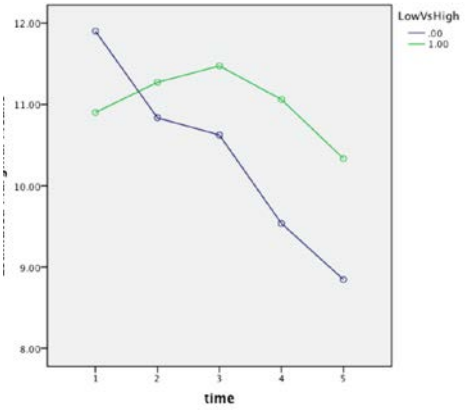

Figure 3. Mean number of risky-deck selections for low and high psychopathy individuals over time in the IGT (B1 – B5)

As in the analysis for Objective 2 that did not take into account psychopathy traits, there was a main effect of condition on risky deck selections, $F(3, 212) = 8.11$, $p = .005$, with the same pattern of results as for the analysis for Objective 2. Of interest here, we did not find a significant *condition* x *psychopathy* interaction, suggesting that psychopathy did not disproportionately impact risky-deck selections in the IGT conditions. Moreover, as before, the *block* x *condition* interaction was not significant.

In terms of impulsiveness, a median split was used to divide participants into high impulsiveness ($n = 124$; $M = 45.4$; $SD = 5.7$) and low impulsiveness ($n = 125$; $M = 27.3$; $SD = 8.1$) groups. A *Block x Impulsiveness* effect was found to be marginally significant, $F(2, 239) = 1.86$, $p = .06$.

Discussion

Damasio's (1994) Somatic Marker Hypothesis posits that somatic markers form from repeated exposure to emotional stimuli, where this information is used to aid in long-term decision making. Damasio (1994) designed the IGT as a means to assess somatic marker functioning as those with lesions to the VMPC, the hub for the somatic marker system, perform poorly on the task. Due to the poor performance of lesion patients who have intact cognitive processes, in corroboration with their decreased anticipatory SCR to risky deck selections, Damasio felt his task was a valid assessment of the role of emotion in decision making.

Directly manipulating emotion within the IGT is thought to provide insight into the theoretical pairing of risky deck selections to emotional responses. While there have been a number of criticisms for this pairing. Research has only indirectly assessed the somatic marker process via emotionally deficit clinical populations or generalizing SCR responses to somatic marker functioning. For example, Tomb and colleagues (2002) found healthy controls displayed anticipatory SCR prior to anticipated wins of a substantial amount (i.e., a positive somatic marker). Thus if If VMPC lesion patients are only concerned with immediate gains, then this would be contradicted by the lack of anticipatory SCR to high wins. There would be no mechanism for basing a decision off of that gain.

Other factors call into question the extent to which modifications of the task parameters may index different emotional/ cognitive processing mechanisms. While previous studies have adjusted the amount of reward, and whether it was monetary or virtual points, no study to date has manipulated the level of emotion, in terms of valence, arousal, and emotional content, attached to the reward or punishment values in the decks.

The findings of the current study found support for objective one: collapsed across the conditions, participants do learn to make less risky selections over time. These findings replicated previous findings of the learning trend that occurs at around the midway point of the IGT where participants decrease selections from risky decks. There was a lower mean number of overall risky deck selections in the later blocks of trials (i.e., B4 and 5) than the earlier traits (i.e., B1). Thus, including images within the decks that corresponded to the point values of the cards did not disrupt learning, and may have supplemented them to ensure adequate somatic marker formation.

There was also support for objective 2: manipulating emotional content directly within the IGT does influence performance (although it did not differently affect learning between the conditions). Collapsed across the blocks of trials, there were significant differences in overall risky deck selections between the conditions. It was also expected that the disgust condition would have the lowest mean number of risky deck selections. This is because the disgust condition contains images that have been previously found to elicit arousal effects and emotional reactions (feeling disgusted) due to their extreme ratings of unpleasantness and highly arousing images of mutilation (Schupp et al., 2000; Cuthbert et al., 2000). However, the fear conditions had the greatest mean number of risky deck selections. The sad condition was found to have the lowest mean number of risky deck selections.

However, this finding should be interpreted with caution:

1) Conditions did not have the same baseline mean number of risky selections at B1 (i.e., the fear condition had a greater mean than the sad condition). The degree of the slope may be biased and it is unclear what condition produced the best learning rate.
2) Baseline differences were found for the sad condition on levels of psychopathy, which may possible be due to the low number of participants and variability in scores.
3) Issues of cognitive load as each image was displayed for 1s, which may not be enough time to allocate attentional resources from selecting decks and processing the previous selection's outcome/point value to register complex/arousing images. The images for the punishment cards did not repeat and some of the images may take up more cognitive load than others.
4) IAPs images cannot completely separate into discrete emotion categories. For example, the sad conditions contain images that maybe viewed as disgusting to some people (i.e., a sick baby). In the fear condition an example of an image is a man holding a gun, where the participant maybe emotionally distant to the image (he is not pointing at them in real life). Thus the participant could make a judgment that the image is of something that is fearful but they may not experience the emotion themselves.

The purpose of the third objective was to investigate three types of risk taking traits on risky deck selections during the IGT. Risk taking traits of impulsiveness and psychopathy had a significant and positive association with each other. All risk taking traits were positively associated with risky deck selections; however, sensation seeking was only marginally significant. This may be due to problems of variability from the low levels of sensation seeking in the current sample. The modified versions of the IGT may also be more susceptible to cognitive and emotional deficits that may be present in individuals with high levels of impulsiveness and psychopathy. Further investigation will be needed to understand the mechanisms underlying

sensation seeking and impulsiveness during emotion-based decision making.

Further analysis was carried out on psychopathy on risky deck selections. Collapsed across the conditions there was a main effect of *Block*, and *Block x Psychopathy*. This means that, in line with Objective 2, when taking psychopathy into account, learning to avoid selections from risky decks continued. Participants with higher levels of psychopathic traits had higher risky deck selections at the onset and at the end of the task, compared to those participants with lower levels of psychopathic traits. A *Block x Impulsiveness* effect was marginally significant and is in line with prior research that did not find a connection between impulsiveness and risky decision making on the IGT (Franken & Muris, 2005).

Psychopathy was not found to have an impact of risky deck selections across the conditions as no *Condition X Psychopathy* or *Block X Condition* interaction was found to be significant. This was also the case for psychopathy. These results that were found for psychopathy were interesting even though they were not all significant. The findings fall in line with that of Mahmut et al., (2008), van honk et al., (2002), and Miranda and colleagues (2009), who also found an association between sub clinical levels of psychopathy in an undergraduate sample and IGT performance. Surprisingly, there was not an effect on discrete emotions on IGT performance, even though psychopathy is associated with a specific deficit for fear and sadness.

As previously noted, Hardy (2009) did not gauge valence and intensity ratings on the IAPs images to the point values, nor was there a significant effect on performance. In the current study, the sad condition was not included in this analysis due to baseline differences on ratings of psychopathy and a low number of participants in that condition.

Similar to the findings of Hardy (2009), there was not a significant effect on performance.

Limitations

The study is limited namely because of its small sample size and unequal number of participants between conditions. The sample size becomes problematic due to the high number of conditions and when additional groups are made to examine high and low levels of personality traits. In addition, the sad condition, which also showed baseline differences in psychopathy, was significantly smaller in the number of participants than the other conditions. The results may be more reliable and stronger if there were more participants that may balance out any baseline differences.

A more comprehensive analysis that includes time (five blocks), risk taking traits, and the five conditions into one model may provide a bigger picture of the interaction between emotion and personality in learning to avoid risky deck selections. Cognitive models [e.g., Fum and Stocco Model (20050] of the IGT maybe useful investigating the psychological processes underlying varying levels of performance found in healthy populations utilizing modified version of the IGT that directly manipulate emotion.

Direction for future research

It would be beneficial to look at additional traits that have been found to affect IGT performance in healthy populations. Research has consistently found that negative mood is associated with a decreased performance on the standard IGT (Suhr & Tsanadis, 2007; Vries et al., 2008). One avenue would be to examine mood states before and after performance. This is because the modified IGT conditions that utilize content that evokes discrete emotions may alter mood states.

Additional manipulations to the IGT that follow the design of the current study would also be beneficial. One method would be to examine valence more closely with having three valence conditions: neutral, pleasant, and unpleasant. Similarly, to the current study, reward cards would be paired with neutral IAPs images and punishment cards would be altered depending on the valence group. The pleasant condition would be of interest as it may disrupt learning as participants may be more responsive to a pleasant image attached to a punishment card than the viewing the point values. Another possible condition is to have an IGT that has only IAPs images and no point values assigned to any of the cards. The IAPs images will be organized by valence and intensity ratings according to the point values of reward and punishment cards. In theory, if optimal IGT performance is reliant on the formation of somatic markers, than having decks that include intensely negative images would deter people from selecting that deck, similar to receiving cards that have high punishment values written on them.

The current study provides a preliminary investigation of directly manipulating emotional content within the IGT. It appears that incorporating images that correspond to discrete emotion categories do not disrupt learning to avoid risky deck selections. Out of the three risk taking traits, levels of psychopathy appear to have the greatest effect on learning across the conditions. However, further research is needed to understand the interaction between emotion during decision making in the IGT.

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