Personality and Individual Differences 51 (2011) 112–116

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Individual differences in need for cognition and decision making in the Iowa Gambling Task

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ARTICLE INFO

Article history:
Received 17 December 2010
Received in revised form 14 March 2011
Accepted 15 March 2011
Available online 13 April 2011

Keywords:
Need for cognition
Risky decision making
Iowa Gambling Task

ABSTRACT

Differences in decision making between individuals differing in Need for Cognition (NFC) are examined using the Iowa Gambling Task (IGT). Previous work using normative one time decisions suggests that individual low in NFC process gains and losses differently than those high in NFC and are more susceptible to decision biases. The IGT is a popular laboratory task that involves making risky decisions from experience involving both gains and losses. In the first experiment, low NFC participants performed significantly worse than the high NFC participants. A second experiment designed to examine the nature of these differences provides evidence that low NFC participants place more importance on gains as opposed to losses when performing the IGT. Results are discussed in light of previous work suggesting that low NFC participants place more importance on losses in mixed outcome decisions.

1. Introduction

Many of the most important decisions we make in our life are complex, involving risks, trade-offs between possible gains and losses, and personal experience. Though a great deal of insight onto human decision making performance has come from the study of simple gambles and one time decisions, few paradigms have been developed to capture the complex interaction of factors at work in many real world decision making situations. One exception to this is the Iowa Gambling Task (IGT, Bechara, Damasio, Damasio, & Anderson, 1994), a widely used decision making task originally developed to examine real world decision making deficits in individuals with lesions of the ventromedial prefrontal cortex. Since its inception, the IGT has been used to discriminate healthy control participants from multiple populations that display poor decision making in the real world such as: groups with brain damage, antisocial personality, drug abuse problems, and Huntington's disease and incarcerated criminals (Bechara, Tranel, & Damasio, 2000; Bechara & Damasio, 2002; Bechara, Dolan, & Hindes, 2002; Monterosso, Ehrman, Napier, O'Brien, & Childress, 2001; Yechiam et al., 2008). However, not all control participants perform advantageously on the IGT and little research has been focused on individual differences that could lead to disadvantageous performance in healthy controls. The current work uses the IGT to examine decision making in individuals who differ in the individual difference variable need for cognition (NFC; Cacioppo & Petty, 1982).

1.1. The Iowa Gambling Task

The IGT is a laboratory based card playing paradigm developed to study decision making deficits in impaired clinical populations. Recently the IGT has been made available as a clinical measure designed to support diagnosis of brain dysfunction and to assess clinically relevant decision-making impairment (Bechara, 2007). In the IGT, participants make repeated choices between four decks of cards. After a card is chosen, an amount of money won and sometimes an amount of money lost is displayed and added to a running total. The four decks are designed such that two 'advantageous' decks produce small constant gains with occasional losses (producing net gains over time) while two 'disadvantageous' decks produce large consistent gains but even larger sporadic losses (producing net losses over time; see Table 1 for all deck contingencies). To play the game successfully participants must learn these contingencies over time. The primary dependant variable is the number of choices from the advantageous decks over the course of the game. The IGT is thought to simulate real world decision making abilities because it involves the integration of multiple complex decision making components such as risk, uncertainty, rewards and punishments, ambiguity, and learning from experience (Buelow & Suhr, 2009). The IGT has successfully discriminated risky decision making between healthy control groups and numerous clinical populations known to have difficulties in real world decision making, typically with control groups learning to choose more from the advantageous decks over time and clinical groups failing to do so.

The IGT is unique as a decision making paradigm in that outcomes are mixed (both gains and losses can result from the same

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doi:10.1016/j.paid.2011.03.021

Table 1
Mean gains and losses associated with each deck in the Iowa Gambling Task (IGT) and the modified IGT.

	Deck 'A'	Deck 'B'	Deck 'C'	Deck 'D'
Gains	$100	$100	$50	$50
Losses	.5 of $250	.1 of $1250	.5 of $50	.1 of $250
Net value (10 trials)	−$250	−$250	$250	$250
Modified IGT				
Gains	.5 of $250	.1 of $1250	.5 of $50	.1 of $250
Losses	$100	$100	$50	$50
Net value (10 trials)	$250	$250	−$250	−$250

Note: Each deck produces a variable gain (loss) on each trial with some probability of a loss (gain) for an average net value over 10 trials.

choice) and it links two types of decision making, decisions under ambiguity and decisions under risk (Brand, Recknor, Grabenhorst, & Bechara, 2007). In early stages of the IGT participants are making decisions under ambiguity as they learn the contingent payoffs of each deck. In later stages the contingent payoffs of each deck are known and participants are performing a risky decision making task (Brand et al., 2007; Maia & McClelland, 2004). Successful performance in the later stages of the IGT then depend on the participant's appropriate weighting of the sporadic losses compared to the consistent gains. While most healthy control participants in the above studies perform this task advantageously, up to 25% of controls do not (Desmeules, Bechara, & Dube, 2008). This variability in the performance of control participants makes the IGT a promising paradigm to study individual differences in decision making is a task more complex than simple gambles and one time decisions.

1.2. Individual differences in the IGT

Individual differences in IGT performance in the normal population has garnered little study (see Suzuki, Hirota, Takasawa, & Shigemasu, 2003; Desmeules et al., 2008 for exceptions). Recently Weller, Levin, and Bechara (2010) found that poor IGT performance in non-clinical participants was related to poor performance on a simpler task that separated choices in the gain domain from choices in the loss domain. Specifically, participants who performed poorly on the IGT performed poorly on risky decisions in the loss domain, showing less discrimination to differences in expected value, but not in the gain domain. This result suggests that susceptibility to framing could lead to disadvantageous performance on the IGT underweighting losses in a paradigm where losses and gains are mixed and should be weighted equally.

1.3. Need for cognition

To test this prediction, we used NFC, an individual difference capturing people's tendency to engage in and enjoy effortful thought (Cacioppo & Petty, 1982). NFC is measured through 18 scale items such as "I prefer complex to simple problems" and "Thinking is not my idea of fun (reverse scored)" (Cacioppo, Petty, & Kao, 1984). In a review of over 100 empirical studies, Cacioppo, Petty, Feinstein, and Jarvis (1996) found consistent reliability (αs > .85; test–retest reliability r = .88) and validity for NFC, supporting a single factor capturing people's tendency to engage in and enjoy effortful cognitive activity, related to reliable differences in information processing.

Pertinent to the current study, Smith and Levin (1996) found that individuals high in NFC had fewer framing errors than those low in NFC, suggesting that high NFC may facilitate discovering the deeper structure in different decision problems, though this finding has had mixed support (LeBoeuf & Shafir, 2003; Levin, Gaeth, Schreiber, & Lauriola, 2002). Similarly, Chatterjee, Heath, Milberg, and France (2000) found that high NFC participants were resistant to framing effects in the differential discrimination of losses and gains evaluating gains and losses equally, whereas low NFC participants were not. Furthermore, Carnevale, Inbar, and Lerner (2010) investigated differences in decision competence between high and low NFC participants using the Adult Decision-Making Competence Scale (Bruine de Bruin, Parker, & Fischhoff, 2007). Their results showed differences between high and low NFC participants in susceptibility to biases only in psychophysical judgment errors (Arkes, 1991) which are types of biases that result from differential sensitivity to gains and losses (e.g. sunk costs and framing effects). The results discussed above suggest that NFC could be an important predictor of IGT performance. The first experiment is designed to explore this possibility using the standard version of the IGT and separating participants into high and low NFC groups.

2. Experiment 1

2.1. Method: participants and procedure

Forty-three female and 32 male students at Ohio University participated for course credit. Participants completed the IGT and a NFC questionnaire in a counterbalanced order. Need for cognition was assessed using the short form 18 item inventory (Cacioppo et al., 1984).

2.2. Results

Participants were grouped into high and low NFC groups via median split. The high NFC group had a mean score of 67.07 (SD = 6.69) and the low NFC group had a mean score of 52.05 (SD = 6.70).[1] No gender effects were found in any analyses and are omitted from the presented data analyses.

The proportion of selections from advantageous decks were separated into five blocks of 20 trials. A 2 (NFC) × 5 (block) repeated measures ANOVA was performed on proportion of advantageous selections over the five blocks of trials (means are plotted in Fig. 1). Results revealed a NFC × block interaction $F(4,70) = 2.72$, $p < .05$, with the high NFC group choosing more advantageously as trials progress. An expected main effect of trial block was also found, $F(4,70) = 8.075$, $p < .01$, with all participants on average selecting more from the advantageous decks as trials progress. Comparison of the final 40 trials (risky decision making; Brand et al., 2007) finds the high NFC group outperforming the low NFC group $t(73) = 2.93$, $p < .01$. Repeated measures ANOVA, artificially dichotomizing NFC via median split, was chosen to preserve the dynamic structure of the IGT data. Using regression, collapsing across IGT data, does not alter the current results.[2]

2.3. Discussion

The results from experiment 1 show that the high NFC group outperformed the low NFC group on the IGT. However, due to the complex nature of the IGT, this could be the result of multiple processes. One possible explanation consistent with previous work is that high NFC participants recognized the deeper structure of the task choosing a strategy more closely aligned with learned expected values while low NFC participants choose a strategy based

[1] NFC scores had acceptable reliability in both experiment 1 (α = .83) and experiment 2 (α = .87).

[2] NFC is a significant predictor of total IGT performance (advantageous–disadvantageous choices) ($F(1,73) = 3.87$, $p = .05$, $r^2 = .05$) and marginally significant when predicting the final 40 trials ($F(1,73) = 2.975$, $p = .089$, $r^2 = .039$).