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EFFECTS OF EXPLICIT KNOWLEDGE AND METACOGNITIVE THOUGHTS ON IOWA GAMBLING TASK PERFORMANCE

Serra İçellioğlu (a)*, Ece Naz Ermiş (a)
*Corresponding author

(a) Istanbul Kültür University, Department of Psychology, Istanbul, Turkey, s.icellioglu@iku.edu.tr

Abstract

Decision-making is an essential cognitive function in everyday life. The Iowa Gambling Task (IGT) is a popular neuropsychological task that assesses decision-making through reward and punishment in the context of learning from past experiences. Differences in decision-making performances of healthy participants predicted by metacognition levels and having explicit knowledge during IGT were examined. 76 female and 12 male students at İstanbul Kultur University completed the IGT and Metacognition Questionnaire-30 (MCQ-30). After completing task implementations, each participant was asked a list of questions relating to their strategy on IGT and categorized into two groups depending on their level of explicit knowledge. As in conventional analysis of IGT, each block's net score was calculated. Results indicated that group with knowledge had significantly higher net scores and consistently improved their performances across 5 blocks of IGT than group with no explicit knowledge. Study showed there is a difference between healthy controls' learning strategies and this difference reflected to their decision-making performances. In risky blocks of IGT as the task progresses, negative beliefs about uncontrollability and danger subscale scores of metacognition has a negative effect on advantageous decision making, whilst a higher score on cognitive confidence subscale predicts disadvantageous decision making. Results and suggestions for future studies were discussed in light of previous work.

Keywords: Iowa Gambling Task, Decision-Making, Metacognition.

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1. Introduction

In recent years, decision-making has become one of the most frequently studied topics in neuropsychology. In everyday life, we usually encounter with numerous kinds of problems related directly to our personal issues such as emotional and social relationships together with our professional careers. However, decision-making is a complex cognitive function that involves several factors interacting with each other. Hence it had been a challenge for researchers to develop a valid and reliable tool for assessing decision-making behaviour in such a way that it encompasses the real life situations. IGT, (Bechara, Damasio, Damasio, & Anderson, 1994) is a widely used neuropsychological task across healthy and patient groups to assess decision-making. Studies revealed significant performance differences of IGT between healthy and patient groups and among several patient groups in their own (Apkarian et. al, 2004; Bechara & Martin, 2004; Bechara, Tranel, & Damasio, 2000; Blair, Colledge, & Mitchell, 2001; Brand et al. 2005; Rauch, 2000; Shurman, Horan,& Nuechterlein, 2005; Stout et al. 2004, Bonatti et al., 2009). However, different patterns of IGT performances were observed between healthy participants (Caroselli et al., 2006; Fernie&Tunney, 2006; Toplak et al., 2005; Wood et al., 2005; North & O'Carroll, 2001; Overman et al., 2004). Only a few studies focused on individual factors that would lead healthy participants to make disadvantageous choices on IGT. Results of the studies defined particular cognitive and individual differences between healthy participants who perform differently in the context of risk and avoidance on IGT such as impulsivity (Upton et al., 2012), need for cognition (Harman, 2011).

2. Problem Statement

Present study aims to assess the levels of different metacognitive thoughts (Flavell, 1979) as predictors of decision-making performance under risk and ambiguity. As Thompson stated (2009), one function of metacognition is to guide our decisions by detecting an intuitive response and to prevent it over mediation of decision-making process through self-monitoring in case of being in a conflictive situation or when a choice has to be made. In early blocks of the IGT, participants are making decisions under ambiguity because they are not aware of the differences among cards' reward and punishment schemes and as the task progresses, they learn the payoff schemes of each deck, therefore, their decisions are becoming to be risky at later blocks of IGT. Participant's explicit knowledge regarding the changing reward and punishment amounts after selecting from each of the decks contributes to a successful performance on IGT (Brand et. al., 2007; Maia and McClelland, 2004). Therefore, an additional variable named as explicit knowledge may influence the IGT performance.

3. Research Questions

- There is a significant difference between IGT performances of groups with and without explicit knowledge regarding the rules of the task.
- There is a predictive effect of metacognitive thoughts on IGT performance in ambiguous and risky blocks of the task.

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4. Purpose of the Study

In this study, first, we aimed to investigate the predictive role of metacognition on either an advantageous or a disadvantageous performance on ambiguous and risky blocks of IGT. Secondly, we investigated the effect of explicit knowledge regarding the rules of IGT on decision-making performance.

5. Research Methods

5.1. Participants

76 female and 12 male students at Istanbul Kultur University participated voluntarily in return for course credit. Participants' ages ranged from 18 to 41 years (M = 20.70, S.D. = 2.68). All participants with a lifetime history of psychiatric disorders, neurological disorders, or on current medication were excluded.

5.2. Assessing decision-making behaviour: Iowa Gambling Task

Participants were administered to a computerized version of the IGT (Bechara et al., 1994). A computer engineer translated all English words shown on the screen in this task into Turkish ones. The task consisted four decks of cards, labelled A, B, C, and D. Participants were given a stake of 2000 TL and told that the object of the game was to win as much money as possible by selecting a card from the desired deck by clicking on that deck with the computer mouse. A and B decks delivered immediate large rewards but also immediate large losses; thus these decks were disadvantageous in the long term. C and D decks delivered smaller immediate rewards but also immediate small losses, and thus were advantageous in the long term. Participants were not aware of the composition of the decks or the number of trials (100 cards). After 100 selections, the task stopped automatically. As in previous work with this task, a total net score for 100 trials and net scores for each five consecutive blocks of 20 trials were computed by subtracting the total number of choices from decks C and D from the total number of choices from decks A and B [(C′+D′)-(A′+B′)].

5.3. Explicit knowledge in relation to IGT

Each participant's level of explicit knowledge was determined as high or low by using a similar method described by Maia and McClelland (2004). At the end of the task, participants were asked to describe all they knew about the task, whether they found any difference between the decks, and if they had to choose only one deck, which one they would choose in order to earn money in the long run.

5.4. Assessing metacognition: Meta-cognitions questionnaire-30 (MCQ-30)

A standardized Turkish form (Tosun & Irak, 2008) of MCQ-30 developed by Wells and Cartwright-Hatton (2004) was used to assess metacognition. Scale comprised of 30 self-reported Likert-typed questions including five factors as follows; positive beliefs, uncontrollability and danger, cognitive confidence, need to control thoughts and cognitive self-consciousness. Unlike other inventories that had not been mentioned in this study, MCQ-30 assesses maladaptive metacognitive thoughts. For this reason,

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having higher scores from subscales, indicate a dysfunctional metacognitive function. Results should be discussed through this scoring framework. In present study, total scores of each subscale were calculated and included into analysis as distinct independent variables.

5.5. Statistical analysis

Data were analysed with the Statistical Package for the Social Sciences for Windows, version 23 (SPSS Inc., Chicago, IL), using repeated measures ANOVA and linear regression analyses depending on the characteristics of the variables investigated. Data were inspected for normality to ensure that the assumptions of parametric statistics were met before analyses were performed. An alpha level of .05 was used to judge whether findings were significant.

6. Findings

6.1. IGT performance and conscious knowledge

At the end of the task 33 participants (%37.5) reached high level of knowledge and 55 (%62.5) participants failed to comprehend the correct strategy or they specified a preference for one of the two advantageous decks but they could not provide a basis for that preference. A 2x5 repeated measures ANOVA was conducted to compare groups' IGT performances across the task with blocks as within-subjects factor and level of knowledge as between-subjects factor. Because the assumption of sphericity was not met (Mauchly's W = .68, p = .00), the degrees of freedom for tests of within-subjects effects were adjusted using the Greenhouse-Geisser F test. Between subjects tests revealed a significant main effect of group ($F_{(1,85)}$ = 18.74, p = .00) indicating that overall, group with high level of conscious knowledge made significantly more advantageous choices than the group with low level of conscious knowledge. Within subjects tests revealed a significant main effect of block ($F_{(3.44,\ 292.59)}$ = 3.71, p = .09), and a significant block x knowledge interaction ($F_{(3.44,\ 292.59)}$ = 4.41, p = .03; Fig.1) indicating that compared to group with low level of conscious knowledge, group with high level of conscious knowledge improved their performance across blocks in an advantageous manner over time.

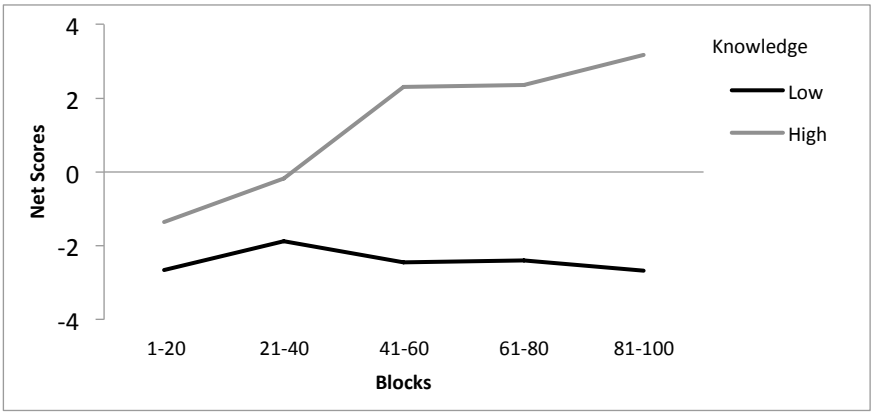

Figure 01. Mean number of net scores of group with high conscious knowledge (N = 33) and group with low conscious knowledge (N = 55) across 5 blocks of IGT.

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6.2. Effect of metacognition during IGT tasks under ambiguity and under risk

Table 1 presents the results of the linear regression models for predicting performance on each of the IGT tasks, both under ambiguity (blocks 1 and 2) and under risk (blocks 4 and 5). Under ambiguity the model was null (p = .151). By contrast, under risk the model was statistically significant (p = .00). Lower level of uncontrollability and danger (p = .04), higher level of cognitive confidence (p = .04) and higher level of knowledge (p = .00) were related to decisions made under risk (R^2 = .26).

Table 01. Predictors of decisions made under ambiguity and under risk on IGT

IGT PERFORMANCE						
Criterion	**Ambiguity (blocks 1 and 2)**			**Risk (blocks 4 and 5)**		
Predictors	*B* (CI 95%)	*β*	*p*	*B* (CI 95%)	*β*	*p*
Positive Beliefs	.22 (-.14; .58)	.135	.23	.50 (-.09; 1.09)	.172	.09
Uncontrollability and danger	-.48 (-1.06; .06)	-.237	.08	-.92 (-1.82; -.01)	-.247	.04
Cognitive confidence	.34 (-.03; .72)	.202	.07	.63 (-.02; -1.24)	-.209	.04
Need to control thoughts	.08 (-.34; .51)	.049	.69	.29 (-.39; .99)	.098	.39
Cognitive self-consciousness	.21 (-.43; .84)	.081	.52	.71 (-.32; 1.75)	.159	.17
IGT knowledge	3.86 (.75; 6.98)	.270	.01	12.37 (7.36; 17.38)	.488	.00
Model goodness-of-fit						
***F* (*p*-value)**	1.62 (.15)			4.79 (.00)		
R^2	.109			.265		

7. Conclusion

This study was conducted to evaluate the relationship between metacognitive beliefs, explicit knowledge regarding the changing rules of a gambling task and decision-making performances of a Turkish university student sample. The results showed that: (1) performance in the IGT was associated with having explicit knowledge about the underlying contingencies; (2) uncontrollability and danger subscale scores of MCQ-30 was negatively associated with IGT performance in risky blocks; (3) cognitive confidence subscale scores of MCQ-30 was negatively associated with IGT performance in risky blocks; (4) No association was found between performance in early blocks of IGT and neither of MCQ-30 subscales scores.

First, our results are compatible with the data of Maia and McClelland (2004) and Guillaume et al. (2009) establishing the involvement of explicit knowledge of rules to a successful performance during IGT. In recent years, Somatic Marker Hypothesis (SMH) proposed by Bechara et al. (1997) has been questioned and the main criticism concerns the explicit knowledge regarding the payoff schemes of disadvantageous and advantageous decks. According to our study results, performance may be explained by consciously accessible knowledge and explicit knowledge may therefore be more important than stated by Bechara et al. (1997).

Second, scores of uncontrollability and danger subscale predicted IGT performance negatively. Having metacognitive thoughts comprising uncontrollability and danger is a predictor of anxiety as well (Irak & Tosun, 2008). Higher levels of anxiety have a negative predictive effect on decision-making process (Massoni, 2014). In order to make an advantageous decision, anxiety level should be kept in an

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optimum level. The negative effect of higher anxiety levels and trait anxiety on decision-making assessed by IGT performance was shown by Miu et al. (2008). Therefore, reducing the anxiety that arises from uncontrollability and danger may have an effect on bringing out a better performance on risky blocks of IGT.

Our third result was the negative predictive effect of cognitive confidence subscale scores on IGT performance in risky blocks. Cognitive confidence concerns the intrinsic processes. Decision- making in a risky situation is determined by the way that how contingencies are formulated in a cognitive level (Kahneman & Tversky, 1979). Internal processes accompanying conscious feelings have a decisive role in risky situations and individual metacognitive experiences are crucial for maintaining the balance between these intrinsic and conscious feelings. In a study examining the relationship between metacognitive skills and risky decision-making, it was found that subjects who made significantly more risky choices, had also lower scores on a metacognitive task and yet their responses on the task were impulsive and intuitive. Subjects who made less risky choices spent significantly more time on analysing the options and their behaviours were related to their cognitive confidence scores (Frederick, 2005). Therefore, having decreased cognitive confidence scores may have an effect on choices in risky blocks of IGT in an advantageous manner.

MCQ-30 subscale scores had no predictive effect on performance in ambiguous blocks of IGT. The results of studies that assessed healthy groups' IGT performances, demonstrated that a large majority of this population prefer to switch their choices between four of the decks randomly in early blocks of the IGT in order to understand the changing payoffs of the decks and to comprehend a strategy rather than choosing from one deck continuously. Therefore, it may be argued that in early blocks of the IGT healthy subjects tend to make more spontaneous choices and as the task progresses and punishment feedbacks become to appear more often, they initially attempt to earn more money and yet, they tend to develop a strategy regarding the rules of the task in their minds. These processes involve metacognitive thoughts and therefore decision-making performance on risky blocks of IGT is significantly related to metacognitive thoughts.

As an end, there are limitations for this study. First, MCQ-30 assesses metacognitive thoughts. For a better understanding, task dependent methods for assessing metacognition are needed to be developed. The findings of metacognitions rely on self-report data and there are no objective measures for metacognitions. Second, the findings of this study should be tested with a large sample of participants to obtain analysis with greater effect sizes and strong significant relationships. It should be noted that however there are significant predictive effects of independent variables, these significance values were low. Despite the limitations, we believe the present study might provide a step for understanding the role of metacognitions in risky decision-making.

References

Apkarian, AV., Sosa, Y., Krauss, BR., Thomas, PS., Fredrickson, BE., Levy, RE., Harden, RN., Chialvo, DR. (2004). Chronic pain patients are impaired on an emotional decision-making task. Pain, 108, 129-136.

Bechara, A., Damasio, A.R., Damasio, H., & Anderson, S.W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. Cognition, 50 (1-3), 7-15.

Bechara, A., Damasio, H., Tranel, D., & Damasio, A.R. (1997). Deciding advantageously before knowing the advantageous strategy. Science, 275, 1293-1295.

Bechara, A., Tranel, D., & Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. Brain, 123(11), 2189-2202.

Bechara, A., & Martin, E., M. (2004). Impaired decision-making related to working memory deficits in individuals with substance addictions. Neuropsychology, 18(1), 152-162.

Blair, R. J. R., Colledge, E., & Mitchell, D. G. V. (2001). Somatic markers and response reversal: is there orbitofrontal cortex dysfunction in boys with psychopathic tendencies? Journal of Abnormal Child Psychology, 29 (6), 499-511.

Bonatti, E., Kuchukhidze, G., Zamarian, L., Trinka, E., Bodner, T., Benke, T., & Delazer, M. (2009). Decision making in ambiguous and risky situations after unilateral temporal lobe epilepsy surgery. Epilepsy and Behavior, 14(4), 665-673.

Brand, M., Kalbe, E., Labudda, K., Fujiwara, E., Kessler, J. & Markowitsch, H. J. (2005). Decision-making impairments in patients with pathological gambling. Psychiatry Research, 133 (1), 91-99.

Brand, M. Recknor, E. C., Grabenhorst, F., & Bechara, A. (2007). Decisions under ambiguity and decisions under risk: correlations with executive functions and comparisons of two different gambling tasks with implicit and explicit rules. Journal of Clinical and Experimental Neuropsychology, 29 (1), 86-99.

Caroselli, J. S., Hiscock, M., Scheibel, R. S., & Ingram, F. (2006). The simulated gambling paradigm applied to young adults: An examination of university students' performance. Applied Neuropsychology, 13, 203-212.

Fernie, G., & Tunney, R. J. (2006). Some decks are better than others: The effect of reinforcer type and task instructions on learning in the Iowa Gambling Task. Brain and Cognition, 60, 94-102.

Flavell, J.H. (1979). Metacognition and cognitive monitoring. A new area of cognitive-development inquiry. American Psychologist. 34 (10): 906–911.

Frederick, S. (2005). Cognitive reflection and decision-making, Journal of Economic Perspectives, 19 (4), 25-42.

Guillaume S, Jollant F, Jaussent I, Lawrence N, Malafosse A, Courtet P. (2009). Somatic markers and explicit knowledge are both involved in decision-making. Neuropsychologia, 47(10), 2120-2124.

Harman, J.L. (2011). Individual differences in need for cognition and decision-making in the Iowa Gambling Task. Personality and individual differences, 51, 112-116.

Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision-making under risk. Econometrica, 47(2), 263-291.

Maia, T. V., & McClelland, L. (2004). The somatic marker hypothesis: still many questions but not answers. Trends in Cognitive Sciences, 9 (4), 162-164.

Massoni, S. (2014). Emotion as a boost to metacognition: how worry enhances the quality of confidence?, Consciousness and Cognition, 29, 189-198.

Miu, A.C., Heilman, R. M., & Houser, D. (2008). Anxiety impairs decision-making: psychophysiological evidence from an Iowa Gambling Task. Biological Psychology, 77, 353-358.

North, N. T., & O'Carroll, R. E. (2001). Decision making in patients with spinal cord damage: afferent feedback and somatic marker hypothesis. Neuropsychologia, 39, 521-524.

Overman, W. H., Frassrand, K., Ansel, S., Trawalter, S., Bies, B., & Redmond, A. (2004). Performance on the Iowa card task by adolescents and adults. Neuropsychologia, 42, 1838-1851.

Rauch, S. L. (2000). Neuroimaging research and the neurobiology of obsessive-compulsive disorder: where do we go from here? Biological Psychiatry, 47, 168-170.

Shurman, B., Horan, W.P., & Nuechterlein, K. H. (2005). Schizophrenia patients demonstrate a distinctive pattern of decision-making impairment on the Iowa gambling task. Schizophrenia Research, 72, 215-224.

Stout, J.C., Busemeyer, J. R., Lin, A., Grant, S. J., & Bonson, K. R. (2004). Cognitive modelling analysis of decision-making processes in cocaine abusers. Psychonomic Bulletin and Review, 11, 742-747.

Thompson, V. A. Dual-process theories: A metacognitive perspective. In Evans, J. and Frankish, K., eds.: In Two Minds: Dual Processes and Beyond. Oxford University Press, Oxford, pp. 171-195, 2009.

Toplak, M., Jain, U., & Tannock, R. (2005) . Executive and motivational processes in adolescents with attention-deficit-hyperactivity disorder (ADHD). Behavioral and Brain Functions, 1, 1-12.

Tosun, A. and Irak, M. (2008). Adaptation, validity, and reliability of the Metacognition Questionnaire-30 for the Turkish population, and its relationship to anxiety and obsessive-compulsive symptoms. Turkish Journal of Psychiatry, 19 (1), 67-80.

Upton, D.J., Bishara, A. J., Ahn, W., & Stout, J.C. (2012). Propensity for risk taking and trait impulsivity in the Iowa Gambling Task. Pers Individ Dif., 50, 492–495.

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the Metacognitions Questionnaire: properties of the MCQ- 30. Behaviour Research and Therapy, 42, 385–396.

Wood, S., Busemeyer, J., Koling, A., Cox, C. R., & Davis, H. (2005). Older adults as adaptive decision-makers: Evidence from Iowa gambling task. Psychology and Aging, 20, 220-225.