Cognitive Functions and the Model of Decision-Making Competence: The Specific Case of Organizational Setting

Salehe Piryaei[1], Molouk Khademi Ashkzari[2], Vahid Nejati[3], Nasrin arshadi[4], Mahmoud Talkhabi[5]

[1]PhD Candidate of Educational Psychology, Alzahra University, Tehran, Iran
[2]Department of Educational Psychology, Alzahra University, Tehran, Iran
[3]Institute for Cognitive and Brain Sciences, Shahid Beheshti University, Tehran, Iran
[4]Department of Industrial and Organizational Psychology, Shahid Chamran University of Ahvaz, Ahwaz, Iran
[5]Cognitive Sciences Studies Institute (ICCS), Tehran, Iran

Submitted: 15 July 2017
Accepted: 18 November 2017

Int J Behav Sci. 2017; 11(2): 67-73

Corresponding Author:
Salehe Piryaei
PhD Candidate of Educational Psychology
Alzahra University
Tehran
Iran
E-mail: s.piryaei@alzahra.ac.ir

Abstract

Introduction: Decision- making as an executive process, consists of a wide range of inputs such as conditioning based on past experiences, sensory and emotional responses, and the anticipation of future goals. The present study aims to investigate the effects of cognitive/executive functions on decision making competence in organizational settings.
Method: The sample of this research consisted of 430 managers from 5 industrial companies in Iran who were selected by random sampling method. The instruments which were used in this study were the Cognitive Ability Questionnaire and the Adult Decision Making Competence (A-DMC) tasks. Structural Equation Modeling (SEM) was used through AMOS-22 for data analysis.
Results: The results indicated that cognitive/executive functions –planning, cognitive flexibility, inhibitory control, & social cognition- had significant effects on 5 decision making competencies mediating by applying decision rules in the current model.
Conclusion: To conclude, from our point of view, different decision-making tasks are separately related to cognitive/executive functions specifically at managerial frameworks. Thus, the current study indicated which cognitive control processes are most operative in the successful performance of managers on different decision tasks. If different executive functions are mainly needed for the successful accomplishment of some decision-making tasks, training these functions in organizations may improve some facets of decision-making performance.

Keywords: Cognitive Functions, Decision-making Competence, Organizational Setting

Introduction

Human performance in decision making has been considered as a major subject in various studies. Examining decisions for a set of needs and preferences that an individual values and seeks alongside identifying the best available and accepted resources to satisfy the specific organizational needs are mainly discussed in literature [1-3]. According to MacLeod et al. [4], the influences on job performance are many but can be considered to include professional goals, time, functional and performance requirements, constraints, influencing conditions, environmental effects, levels of effort, plans, tasks, customs, and the means of performing the work. Decisions as a complex process, including alternative generation, evaluation of risks and consequences, and selection of an alternative is consistent with personal preferences impact on person's professional and personal life [5]. Considering advantages and disadvantages of each alternative and predicting the consequence of each option in specific situation is essential for effective decision making. Therefore, as stated by Reason [6], decision making means mental or cognitive process of selecting a logical choice from the available alternatives [7].

On the cognitive perspective, the decision making process should be regarded as a continuing process interacting with the environment. At another level, it could be regarded to be a problem solving activity which is terminated whenever a satisfactory solution is reached. Nevertheless, in dual-process theories, decision making is based on heuristic and analytic processes [8]. According to dual process theories [9], heuristic decision making depends on learned associations, fast automatic processes, and intuitive heuristics, while analytic decision making is guided by rules involving control processes and working memory.

In this regard, decision making may require a high degree of cognitive control [10] which consists of a wide range of inputs such as multi-modal sensory inputs, conditioning based on past experience, sensory and emotional responses, and the anticipating future goals. Moreover, these inputs must be integrated and associated with uncertainties, expectations and outcomes and subsequently processed to make the most appropriate decisions [5]. In this regard, the topic of decision making falls under the broad topic of executive functions, which is a basic concept for cognitive processes that regulates, controls, and manages other cognitive processes [11]. Basically as the management system of the brain, Goldstein & Naglieri [12] stated that executive function (EF) indicates to an umbrella term used for various hypothesized cognitive processes, including planning, working memory, attention, inhibition, self-monitoring, self-regulation, and initiation carried out by prefrontal areas of the frontal lobes. Therefore, impairments in executive functions, which are thought to involve the frontal lobes of the brain can have a major impact on one's ability to perform such tasks as planning, prioritizing, organizing, paying attention to and remembering details, controlling emotional reactions, and decision making [13].

Executive functions have frequently been investigated in literature [14-15-16] and have also been defined as the key components of executive control [17]. In line with this idea, a close link between frontal/executive functions and decision-making processes has been suggested by patient studies [18], brain-imaging research [19], and behavioral experiments [20]. Executive functions as a non-exhaustive conceptualization of control processes, in a relatively low level of analysis, can be appropriate for reaching an improved understanding of the relationship between control processes and complex cognitive tasks [21].

On the other hand, decision-making processes have been studied in isolation in order to know each in more detail [22]. Recently, researchers have shown interest in the role of individual differences in decision making process [23] and they have investigated the preference or ability that people apply to make decisions in consistent ways, across tasks and situations [24]. Bruine de Bruin, Parker, & Fischhoff [22] stated that individual differences have an effect on the preference for rational, intuitive, dependent, avoidant, or spontaneous decision-making styles [24] and decision-making competence [22, 25, 26]. So, among the causes of poor knowledge of the nature of control processes in decision making, the rare attention devoted to individual differences and measurement instruments are considerable. Consequently, little is known about how individual decision making skills are related to each other, to cognitive abilities and to real-world outcomes [22]. In addition, past research made only infrequent attempts to develop and validate measures of individual differences in decision-making competence which are essential to investigate the connections between cognitive processes and decision behavior. In this regard, Bruine de Bruin et al. [22] introduced a battery of six tasks chosen to represent skills needed by normatively competent decision makers such as resistance to framing, recognizing social norms, under/overconfidence, applying decision rules, consistency in risk perception, and resistance to sunk costs. Using a diverse sample and a variety of performance criteria, the Adult Decision Making Competence (A-DMC) battery were found to have appropriate reliability and validity [25, 27]. Investigating the connection between cognitive skills and decision-making tasks are possible with the validated A-DMC measure of individual differences in a more reliable way.

The present study adopted an individual differences approach to investigate executive functioning processes that are assumed to play a role in decision making. In particular, the current study aimed to investigate the effects of executive functions including planning, flexibility, inhibitory control, and social cognition on adult decision making competence in the organizational setting. The hypothetical model of the study is presented in Figure 1.

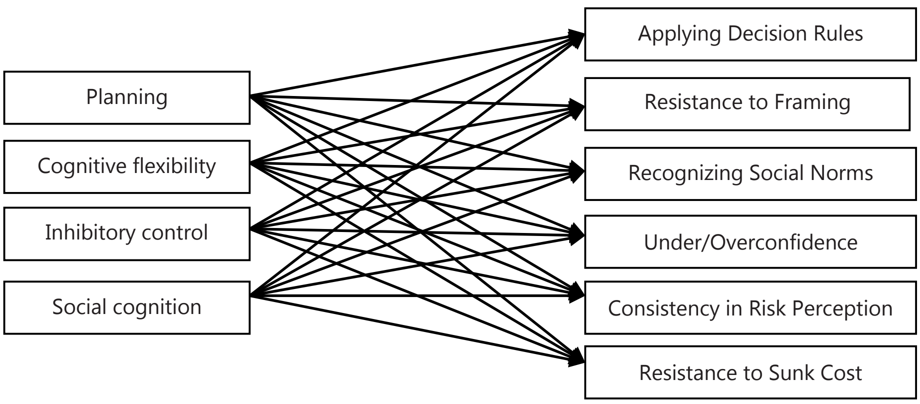

Figure 1. The hypothetical model of the current research

Method

The participants of this research were 430 managers that were selected by random sampling method from 5 industrial organizations in Iran. After incomplete questionnaires were eliminated, 379 questionnaires were obtained over the eight-week period (a response rate of 88.13%). All the participants were male and 75.5% were 35–46 years of age.

Instruments

Cognitive Abilities Questionnaire. The cognitive ability questionnaire put forth by Nejati [28] is a self-report measure that assesses cognitive abilities incorporating many of the important cognitive functions consisting of 50 items that answered by 5 point Likert scale with the following subscales: memory, inhibitory control, selective attention, decision making, planning, sustain attention, social cognition and cognitive flexibility. There are strong support for quite a strong Cronbach's alpha (0.834) and Pearson correlation test that showed a significant correlation in the test- retest analysis (p<0.01) [28]. We used 16 items of this questionnaire involving planning (3 items), cognitive flexibility (4 items), inhibitory control (6 items), and social cognition (3 items) in this study. At the current research, the internal consistency of the items was satisfactory, as reflected in the separation indices (Cronbach's alpha) ranging from 0.71 to 0.93.

Adult Decision Making Competence (A-DMC). The Adult Decision Making Competence scale (A-DMC) developed by Bruine de Bruin et al. [22] was used to assess the decision making competencies in organizational/managerial setting. The A-DMC consists of 36 items and five subscales including resistance to framing, recognizing social norms, under/ overconfidence, applying decision rules, consistency in risk perception, and resistance to sunk costs. A brief description of ADM-C components is presented below.

Applying decision rules subscale inquires people to indicate, for hypothetical individual consumers using different decision rules, which of five DVD players they would buy. Each consumer decides to choice from a various set of five equally priced DVD players with varying ratings of picture quality, sound quality, programming options, and brand reliability (from 1 [very low] to 5 [very high]). The decision rules include elimination by aspects, satisficing, lexicographic, and equal weights rules. *Consistency in risk perception* assesses the capacity to follow probability rules. 20 items ask participants to judge the possibility of an event occurring to them on a linear scale ranging from 0% (no chance) to 100% (certainty). Ten events are judged twice: for the next year and for the next 5 years. Each time frame pair is scored as correct if the probability for the event happening the next year is no larger than for it happening in the next 5 years. Responses to each pair are scored as correct if their combined probability is 100%. *Resistance to framing measures* whether value assessment is affected by irrelevant variations in problem descriptions. Resistance to framing would be assessed by a strength-of-preference rating scale, that endpoints reflecting a strong preference for each of the two original choice options, following Levin et al. [29]. Because the 6-point scale lacks a midpoint, it forces respondents to express a relative preference between options, if only weakly. *Recognizing social norms* subscale measures how well participants assess peer social norms. Participants first judge whether "it is sometimes OK" to engage in each of 16 undesirable behaviors (e.g., to steal under certain circumstances). Later in the test battery, participants estimate how many "out of 100 people your age" would endorse each behavior. The first set of responses allowed us to compute the percentage of participants who endorsed each behavior. For each participant, performance is measured by the rank-order correlation (from -1 to +1) between the actual percentage and the estimated percentage of peers' endorsements across the 16 behaviors. *Under/overconfidence* assesses how well participants identify the level of their own knowledge or understanding. Respondents reveal whether or not each of a set of statements is true or false, then assess their confidence in their answer, on a scale from 50% (just guessing) to 100% (absolutely sure). Participants first judge whether "it is sometimes OK" to participate in each of 16 undesired behaviors (e.g., to steal under certain circumstances). Later, participants estimate how many people in your age would endorse each behavior. The first set of responses indicate the percentage of participants who endorsed each behavior. For each participant, performance is measured by the rank-order correlation (from -1 to +1) between the actual percentage and the estimated percentage of peers' endorsements across the 16 behaviors. *Consistency in Risk Perception* assesses the capability to check out the probability rules. Participants judge the chance of an event happening to them on a linear scale ranging from 0% (no chance) to 100% (certainty) in 20 items. Ten events are judged twice in the next year and for the future 5 years. Each time frame pair is scored as correct if the probability for the event happening the next year is no larger than for it happening in the next 5 years. Responses to each pair are scored as correct if their combined probability is 100%. *Resistance to Sunk Costs* measures the ability to ignore prior investments when making decisions. The A-DMC has 10 items, using a rating scale ranging from 1 (most likely to choose [the sunk-cost option]) to 6 (most likely to choose [the normatively correct option]). Performance is measured by the average rating across the 10 items [22].

Table 1 presents the characteristics of A-DMC components and the reliability coefficients for each subscale. In the current study, results of CFA and Cronbach's alpha coefficient showed that the 5 factors had acceptable validity as shown by the goodness-of-fit index values: χ^2/df = 42.769 (p > .05), CFI = .80, NFI = .80, TLI= .66, & RMSEA = .07, with Cronbach's alpha coefficients ranging from .78 to .94 as for the construct validity, and the CFA results showed that the original first-order factor structure had acceptable goodness of fit indices.

Table 1. Characteristics of A-DMC components

	Variables	Potential range	Cronbach's α
1	Applying Decision Rule	.00–1.00	0.73
2	Resistance to Framing	.00–5.00	0.62
3	Recognizing Social Norms	-1.00–1.00	0.64
4	Under/Overconfidence	.00–1.00	0.77
5	Consistency in Risk Perception	.00–1.00	0.72
6	Resistance to Sunk Cost	1.00–6.00	0.75

Note. All Adult Decision-Making Competence (A-DMC) components are scored so that higher numbers reflect better performance [21].

Methods

The conceptual model detailed in Figure 1 was analyzed using path analytical procedures with the statistical software package, AMOS-22. Path analytical procedures are more advantageous in enabling researchers to test and compare competing priori models, decomposition of effects, similarly, and provides clarity into the direct and indirect interrelations between variables**.** In relation to the goodness-of-fit index values, we chose to use the following: (i) the Chi-square statistics (χ^2) and degree of freedom (*df*), (ii) the Comparative Fit Index (CFI)(CFI value ≥ .90), (iii) the Non-Normed Fit Index (NNFI)(NNFI value ≥ .90), and (iv) the Root Mean Square Error of Approximation (RMSEA)(RMSEA value ≤ .080).

Results

Descriptive statistics, involving means and standard deviations for the total sample and similarly the bivariate correlations of the variables under statistical testing are presented in Table 2.

As shown in Table 2, almost all correlation coefficients between cognitive functions and adult decision making competence were significant *($p < 0.05$).* The results of structural equation modeling for the hypothesized model indicates that goodness-of-fit indices suggests an appropriate model-data fitness except for the root mean square error of approximation (RMSEA) which was higher than 0.05 (χ^2/df= 7.594, p <0.05; RMSEA = 0.1; CFI = 0.91; NFI = 0.90, IFI= 0.92; TLI=0.75; GFI= 0.95; AGFI= 0.83). In the basic hypothesized model, the coefficients of the 11 paths were not significant. Thus, in order to modify the model, we removed the hypothetical paths from planning and social cognition to resistance to framing, recognizing social norms, under/overconfidence, consistency in risk perception, and resistance to sunk cost, and the path between cognitive flexibility and recognizing social norms. The final, modified model is presented in Figure 2 considering modification indices and drawing 5 new paths between applying decision rules and resistance to framing, recognizing social norms, under/overconfidence, consistency in risk perception, and resistance to sunk cost. A look at the goodness-of-fit indices of the final model (χ^2/df= 2.792, p <0.05; RMSEA = 0.06; CFI = 0.97; NFI= 0.96, IFI= 0.92; TLI=0.93; GFI= 0.98; AGFI= 0.93) suggests that it relatively fits the data (See Figure 2).

Table 2. Descriptive Statistics and Bivariate-Correlations for Research Variables

	Variables	M	SD	1	2	3	4	5	6	7	8	9	10
1	Planning	7.52	4.10	___									
2	Cognitive flexibility	11.23	4.66	.71*	___								
3	Inhibitory control	16.52	6.47	.23*	.61*	___							
4	Social cognition	7.42	3.17	.29*	.66*	.57*	___						
5	Applying Decision Rule	.47	.23	.11*	.20*	.12*	.25*	___					
6	Resistance to Framing	3.78	.63	.15*	.21*	.11*	.102*	.29*	___				
7	Recognizing Social Norms	.32	.19	.17*	.24*	.10*	.088	.16*	.28*	___			
8	Under/Overconfidence	.95	.09	.10*	.18*	.09*	.13*	.12*	.17*	.14*	___		
9	Consistency in Risk Perception	.72	.11	.20*	.23*	.13*	.10*	.22*	.18*	.16*	.09	___	
10	Resistance to Sunk Cost	5.10	.61	.17*	.19*	.11*	.16*	.24*	.14*	.15*	.12*	.17*	___

Note: *$p < 0.05$

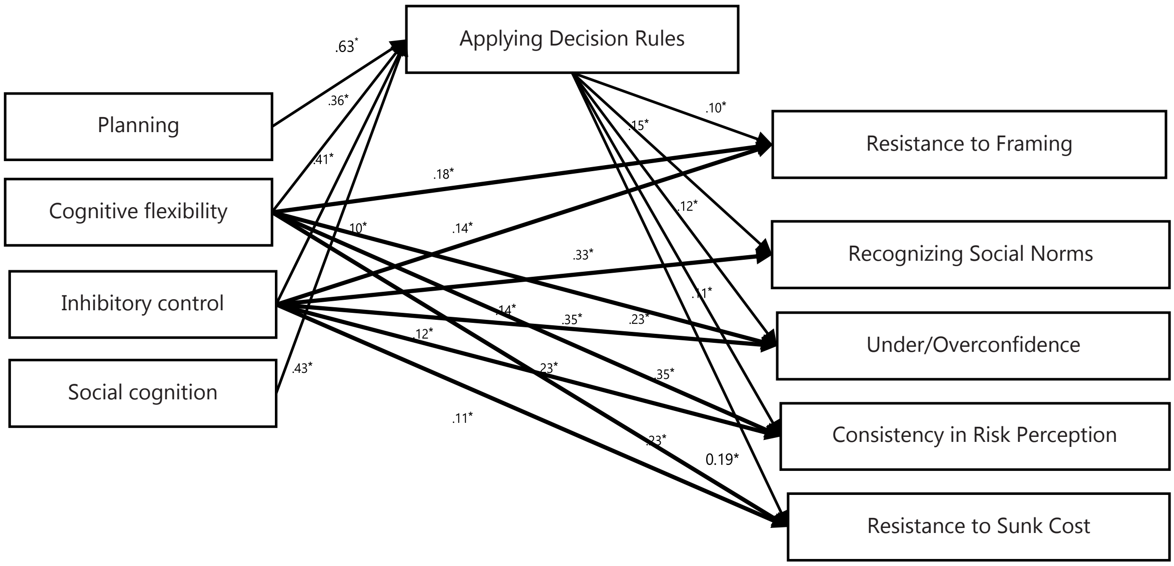

Figure 2. Final model of the effects of cognitive/executive functions on ADM-C
Note. Standard coefficients have been reported (all coefficients are significant at the 0.05 significance level)

Table 3 indicates that a direct effect exists in cognitive/executive functions on adult decision making competence and an indirect effect exists in the cognitive functions on decision making competence mediated by applying decision rules.

Table 3. The standardized effects: Direct, Indirect, & Total

Predictors	Direct effects	Indirect effects	Total
on applying decision rules			
Planning	0.17*	-----	0.17*
Cognitive flexibility	0.51*	-----	0.51*
Inhibitory control	0.118*	-----	0.11*
Social cognition	0.16*	-----	0.16*
On Resistance to Framing			
Applying decision rules	0.25*	-----	0.25*
Planning	-----	0.046*	0.046*
Cognitive flexibility	0.21*	0.131*	0.34*
Inhibitory control	0.1*	0.03*	0.13*
Social cognition	-----	.10*	0.10*
On Under/Overconfidence			
Applying decision rules	0.25*	-----	0.25*
Planning	-----	0.12*	0.12*
Cognitive flexibility	0.333*	0.036*	0.36*
Inhibitory control	0.27*	0.018*	0.278*
Social cognition	----	0.12*	0.12*
On recognizing social norms			
Applying decision rules	0.11*	----	0.11*
Planning	----	0.121*	0.121*
Cognitive flexibility	0.309*	0.018*	0.36*
Inhibitory control	0.20*	0.013*	0.215*
Social cognition	-----	0.18*	0.18*
On Consistency in Risk Perception			
Applying decision rules	0.11*	------	0.11*
Planning	-----	0.008*	0.008*
Cognitive flexibility	0.38*	0.022*	0.358*
Inhibitory control	0.22*	0.005*	0.224*
Social cognition	-----	0.121*	0.121*
On Resistance to Sunk Cost			
Applying decision rules	0.235*	-----	0.235*
Planning	-----	0.042*	0.042*
Cognitive flexibility	-----	0.120*	0.120*
Inhibitory control	0.1*	0.034*	0.139*
Social cognition	-----	0.072*	0.072*

Note: *$p < 0.001$

As shown in Table 3, the direct effects of planning, cognitive flexibility, inhibitory control, and the social cognition on 5 adult decision making competence are mediated by applying decision rules.

Discussion

The present study has introduced a number of key findings in order to enhance the understanding of individual decision-making skills, which support the hypothetical model of decision making regarding the notion of cognitive/executive functions as precedents of decision making competence. The findings of this study are consistent with previous research [5, 7, 22, 30].

Results indicated that the effects of cognitive functions on A-DMC components is mediated by applying decision rules. Therefore, the A-DMC may be influenced by specific cognitive skills instead of general cognitive/executive abilities in terms of their relevance to avoiding negative decision outcomes in organizational settings, indicating that the domain of cognitive ability could be expanded to include decision making competence.

Based on the multi-attribute utility approach [31], the decision maker should determine relevant proportions of the decision, identify the weight of these proportions, estimate the utility (i.e., usefulness) for each option by summing its weighted dimensional values, and then find the highest weighted option [30]. Obviously, the applicability of this extremely rational approach to decision making may have some limitations in more complicated and realistic settings. In contrast, according to normative models, the quality of a decision depends on its process rather than its outcome. So, it is argued that better decision processes will lead to good decision outcomes. In this regard, we can identify the four fundamental skills including assessing the chance of outcomes, evaluating outcomes, integrating beliefs and values to make decisions, and metacognition as the main factors of effective decision making [25, 32].

Boy [30] developed a three-level model of decision making process based on Rasmussen's model of available time for human information processing [33] in three levels of behavior. Firstly, at the perception-action level, decision-making is immediate and is directly based on perception to action without using conscious resources. This is typical whenever an individual replies immediately according to genetic skills. Secondly, at the procedural level, decision-making as a conscious cognitive process may require a considerable time for recognizing a situation design that is interpreted based on the procedures that lead to the execution of actions. Finally, decision-making at the constructive level is an extremely conscious and sophisticated cognitive activity that can be decomposed into three high-level cognitive functions including situation building; evaluation of hypothetical actions, resources and constraints, and planning, building of a sequence of actions that satisfy the constraints with regard to the available sources. People adapt these behavioral levels according to the urgency of action and the constructive level is the last cognitive resource when the other two levels do not provide appropriate solutions.

Currently, the application of the above competencies requires the application of human expertise in the workplace. People use executive functions to perform activities such as planning, organizing, strategizing, paying attention to and remembering details, and managing time and space [7]. Like the control processes, executive functions are important in activation, arousal, effort, getting started, paying attention, finishing work, controlling emotions, ability to tolerate frustration, manipulating information, accessing facts stored in long term memory, shifting, inhibiting and changing activities, stopping existing activity, stopping and thinking before acting or speaking, organizing/planning projects, materials, and possessions, and finally monitoring, controlling and prompting [5].

Conclusion

This study indicated that executive functions are most operative in the successful performance of managers in decision tasks. If different executive functions are mainly required for the successful accomplishment of some decision-making tasks, training these functions in organizations may improve some facets of decision-making performances. Thus, it could be helpful to examine the consequences of training and rehabilitation of executive functions specifically for managers. These findings may be important in terms of understanding what drives the decision making competence and the foci of interventions for improving the quality of decision making process in organizations. We suggest that institutions invest in interventions aiming at enhancing the managerial cognitive constructs and metacognitive awareness with other strategies for improving job performance in organizational settings.

Acknowledgement:

The authors would like to thank all those who helped conducting this research.

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