



The Validity and Reliability of the Cognitive Flexibility Scale

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Abstract

The aim of this study is to study the validity and reliability of the cognitive flexibility scale (CFS) for a Turkish adaptation. For the factor analysis and reliability studies, data was collected from 370 high school students (160 female, 210 male, $\bar{X}_{age}=16.15$, $ss=1.33$). In addition, data was collected from 392 adolescents for scale dependant reliability (218 female, 174 male, $\bar{X}_{age}=16.11$, $ss=1.14$). The results of the completed studies reveal that the CFS, which consists of 11 items, explains 43%, of the variance in the total groups, and that CFS is unidimensional. In addition, the internal coefficient (α) parameters of the measuring tools in the total group were .74. A significant difference was found in the 27 percentile of sub and top groups with regard to all CFS items. In a criterion referenced reliability study, significant correlations were found between CFS and problem solving inventory sub scales and their total score.

Keywords

Cognitive flexibility
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Introduction

Human behaviours and the biological and psychological processes behind these behaviours have been important subjects of interest to contemporary scientists. In studies on the processes behind certain behaviours, it has been found that these processes can be discussed in biological, affective, and cognitive terms. The cognitive aspect of human behaviours continues to be one of the key areas of study in psychology. In this paper, the cognitive development (Onyehalu, 1985; Piaget, 1950; Piaget & Inhelder, 1969; Zeytinoğlu, 1980), cognitive distortion (Bridges & Roie, 1997; Ellis, 1993; Hamamcı & Duy, 2007; Hamarta & Demirbaş, 2009), and cognitive learning processes of individuals and their effects on individual behaviors are examined.

Another variable of recent interest to scientific studies is cognitive flexibility. The concept of cognitive flexibility was first defined by Spiro & Jeng (1990) as "an individual's ability to reconstruct his/her knowledge on being able to give suitable reaction to the demands caused by changing situations". The same variable was collectively defined by Martin & Rubin (1995), Martin & Anderson (1998), and Martin, Anderson, & Thweatt (1998) as "an individual's being aware of the fact that there are suitable options and accessible alternatives for every given situation, being willing to be flexible and feeling competent about adapting the situation and being able to be flexible".

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Although flexibility refers to an individual's capacity to adapt to various situations (Payne, Bettman, & Johnson, 1933), adaptation may not always happen. If a person with the ability to act flexibly to deal with a certain change fails to do so this person can still be said to have cognitively flexibility. According to Martin, Anderson, & Thweatt (1998), individuals who show flexibility in their daily lives are commonly flexible not only in certain situations or at a single time, which speaks to the fact that cognitive flexibility can be a general condition. According to Spiro & Jehng (1990), people who have previously faced multiple tasks at once can be more flexible in terms of effectively evaluating conditional situations. Such individuals commonly have the ability to reconstruct their knowledge easily, and thus they can change their reactions radically in the presence of conditional demands. According to Martin & Anderson (1994; 1996; 1998), cognitively flexible individuals are precipitous, responsible, and can make sense of what they experience. In addition, cognitively flexible individuals feel safe about communicating in different situations (Martin & Anderson, 1998). Cognitive flexibility also increases individuals' trust in others through the ability to act competently, as well as makes individuals more flexible in certain matters (Martin, Anderson, & Thweatt, 1998). Individuals who consider themselves cognitively flexible are also stated to be incredibly self-confident, good at repartee, careful, and understanding (Martin & Anderson, 1996, 1998). These individuals also have higher beliefs in their own self-efficacy and self-observation skills than individuals who have low cognitive flexibility (Martin & Rubin, 1995).

Previous studies have propounded that cognitive flexibility is positively related to non-aggressiveness and toleration, belief in social self-efficacy and problem-solving skills (Bilgin, 2009b), coping with problem-solving oriented stress (Dennis & Vaner Val, 2010), and decision-making (Dunleavy and Martin, 2006). However, cognitive flexibility has been found to have a significant negative relation with depression (Merrill et al., 2005) and verbal aggression (Martin & Anderson, 1998). It has also been related to many cognitive skills (Carlson & Moses, 2001; Müller, Zelazo & Imrisek, 2005), such as language skills (Jacques & Zelazo, 2005) and arithmetical skills (Bull & Scerif, 2001). When these studies are taken together, it appears that cognitive flexibility shows positive relations with positive psychological features and negative relations with negative psychological features.

Cognitive Flexibility and Problem-Solving Skills

Problem solving as a positive psychological characteristic defined by Heppner and Krouskopf (1987) as the ability to practice cognitive and affective behavioural processes toward the acquisition of internal and external wishes/desires. Bingham (1998) defines it as a process involving a set of actions to eliminate difficulties and reach a certain aim. Alternatively, Arslan (2001) defines the problem-solving process as one through which people locate the source of a problem and develop different solutions to find harmony within their environment. While many definitions of problem-solving have been put forth, Maher & Bennett (1984) note that the majority of these definitions are similar in their focus on systematic procedures that are carried out due to an undesired situation.

According to Stevens (1998), problem-solving involves the following stages: identifying a problem, collecting required data, getting to the root of the problem, determining a potential solution, choosing the best/most suitable solution, and solving the problem. At a certain stage of the problem-solving process, individuals have to use their cognitive and behavioral capacities to solve problems they encounter in their daily lives (Reis & Heppner, 1993). For individuals to present their capacity in every aspect requires them to be cognitively flexible and to use effective problem-solving skills. This shows that there can be a positive relation between cognitive flexibility and problem-solving skills.

Analyzing the relevant literature, only one scale, developed by Bilgin (2009b), has been made in our country. This measuring tool is limited by the following aspects: it consists only of phrases such as "I can, I can't" and "I am successful, I am unsuccessful", it does not include item roots, and it includes words such as "what" and "on which subjects". This study aims to adapt this measuring tool, which has been used in many studies (Chung, Su & Su, 2012; Esterhuysen et al., 2013; Hamtiaux & Houssemand, 2012; Martin & Anderson, 2009; Martin & Rubin, 1995; Martin, Anderson & Thweatt, 1998), in order to provide an alternative measuring tool for researchers interested in cognitive

flexibility. It is seen as important. In this study, the the cognitive flexibility scale, developed by Martin & Rubin (1995), and used in many studies (Kim & Omizo, 2005; Martin & Myers, 2006; Maltby, Day, McCutcheon, Martin & Cayanus, 2004, Roothman, Kirsten & Wissing, 2003) was adapted in this study for the Turkish context.

Method

Study Group

In this study, factor analysis and reliability studies were carried out with 370 students in different high schools throughout the Muğla Province Center (160 female, 210 male, $\bar{X}_{age}=16.15$, $ss=1.33$), whose ages ranged from 14 to 19 years of age. These students were 222 (60%) Anatolian high schools and 148 (40%) vocational high school students. Furthermore, data was collected from 59 students for the test-retest study of the measuring tool, from 24 students for language validity, and from 392 adolescents for the criterion dependant validity of the cognitive flexibility scale (218 female, 174 male, $\bar{X}_{age}=16.11$, $ss=1.14$). This working group, the 216's (55%) from Anatolian high schools and 176 (45%) were selected from the vocational school. The working groups, creating a easily sampling (convenience sampling) method was used (Erkuş, 2013).

Data Collecting Tools

Cognitive flexibility scale (CFS): The cognitive flexibility scale, developed by Martin & Rubin (1995), consists of 12 items and one dimension. The CFS is a 6-point Likert-type measuring tool in which 1 stands for "strongly disagree" and 6 stands for "strongly agree". In this study, the internal consistency coefficient was .80, and the test-retest reliability coefficient (α) was .83. In a reliability study by Martin & Anderson (1998), the internal consistency of the CFS was calculated to be .72, .73, and .81 respectively. The fact that CFS scores shows a significant positive relation between communication skills and in the communication skills self efficacy behaviors points, increases in cognitive flexibility, and positive friendships speaks to its criterion-dependant reliability (Martin & Rubin, 1995). Scores can be obtained from the measuring tool in which 2nd, 3rd, 6th, and 10th items are reverse graded, the scores changes ranged between 10 and 60. The height of a given score means that the cognitive flexibility level is also high. In another study, Maltby et al. (2004) calculated the internal consistency coefficient of the CFS as .92.

Problem Solving Inventory (PSI): The PSI, which was developed by Heppner & Peterson (1982), is a Likert-type scale that is graded from 1 to 6 and consists of 35 items. A Turkish adaptation of the PSI was made by Şahin, Şahin, & Heppner (1993). The PSI, which consists of three sub-scales (trust in problem-solving, self-control, and approach-avoidance), has three points to be calculated for each participant. The internal consistency coefficient of the PSI was found to be .88 in a reliability study, and its correlation coefficient was found to be .81 in a split-half reliability study. In a criterion dependant validity study of the scale, the correlation between the total points of the Beck Depression Inventory was calculated to be -.33, whereas it was calculated to be -.45 between the points of the State-Trait Anxiety Inventory. The internal consistency coefficient of the measuring tool was calculated to be .90 from the data collected within this study.

Process

For the adaptation of the cognitive flexibility scale, Matthew M. Martin (who developed the scale) was contacted via e-mail, and permission to adapt the scale into Turkish was received. From here, the adaptation of the cognitive flexibility scale into Turkish was carried out in stages. First, the measuring tool was translated into Turkish by the researcher. Along with this translation, the original English measuring tool was given to seven academics in English Language Education Departments who were asked to comment on the translation items and original items. It was then submitted to experts in the field of translation studies 5 psychological counselors. Based on these comments, a trial form in Turkish was created. Three academics from Turkish Education Departments then examined the trial form of the scale in terms of its grammar and understandability, and the final form given to

the scale. In order to test the understandability of the trial form, the measuring tool was applied to a group similar to the study group, and new adjustments were made based on the adolescents reactions.

After this process, the validity and reliability studies of the cognitive flexibility scale were carried out. For these purposes, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), criterion dependant reliability, total item test correlations, and item factor loads were calculated in order to test the structure validity of the cognitive flexibility scale. As for the reliability studies, a *t* test was used to test whether CFS reveals the difference between the internal consistency coefficient (Cronbach alpha α), the test-retest correlation coefficient (three weeks apart), the correlation coefficient between the equal halves of the Spearman-Brown test, and the difference between the top 27% and sub 27% of each item in a group.

Lastly, sampling adequacy and Barlett Sphericity tests were applied in order to apply factor analysis to the data. According to Büyüköztürk (2004), for data to be adequate for factor analysis, its Kaiser Meyer Olkin KMO value must be higher than .60, and the Barlett test must present a significant result. SPSS 20.0 and AMOS 18 package programs were used in the analysis of the data.

Findings

In this section of the research, the validity and reliability findings of the CFS are given. Firstly tested whether it is appropriate for multivariate statistics data set. Accordingly, the KMO sampling adequacy coefficient was .819 (>.60). The Barlett Sphericity test (i.e., an indicator of multi-variable normal distribution) was $\chi^2=840.823$ ($p<.001$) in total overall of the group. These findings revealed that data obtained from the research group was adequate for factor analysis.

Validity Studies

As a result of the EFA, which tested the structure validity of the CFS, the second item in the measuring tool was removed, as it could not present the factor load and total item correlation value or differences in the top-sub group in a significant way. The internal consistency coefficient of the measuring tool was .71 when the second item existed, though was .74 in total after the item was removed. A structure validity study was undertaken with the remaining 11 items. The findings regarding the validity and reliability of the CFS are given in Table 1.

As seen in Table 1, the factor loads items of the CFS change between .20 and .74. It can be seen that CFS has an eigen value of 5.3 in total group, as well as a structure that consists of a single factor, which explains the variance in cognitive flexibility rates between 43% and 53%. In addition, the correlation coefficient between the items of the CFS changed between .20 and .43 ($p<.01$). This finding indicates that similar behavior examples of substances and the test have high internal consistency (Büyüköztürk, 2007).

In the criterion referenced validity study of the CFS, significant correlations were found between the CFS and the PSI sub-scale scores. A positive relation between trust in problem-solving ($r=.15$, $p<.01$) and self-control ($r=.23$, $p<.01$), both of which are sub-scales of the CFS and the PSI, was obtained, and a negative relation was obtained between the CFS and the approach-avoidance sub scale ($r=-.12$, $p<.01$). Therefore, it can be said that there is a significant relation between the cognitive flexibility and problem-solving skills of adolescents.

Lastly, the Turkish form and the original English form of the measuring tool were applied to senior students in English Language Teaching Departments and correlations obtained as $\rho=.88$ ($p<.001$).

Confirmatory Factor Analysis (CFA)

For the structure validity of the CFS, CFA was applied to confirm the single-structure structure that was present in the original form of the scale. The consistency indexes of the model were examined in the CFA, through which the chi-square value was found to be significant ($\chi^2= 83.8$, $N= 392$, $sd= 43$, $p= 0.00$; $\chi^2/sd=1,93$). The consistency index values were $RMSEA=.059$, $NFI=.85$, $CFI=.92$, $IFI=.92$, $GFI=.95$, and $AGFI=.92$. In addition, as seen in Table 1, the regression values of the scale items change between .17 and .63 ($p<.01$). According to Byrne (2001), the goodness of fitness values are obtained according to acceptable levels.

Table 1. The Factor Loads, Item Total Test Correlations, t-Test, and CFA Results of the CFS Items

Items	Total Group		Lower - upper Group Diff.	CFA λ
	EFA	ITTC	t	
Item 1	.57	.34	-4.363*	.43*
Item 2	-.09	.05	-.767	.08
Item 3	.22	.30	-2.942*	.17*
Item 4	.65	.45	-7.810*	.62*
Item 5	.63	.41	-5.456*	.62*
Item 6	.27	.35	-2.328*	.24*
Item 7	.69	.46	-6.524*	.63*
Item 8	.63	.38	-6.221*	.51*
Item 9	.50	.27	-6.338*	.41*
Item 10	.27	.33	-3.310*	.17*
Item 11	.67	.44	-8.544*	.60*
Item 12	.64	.47	-26.806*	.57*
N	370			392
Explained variance (%)	.43			
Eigen values	5.3		* $p<.01$	
Cronbach α	.74			
r_{xx}	.77			

EFA= Exploratory Factor Analysis, ITTC= Item-total test correlation r_{xx} = Spearman-Brown Correlation Coefficient, CFA= Confirmatory Factor Analysis

Reliability Studies

As seen in Table 1, the internal consistency coefficient of the CFS for total group was obtained as .74. The test-retest correlation coefficient of the measuring tool was .98, and the split half reliability (r_{xx}) was .77 for total group. In addition, in the item analysis study, it was revealed that the t-test values for the independent groups, regarding the difference between 27% sub- and top-groups determined according to the average of each item, were at a significant level of $p<.01$ (Table 1). Obtaining a difference in analysis results indicate that the extent to distinguish between the behavior of the substances measured individuals (Büyüköztürk, 2007).

These findings, which speak to the validity and reliability of the CFS, show that the measuring scale has acceptable psychometric values.

Conclusion and Discussion

In the first phase of this research translation studies was conducted. In this context, the translation made by the researcher presented the views of experts in the field. Letter, English and Turkish forms of the measurement instrument is applied to adolescents and a high correlation was obtained between the two applications. These findings evaluated the translation was successful and obtained linguistic equivalents.

As a result of the factor analysis of the total group, the second item of the measuring tool was removed because it had low values in terms of total test correlations and correlations calculated between items. In examination of the items, it was discovered that the question root of the item may have been misunderstood. Therefore, it was thought that, to provide better results, the question root to the analysis on the data that would be obtained by giving the question root bold, underlined and italic in other studies to be carried out. According to Erkuş (2007), the fact that the responses to the item 2 ("I agree - I disagree") cannot be distinguished and that the item has a negative root and may not be noticed can cause certain problems.

In order to determine how much the model obtained from EFA and present data cohere, CFA was performed. Whether the CFA and the model which was theoretically propounded accorded with the data or not was tested. In other words, whether the covariance structures of the observed variables and the model were in accordance was tested. According to the CFA, the Turkish sampling of the cognitive flexibility scale developed by Martin & Rubin (1995) may be considered to have structural validity (save for the second item).

In the finding made on validity, significant relations were obtained between cognitive flexibility and problem-solving. Cognitive flexibility showed a positive relation with positive problem-solving skills and negative relations with negative problem-solving skills. The fact that the measuring tool adapted and the other measuring tool that is accepted as the criterion had a significant correlation meant that the measuring tool had criterion validity (Güler, 2012). In other words, it can be said that CKF scale has concurrent validity.

In the study of the reliability of the measuring tool, the internal consistency coefficients of the total group obtained was .74. The test-retest correlation coefficient was .98. The findings showed a lot of parallels with the research findings (Martin & Rubin, 1985; Martin & Anderson, 1998; Maltby et al, 2004). These findings are close to those obtained using the original form of the measuring tool. According to Tezbaşaran (1996), a measuring tool can be said to be reliable with a predicted reliability level of .70. Therefore, the CFS can be said to be a reliable measuring tool.

For the total sampling, arrangement, and validation groups, the Spearman-Brown correlation coefficients of the measuring tool were calculated. In this study, the correlation coefficients obtained with the method of equivalent halves was .77 for total group. These findings also contribute to the reliability of the scale.

The CFS item total test correlations were within acceptable limits (save for the second item), and there was a significant difference between the items after the analysis made between the score averages of the 27% top- and sub-groups. This finding shows that the items of the measuring tool have a distinguishing quality between groups (Büyüköztürk, 2007).

As a result, the findings obtained from the validity and reliability studies show that the Turkish form of the CFS has acceptable psychometric values for samples of adolescents who continue high school. To researchers who are interested in cognitive flexibility issues provided easy application and scoring a measurement tool. Measuring tool can be use education, psychology, and counseling psychology.

The fact that the study was carried out in Muğla Province Center can be understood as a limitation. Therefore, it is suggested that studies to be carried out in the future should be done with broader samples and different age groups using a 12-item measuring tool form arranged according to Erkuş (2007). In attachment 1, the 12-item form of the measuring tool is given. In addition, studies in which cognitive flexibility can be a medium or a causative variable should be carried out. Lastly, the relation between cognitive flexibility and depression, anger, aggression, emphatic tendencies, psychological indications, and personality traits should be examined.

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