Testing the Reliability of CSA Test on a Sample of Turkish Population

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Abstract
We tested the reliability of a parallel version of Cognitive Styles Analysis Test on a sample of Turkish population. The reliability measurements were performed through test-re-test and split-half analysis. The split-half reliability coefficients were found to be high for both the analytic/wholist style dimension and the verbal/imagery style dimension. For the test-retest reliability analyses that were done on two sessions taken with a mean interval of two weeks, the median values of user reaction times were compared for the two sessions and found not to be significantly different.

Keywords: Cognitive style, analytic/wholist style, verbal/imagery style, Cognitive Styles Analysis Test.

Introduction

A person's cognitive system determines individual cognitive styles; these styles are integrally related to a person's preferred way of processing information. We all use individually-determined brain-based mechanisms and structures in our data processing. As a result, our cognitive system creates our unique way of perceiving, organizing and analyzing information, which are fixed to a certain extent (Peterson, Rayner & Armstrong, 2009).

Determining the preferred cognitive styles of people has been a subject of interest in recent studies (e.g. Riding, 1991; Glass and Riding, 1999; Peterson et al, 2003ab, 2007). One of the tests developed for that purpose is the one designed and utilized by Riding (1991). This test relied on the ratios of median reaction times to categorize the subjects according to their preferred cognitive styles but did not provide more detail on subjects' performances. Peterson et al (2003a, 2003b) filled in this gap with an extended version of the test and showed that this extended version was more reliable (2007).

For the assessment of field dependence-independence, Embedded Figures Test has been used (e.g. Witkin, 1977). Trials of this test features a simple geometrical shape embedded in a more complex model and the test is assessed in pencil-paper format. The test score is based on the number of correct responses in a given time. Its limitation is that it can positively assess only field independence. Moreover, if atypical amounts of time have been spent on certain items, either due to distractions or because of finding them unusually difficult, that time is added to the total time and the final score may be affected. In order to overcome these problems, Riding (1991) developed the wholistic/analytic style of Cognitive Style Analysis (CSA). The CSA was developed as a computer-presentation format. CSA was intended to measure cognitive styles in two dimensions: wholistic/analytic style and verbal/imagery style (Riding and Rayner, 1999, p.44). According to Riding and Cheema (1991), the wholist/analytic dimension relates to the way about how can individual organize the information in parts or as a whole and the

verbal/imagery dimension is associated with the way about how an individual represents his/her knowledge in mental pictures or in words.
When the literature on cognitive styles are examined, it is noted that cognitive styles are considered to be personal attributes, which affect human behavior in multiple contexts. Thus, a need has arisen to analyze cognitive styles as other personal attributes. However, the kind of tests which determines cognitive styles are not found in Turkey. We believe that adapting a test of this kind to a sample of Turkish population and analyzing its reliability will contribute to the literature on this subject.

Participants
The participants were 151 university students, 90 women and 61 men from Psychology and CTIS departments, whose ages ranged from 19 to 27 (mean= 21.24, std= 1.30).

1. Method
This study has aimed at measuring the reliability of the Cognitive Styles and Analysis Test, originally designed by Riding (1991) on a sample of Turkish university students. In order to have greater access to subjects' performance data, we utilized the computerized version of a parallel form (Peterson et al, 2007), which included 40 items of analytic cognitive style, 40 items of wholist cognitive style, 116 items of imagery cognitive style and 116 items of verbal cognitive style. We translated the verbal items to Turkish and presented the tests though desktop or laptop computers.

1.1 Presentation of Stimuli
1.1.1 Analytic/Wholist Dimension
The participants were presented with a simple shape and a combination of simple shapes in each item of the analytical part of the cognitive style items. They were asked whether the simple shape on the left was part of the combination on the right. They answered "YES" or "NO" using the "1" and "2" keys of the numeric keypad of the computer keyboard. The reaction time was recorded along with the correctness of each answer.
In the wholistic part of the cognitive style items, the participants were asked whether the shape combinations shown on both sides were identical. Again, participants answered "Yes" or "No" using the "1" and "2" keys on the keypad, and the reaction time was recorded, as well as the correctness of each answer.
We determined the cognitive style preference of a participant by dividing his/her median reaction for the wholist part (W) to the median reaction time for the analytic part (A). X being the ratio W/A, a value in the $X < 1$ range indicated a preference for the wholist style, whereas a value in the $X > 1$ range indicated an analytic preference.

1.1.2 Verbal/Imagery Dimension
In the imagery (visual) portion of the experimental items, the participants were presented with pairs of words or images describing commonly known living beings or material objects and were asked whether the one on the left was bigger than the one on the right in the real life. The participants answered by pressing "1" (for "Yes"), "2" (for "No") or "3" (for "Approximately Same") keys on the numeric keypad. The reaction time was recorded along with the correctness of each answer.
In the verbal portion, participants judged whether the two beings or objects described by words or images were natural or man-made. The answers "Yes", "No" or "Mixed" (one natural and the other man-made) were given through keys "1", "2" and "3" on the numeric keypad. Again, the reaction times and the correctness of answers were recorded.
The ratio of the median reaction time for the verbal part (V) to the median reaction time for the imagery part (I) was the criterion used to determine a participant's preferred cognitive style. A value in the $V/I < 1$ range indicated a leaning towards the verbal style, whereas a value in the $V/I > 1$ range indicated a leaning towards the imagery style.

2. Analysis
2.1 Responses to Each Stimulus
Participants were separated into two groups as analytic and wholistic depending on test scores for WA dimension. In addition, participants were also separated into two groups as verbal and imagery for VI dimension. Total corrects were recorded for each participant on each test section and session. Error rates were found to be very low for all dimensions.

A one-way between subjects ANOVA was conducted to compare the effect of responses on Wholistic or Analytic test items on wholistic and analytic participants' correct rates for WA dimension. There was a significant effect of correct rates of WA dimension (F(2,139)= 3.23, p= .042). Post hoc comparisons using the Tukey HSD test indicated that the mean score for the Analytic test items were significantly different between wholistic (mean=36.89, std=2.02) and analytic (mean=38.10, std=1.49) participants. Analytic participants' performance was better than wholistic participants' performance on the Analytic test items.

A one-way between subjects ANOVA was conducted to compare the effect of responses on Verbal or Imagery test items on verbal and imagery participants' error rates for VI dimension. There was a significant effect of error rates of VI dimension (F(2,138)= 3.42, p= .036). Post hoc comparisons using the Tukey HSD test indicated that the mean score for the Imagery test items were significantly different between verbal (mean=3.85, std=3.48) and imagery (mean=2.29, std=2.22) participants. Imagery participants' performance was better than Verbal participants' performance on the Imagery test items.

2.2 Split Half Reliability Analysis

We have done a reliability analysis to determine the reliability coefficients of the tests evaluating the preference for the analytic or the wholist cognitive style. According to the results, we concluded that the split-half reliability coefficients were high for both the analytic and the wholist dimensions of the test. In the first test sessions, we calculated Cronbach α = 0.89 for the analytic cognitive style dimension and Cronbach α = 0.88 for the wholist cognitive style dimension. In the second sessions of two weeks later, Cronbach α values were 0.95 for the analytic dimension and 0.89 for the wholist dimension. The reliability coefficients were high for both the original analytic/wholist cognitive style dimensions developed by Riding (1991) and for the parallel test designed by Peterson et al (2003). When both sessions were considered, Cronbach α varied between 0.80 and 0.90 for the analytic dimension and between 0.75 and 0.90 for the wholist dimension. The reliability coefficients calculated before and after eliminating outliers are shown in Table 1.

Split half reliability coefficients were also high for the verbal and imagery cognitive styles dimensions. For the first sessions, Cronbach α values were 0.96 for the imagery dimension and 0.95 for the verbal dimension, and for the second sessions, α values were 0.94 and 0.95, respectively. For both the original test of Riding (1991) and the parallel test of Peterson et al, Cronbach values were found to be high. When both sessions were considered together, Cronbach α value ranges were 0.87 - 0.94 for imagery cognitive style dimension and 0.91 - 0.94 for the verbal cognitive style dimension. The reliability coefficients were high both for the imagery type items (0.91 - 0.93 for the imagery and .91 for the verbal) and word type items (0.93 - 0.94 for the imagery and 0.92 - 0.95 for the verbal). The reliability coefficients calculated by including or excluding outliers are summarized in Table 1.

Table 1. Split-Half Reliability for CSA Dimensions at Session 1 and Session 2.

	Cronbach α (Session 1)		Cronbach α (Session 2)	
	Week 1	Week 2	Week 1	Week 2
Verbal, CSA-A	.94	.90	.89	.94
Verbal, CSA-B	.90	.92	.95	.91
Verbal	.94	.95	.98	.95
Verbal Word	.91	.92	.94	.95
Verbal Picture	.92	.91	.95	.90
Imagery, CSA-A	.92	.90	.89	.94
Imagery, CSA-B	.92	.89	.90	.87
Imagery	.94	.96	.93	.94
Imagery Word	.91	.93	.86	.93
Imagery Picture	.93	.91	.92	.93
Wholistic, CSA-A	.74	.81	.55	.75
Wholistic, CSA-B	.85	.88	.90	.90
Wholistic	.83	.88	.83	.89
Analytic, CSA-A	.73	.80	.71	.85
Analytic, CSA-B	.84	.84	.88	.90
Analytic	.88	.89	.88	.95

2.3 Test-Re-Test Reliability Analysis

For the test-retest reliability analyses of the analytic/wholistic and verbal/imagery cognitive dimensions, the participants were asked to come to a second session 14 day after the first session. The ratio of the median reaction times for the two sessions was evaluated with the t-test analysis for the dependent groups. According to the results, the analytic/wholistic dimension was not different in the two sessions ($t(68) = -0.640$, $p = 0.525$). In other words, the ratios of mean reaction times were not different in the two sessions (mean = 1.11 and std = 0.18 for the first session and mean = 1.16 and std = 0.58 in the second session). A Pearson correlation coefficient was computed to assess the relationship between the two sessions of the analytic/wholistic dimension. There was high correlation between two sessions of the analytic/wholistic dimension, as shown in Table 2.

The verbal/imagery cognitive dimension was also found to be not different over the two sessions. According to the dependent-groups t-test, $t(69) = 0.053$ and $p = 0.958$. The ratio of the median reaction times was not different for those two sessions mean = 1.02 and std = 0.21 for the first session and mean = 1.02 and std = 0.73 in the second session. A Pearson correlation coefficient was computed to assess the relationship between the two sessions of the verbal/imagery dimension. There was high correlation between two sessions of the verbal/imagery dimension (see Table 2).

Table 2. Pearson Correlation Coefficient for Session 1 (S1) and Session 2 (S2) and for the CSA on Each Section and Session of the Tests.

Session 1 & Session 2	r (*p*)	V/I and W/A Dimensions	r (*p*)
Verbal, CSA-A, S1 & S2	.77 (.000)		
Verbal, CSA-B, S1 & S2	.80 (.000)		
Verbal, S1 & S2	.81 (.000)	VI, S1 & S2	.08 (.515)
Imagery, CSA-A, S1 & S2	.79 (.000)		
Imagery, CSA-B, S1 & S2	.79 (.000)		
Imagery, S1 & S2	.81 (.000)		
Wholistic, CSA-A, S1 & S2	.56 (.000)		
Wholistic, CSA-B, S1 & S2	.61 (.000)		
Wholistic, S1 & S2	.55 (.000)	WA, S1 & S2	.21 (.080)
Analytic, CSA-A, S1 & S2	.73 (.000)		
Analytic, CSA-B, S1 & S2	.65 (.000)		
Analytic, S1 & S2	.75 (.000)		

3. Discussion and Conclusion

The aim of the study was to test the reliability of an extended version of Cognitive Styles Analysis Test that was conducted on a sample of Turkish population. We found same results with study of Riding (1991) and study of Peterson, Deary and Austin (2003a). In this study we observed that the reliability coefficients were very high for both WA and VI dimensions. Reliability coefficients of Verbal/Imagery dimensions of CSA were observed to be very low in other studies.

According to the results of the analysis shown in Table 3, the frequency of those who have a tendency for each dimension was similar to the other studies (Pearson et al., 2003ab).

Table 3. Style Label Frequency at Session 1 and Session 2.

Dimensions	S1 Frequency	S2 Frequency
Verbal-Imagery Dimension		
Verbal	41	33
Bimodal	70	41
Imagery	28	7
Analytic/Wholistic Dimension		
Wholistic	19	11
Intermediate	71	40
Analytic	50	29

Riding supports this claim in these studies in terms of the construct validity of CSA. Although he reports substantial research to demonstrate the validity of the CSA test, the results seem to be mostly qualitative in need of further proof concerning validity scores for CSA (Riding, 1997).
Some studies argue that some participants' tendency to respond more slowly to early test items lead to distorted results that make them appear more analytic in CSA (Davies and Graff, 2006). Since test items are always given in the same order, this tendency may be problematic when dimensions are separated. However, if precautions are taken to correct for the effects of sequence, better scores of reliability and validity might be obtained under more controlled experimental designs.

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