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Gender Differences in Trail Making Test Performance in a Nonclinical Sample of Adults

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Abstract Trail making test (TMT) is one of the neuropsychological task to evaluate mental flexibility, visual search, motor speed and executive functions in neurological patients. Attention and speed are two mental functions necessary to complete the task in a short time with the least of errors. It is suggested that age and education have respectively positive and negative relationships with the time of performance of the task by neuropsychological patients. In this study it is hypothesized that (a) there is a positive relationship between education and motor speed in normal adults (b) there is a negative relationship can be seen between age and motor speed in normal adults and (c) normal men and women have not different motor speed in part A and part B of TMT. In order to do this study, 285 normal adults (men=112) were selected and their motor speed and errors were measured in part A and B. The results showed that (a) there was a negative, but not statistically significant, relationship between education and motor speed in groups, (b) there was a negative relationship between age and motor speed in part B only in male group, and (c) there was no differences between men and women in errors of part A and B, and there was no differences between them in motor speed in part A, but there was a significant difference in time of performance of part B. The results are discussed based on evidences of harder tasks in part B of TMT and gender differences in mental functions.

Keywords: *trail making test, gender differences, normal adults*

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1. Introduction

One of the parts of Army Individual Test Battery (1944) is Trail Making Test (TMT) that provides information on executive functions and visual attention. According to [1] TMT is sensitive to brain damages and organic injuries. Prefrontal dysfunction in brain damage effects on flexibly shift responses and can be assessed using part B of TMT [2]. Some researchers have indicated that part B is more difficult than part A. Completing part B needs 56 cm longer lines and has more visually interfering stimuli [3]. It is mentioned that performance in TMT is affected by education, intelligence and age [4]. Aging, chronic alcoholism, depression and cerebral damages are found as effective factors related to TMT performance [5].

The relationship between gender and motor speed in performance of TMT is not clear. In a study with 287 adult Italian normal subjects of women, it is observed longer time scores in only part A in females [6]. Other researchers have reported no differences between men and women in TMT time scores [5,7]. Essentially differences of men and women in cognitive tasks have not been suggested in studies but it is notable that in [8]it is reported that biological bases of cognitive functions and differences thinking related to the sex hormone especially testosterone in men and women.

Testosterone plays a crucial role during brain development but the evidences on its role in cognition throughout life is more complicated. Prefrontal cortex [9], hippocampus [10,11] and amygdale [12] are brain regions including androgen receptors while process of learning and memory are regulated by them. According to [8] in men there is a relationship between poor memory and testosterone deprivation, as well as replacement can improve memory and spatial cognition. In young women some functions like mental rotation and object location memory enhance within hours of injection of testosterone.

2. Materials and Methods

2.1. Material

The instrument that was used in this study for collecting the data was Trail Making Test (TMT). Two parts of TMT are TMT-A that the participant is asked to connect 25 circles including 1 to 25 numbers on a sheet of paper. In part B the person is expected to connect numbers and letters in a regular arrangement (e.g. 1→A→2→B→3→C, etc.). The speed of performance and errors in draw the lines are indices of attention, motor speed, shifting ability, visual search, mental flexibility and impairments of processes [1,7,13].

2.2. Method

Two hundred and eighty five nonclinical Iranian adults from 18 to 60 years old (M=31.68, SD=7.13) were randomly selected from awarded at least diploma in high school. Mean age of men was 32.24 (±7.61) and mean age of women was 30.88 (±6.68). A mean of 16.1 (±1.66) years was calculated in sample's education (16.6±1.9 for men and 16.16±1.48 for women).

All participants were asked about previous illness especially mental disorders and physical or neurological diseases and if there were not clinical symptoms or abnormality in behaviors. All participants were asked to do samples parts of test to know how to perform in the part A and B of the task.

3. Results

Pie chart of genderand Table 1 summarize central tendency and dispersion indices of this study.

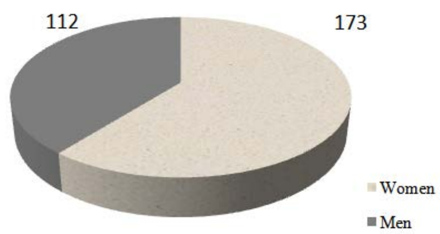

Figure 1. Gender distribution in the sample

Mean age of men and women were respectively 32.24 (±7.61) and 30.88 (±6.68). Mean numbers of errors in part A in two groups were less than one and in part B it was less than two errors.

Table 1. Mean and standard deviation of variables of two groups

	Men	Women
Education (years)	15.94 (±1.95)	16.90 (±9.42)
Age	32.24 (±7.61)	30.88 (±6.68)
Time Scores of Part A	36.35 (±19.52)	40.80 (±32.83)
Time Scores of Part B	77.25 (±35.05)	87.79 (±53.30)
Errors in Part A	.61 (±1.98)	.37 (±1.48)
Errors in Part B	1.57 (±2.00)	1.68 (±1.93)

According to Table 2 and Table 3 the first hypothesis of the study is rejected. However there are negative associations between education and errors in part A and B in two groups but there are not statistically significant relationships between variables.

Table 2. Correlations of Age and Education with Time and Errors of Part A and B in Men (N=112)

	age	Education (years)
Time Scores of Part A	.141	-.155
Time Scores of Part B	.226*	-.085
Errors in Part A	.046	-.025
Errors in Part B	.248**	-.053

**. P<0.01

*. P<0.05

Table 3. Correlations of Age and Education with Time and Errors of Part A and B in Women (N=173)

	age	Education (years)
Time Scores of Part A	.034	.004
Time Scores of Part B	.058	.094
Errors in Part A	.085	-.032
Errors in Part B	.025	-.010

The second hypothesis of the study could be accepted in male group, not female one. A negative relationship between age and motor speed was identified only in men in part B. Time scores of part B (r=.226, p<0.05) and the number of errors in part B (r=.248, p<0.05) increased when the male subjects became elderly. These findings were not seen in women.

In the third hypothesis, the similarity of motor speed and number of errors between men and women was approved, although there was a significant difference in time of performance in part B (F=4.36, P<0.03).

Table 4. ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Time Scores of Part A	Between Groups	2941.00	1	2941.00	3.593	.059
	Within Groups	231629.29	283	818.47		
	Total	234570.30	284			
Time Scores of Part B	Between Groups	9815.51	1	9815.51	4.362	.038
	Within Groups	636808.69	283	2250.20		
	Total	646624.21	284			
Errors in Part A	Between Groups	4.96	1	4.96	1.626	.203
	Within Groups	864.24	283	3.05		
	Total	869.20	284			
Errors in Part B	Between Groups	.062	1	.062	.016	.900
	Within Groups	1105.04	283	3.90		
	Total	1105.10	284			

4. Discussion

Based on findings of this study, men in part B performed the task more quickly than women while the number of their errors was basically similar. Attention, motor speed, shifting ability, visual search, mental flexibility and impairments of processes in part A of TMT is similar between men and women but It seems that there is a better attention shift function, more flexible mental processing and higher motor speed in men in part B. Some previous studies are related to mental functions and their association with hormones. In [14] a positive relationship between bioavailable testosterone levels and memory of older men was found. These findings were mentioned in a sample of men [15] and in a sample of women [16]. These researchers indicated a positive relationship between endogenous testosterone and mental functions. In [17] the relationship between testosterone, memory, and processing speed in men is approved. In women this relationship was suggested in [18]. The researchers suggested that this relationship is particularly true in aging.

Regardless of age, men performance in part B was better and faster than women. It can be said that the findings regarding the role of testosterone in attention and memory function is justified.

It is suggested that in the future studies, age and educational requirements are taken in to account, and the comparison would be possible between different groups of ages. Future studies can also include level of testosterone measurement to explain more conclusive findings. Another finding of this study was that there was a meaningful and positive relationship between the age of men and the number of their errors in part B. This finding can also indicate that TMT was sensitive to the age, and according to [5] finding, the rate of test performance declines with aging and subsequently, the time of test execution increases. The considerable point was that this finding was only observed in men.

5. Conclusions

It can be concluded that probably women have such cognitive deficits in old age, but the mean age of women in this study was 30 years and serious cognitive impairment was not measurable by TMT in this study. Here also recommended that other researches can be done by normal subjects with higher mean age in order to get the accuracy of TMT in determining cognitive deficits in different age groups.

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Statement of Competing Interests

The author has no competing interests.

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