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Attention Similarity among Men and Women

KEYWORDS: Similarity, Attention, Men, Women

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ABSTRACT *Introduction: The attention is assessed by cognitive tests and assessment of this cognitive domain is different between man and woman in every test. Methods: It is a cross-sectional study in 3 months from April to June, 2012 on 45 female and 45 male who are Iranian and 15 to 65 years old. All participants did computer tests of STROOP, CPT after training and consent. Results: No significant difference was observed between two groups in sustain and selective attention domains (P<0.05). Conclusion: Men and women showed a similar sustain and selective attention in mentioned tests.*

Introduction

There are great differences between the two brain hemisphere in men and women and this leads to differences in their neuro-cognitive function. Brain weight of men is more than women and they have larger physical stature, larger muscle mass and larger body size (10). Their right hemisphere and corpus callosum are thicker than women's, so they use only one portion of their brains when communicating. Conversely, women's left hemisphere and corpus callosum are thicker than men's. Therefore the flow of communication between the two hemispheres of their brain is more freely and more synapses are created between two hemispheres (34). They are able to use the two hemispheres of the brain during communication. It enables women to do some works during a call. And neural pathways of sustained selective attention and shifting are involved for each activity. Whole brain activity occurs in the women's brain during speech and this ability of women is partly due to a larger corpus callosum which makes easier transferring between the two hemispheres (7, 23). Result of interaction between cortical structures (frontal, temporal, parietal), sub-cortical (limbic, basal ganglia) and functional systems, includes routes of basal ganglia, thalamus and the frontal lobes. The mentioned areas are involving neural pathways of attention (35). The inferior-parietal lobule (IPL) is an area in parietal cortex which is markedly larger in men than women. Especially the left part of IPL in men is larger than the right and it is reversed in women. IPL allows brain processes to get help from selective sensory input, perception and attention. Since cognitive functions in men and women take place in different areas of brain which are linked together, these performances are measured by a veriety of domains; such as: attention, executive function, memory, language, visuspatial functioning. (8, 30).Attention is defined as the cognitive process of selectively concentration on one aspect of the environment, while other aspects are ignored. Attention is also attributed to the allocation of resources processing (2). Attention is divided into five sub-categories: 1- focused attention (the ability of distinct responding to vision, hearing or touching stimuli), 2- alternating attention (the ability of mental flexibility allowing the person to change the attention focus and moving between tasks that have different cognitive needs), 3- divided attention (high level attention including simultaneously responding ability to multiple tasks), 4- sustained attention or vigilance (ability to maintain stable behavioral response during continuous and repetitive activity), 5- selective attention (the ability to maintain a behavioral or cognitive collection in the presence of a competitive or misleading stimulus), (13, 28, 30). Selective attention is defined as processing capabilities of information and related data while rejecting false or irrelevant data (26). One can utilize a variety of ways for assessing neuro-cognitive function in the attention domain of men and women. Some examples include computerized neuro-cognitive test (CNT). These tests are helpful in new fields and developing cognitive measurement and when speed, efficiency and low costs are considered, they are important and measure different degrees of neuro-cognitive impairments and theoretically, can increase productivity, efficiency and knowledge but like other technologies are faced with restrictions (15). CNT in comparison with conventional psychological tests enjoy matters such as coordination, rating, the possibility of establishing appropriate alternative forms, precise control of stimulus, and the possibility of tracking the various components of response, cost savings and ability to develop great and precise databases. These tests can be helpful in assessing the cognitive domains separately fo every sex.One of these tests is Stroop test which is used for assessing selective attention (41).

The test was created in 1935 by Stroop for measuring selective attention and cognitive flexibility (35). Consistent and disparate errors, and response times and interaction scores of participants are measured in this test. CPT test is a neuropsychological test which measures sustained attention and impulsivity. CPT test is from paradigms measuring sustained attention, the response inhibition or disinhibition and executive control. Sustained attention is the ability of maintaining a consistent focus on continuous activity or on certain stimuli and is associated with impulsivity (6, 9, 25, 41).Since 1956, CPT has been used in studies related to attention and impulsivity done by different changes in task components. Sustained attention requires accomplishing any kind of cognitive programming knowledge and any systematic activity of the mind (25). Although test varieties include the size and type of used stimulus, the main nature of tests is similar (15). Gender differences in cognitive tests have been reported by some researchers. One of the most important factors in these tests, based on previous studies is sex variable (18, 28) but not all of them: (20, 21, 37, 38). Hence, the aim of this study was to compare neuro-cognitive function in male and female regarding brain differences due to selective and sustain attention.

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Materials and methods

This study was a cross-sectional study on 90 healthy volunteers (45 males and 45 females) aged 15 to 65 years with a mean age of 46±3 years done during 3 months from the date of from April to June, 2012 in the Department of Neuroscience, Neurosurgery Research Center at the Shohada Hospital dependent on Shahid Beheshti University of Medical Sciences. Sampling was done randomly. Participants were invited to participate in this study through the call by notices. Participants were required to complete consent form before involving in the project. All participants were initially examined by a physician and eventually they were excluded in the presence of disease. Healthy individuals complete tests after confirmation tests. All participants were trained after accepting doing the computer tests of Stroop, CPT. Inclusive criteria were: individuals who are completely healthy and free of previous or current history of mental and neurological disorders, head injury, without a learning disability, living in Tehran, Persian speaker, and age range between 15 to 65 years. This study was approved in Ethics Committee of Shahid Beheshti University of Medical Sciences in Tehran and approved and implemented in the Functional Neurosurgery Research Center. There are different versions of the tests. One of the differences between them is the choice of target and non-target stimuli. Attention tests are often used as a part of a battery of tests for identifying individual performance or the capacity to sort, management and information control (17). The ratings, from one test to the next is different, the standard performance is measured by the four main points: The number of times the subject fails to answer correctly (omission errors), the number of times subject answers incorrectly (commission errors), reaction time, and its changes (an indication of attention change). Omission errors are regarded as a scale for sustained attention (a high level of this error indicates that or subject does not pat attention to stimuli or distractibility, sluggish response) and commission errors are considered as indicators of impulsivity. It measures reaction time related to the attention changes during the task. The last two indicators are used for assessing cognitive processes rate and extent of trial-to-trial consistent (41).

In many studies, the differences are seen with the corresponding changes in the test running.

Tests are widely used in clinical practices and also often in researches completed on validity or value laboratory scale (22). In the new model of mental processes, researches took into account a more active role in psychophysiological processes. Memory and attention. In this study the following CPT and Stoop versions were used:

CPT Test: In all forms of continuous performance test, subject should pay attention to a collection of relatively simple stimuli, visual or auditory (only visual stimuli is presented in this test) for a while. And in the appearance of the target stimulus, he. she gives his. her answer by pushing one key. This test should be run in a quite favorable time and place and the testing conditions should be preserved in terms of psychometric matters. The subject should use of his maximum capability and this is the aim and at the same time of having good speed he should have good performance too. Totally 150 stimuli are presented in this test which 20% of it is target stimulus (stimulus which the subject should answer to it and is presented in the forms of star, moon, circle at the monitor screen). Any stimulus duration for representing is 200 ms and the interval between stimuli is 1 second. After entering the personal information in its part, the test runs. Before running the main test, experimental test (as an example) would be presented and then the original one. At the beginning of experimental and main part, the necessary explanations are presented on screen and tester should explain it to participant. When the subject is ready, the test starts. Duration of the trial including the stage is totally 200 seconds. According to the test types and required analysis, the designed computerized test of continuous performance in this study will assess commission, omission, reaction time and interaction of participants' answers of sustained attention on the basis of comparison of response rate (5, 30, 41).

Stroop Test: this test has been designed and used for assessing selective attention and cognitive flexibility and several cognitive assessments (3, 12, 35, 36). The used Stroop test in this study is according to the used variables in Stroop test (35) which has been designed by computer (41). The mentioned test has two trends: the first stage is color naming in which tester wants subject to show one of the letters on the keyboard which has colored labor of the same color. There is a colored circle in one of the four colors of red, blue, yellow and green which is shown alternatively on screen. The aim of first stage is training of test to the subject and it has no effect on the result. The second stage is performance in which 48 congruent colored words and 48 incongruent colored ones are presented. (Congruent words are referred to words that word color is the same as word meaning. For example the word blue is the same as blue color. Incongruent word is referred to word that word color is different from word meaning. For example the blue word is shown by red color). Totally 96 congruent and incongruent colored words are displayed on screen randomly and sequentially. And subject by emphasizing on color without considering its meaning should press the related color on the basis of label on keyboard letters. Presentation time of every stimulus is 2 second and interval between two is 800ms. Researchers believe that the category of color-word in the second stage of testing, measures mental flexibility, interference and response inhibition (39). Interference rate is acquired by subtracting the score of correct numbers of incongruent from correct numbers of congruent ones. In this stage red, yellow, green and blue circle is shown to subject sequentially and he should identify the correct color on keyboard buttons by pushing categorized buttons with colored labels of red, yellow, green with maximum speed. It should be explained to subject that the apparent color of words may be different from their meanings and the focus is on color. Measurable variables include congruent and incongruent errors, congruent reaction time, incongruent reaction time and interference score (3, 12, 36, 41).

The hypothesis of this study was assessing selective and sustained attention between men and women through CPT and Stroop tasks according to the study aim. Statistical analysis was done through software $SPSS_{18}$.

Results

First the variables which may affect performance and the way of testing including age and educations were determined which are shown in table 1.

Table 1- Frequency of age and education variables in men and women

Variables		Groups	
		Healthy	
		Number	Percentage
Gender	Woman	45	50%
	Man	45	50%
Education	Illiterate	0	0%
	Lower than diploma	18	20%
	Diploma	24	26.66%
	BA	27	30%
	MA and PhD	21	23.44%
Age groups	15-24	15	16.77%
	25-34	21	23.33%
	35-44	9	10%
	45-54	27	30%
	55-65	18	20%

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This table shows that the number of man and woman in participants are equal. The number of participants with various educations was different but they are same in age groups. The mean of age groups is equal too.

Table 2 - the means of CPT test variables in two groups of men and women

Variables group	M±SD Men	M±SD Women	M±SD Mean differences	t	P-value
Total of test errors for first 50 stimuli	1.01±1.47	50.85±1.16	0.167±0.205	0.814	0.417
Total of non-responding for first 50 stimuli	4.4±3.95	4.36±4.35	0.048±0.642	0.074	0.941
Total of correct answers for first 50 stimuli	46.5±3.49	47.42±2.63	-0.917±0.478	-1.919	0.057
Reaction time of first 50 stimuli for correct answer	400.15±123.11	416.87±142.3	-16.714±20.53	-0.814	0.417
Total of test errors for second 50 stimuli	0.56±0.91	0.35±0.611	0.214±0.12	1.792	0.075
Total of non-responding for second 50 stimuli	4.44±4.03	4.46±4.4	-0.024±0.149	-0.037	0.971
Total of correct answer for second 50 stimuli	45.63±3.15	46.23±2.8	-0.595±0.46	-1.294	0.197
Reaction time of second 50 stimuli for correct answer	429.15±151.83	407.25±119.32	21.91±21.07	1.024	0.3
Total of test errors for third 50 stimuli	0.82±1.46	0.62±1.05	0.202±0.197	1.028	0.3
Total of non-responding for third 50 stimuli	4.44±3.93	4.69±4.35	-0.25±0.64	-0.391	0.696
Total of correct answer for third 50 stimuli	44.43±3.67	44.89±3.56	-0.464±0.558	-0.832	0.407
Reaction time of third 50 stimuli for correct answer	432.25±177.44	432.82±149.11	-0.571±25.28	-0.023	0.982

In the previous table equality or non-equality of two groups of men and women's averages was analyzed by independent t test. Since P amount is more than significant level of test (0.05), assumption of equality of averages is accepted. Here the total test variables in man and woman did not show a main difference and it suggests the similarity of scores average of test variables.

Table 3- the means of Stroop test variables in two groups of men and women

Variables group	M±SD N=45	M±SD 45=N	M±SD Mean differences	t	P-value
Congruent testing time	58.74±14.96	60.31±16.01	-1.57±2.39	-0.657	0.512
Congruent testing error	2.05±3.12	1.64±2.02	0.583±0.405	1.44	0.152
Non-responding congruent	10.01±10.61	11.61±12.22	-1.59±1.76	-0.904	0.368
Congruent correct answer	38.13±12.83	37.3±14.3	0.833±2.09	0.398	0.691
Average of congruent response time	1213.5±188.99	1202.39±184.696	11.11±28.83	0.385	0.701
Incongruent testing time	60.63±16.7	62.79±17.123	-2.15±2.6	-0.826	0.41
Incongruent testing error	6.82±12.004	3.83±5.64	2.98±1.44	2.065	0.04
Non-responding incongruent	10.52±11.609	12.56±12.84	-2.04±1.88	-1.078	0.283
Incongruent correct answer	32.62±16.22	34.17±15.53	-1.54±2.45	-0.632	0.528
Average of response incongruent time	1149.57±359.36	1246.8±197.47	-97.22±44.74	-2.172	0.031
Interference score	5.8±12.166	3.45±6.287	2.34±1.49	1.57	0.118

We investigate the equality of averages in two groups of man and woman in Stroop test variables by independent t test. Since P amount is more than significant level of test (0.05), assumption of equality of averages is accepted. This hypothesis is rejected only in incongruent testing error and average of incongruent response time.

We examined the correlation rate between gender and variables in CPT and Stroop tests by Pearson correlation test and the following correlation matrix was acquired.

Table 4- Investigating the relationship and correlation values between genders by variables of Stroop test

Variables	Man Sample volume 45=	Woman Sample volume 45=
Congruent testing time	r=0.096 p-value=0.386	r=0.026 p-value=0.812
Congruent testing error	0.124- r= p-value=0.26	0.145- r= p-value=0.188
Non-responding congruent	r=0.112 p-value=0.312	r=0.000 p-value=1
Congruent Correct answer	0.078- r= p-value=0.478	r=0.089 p-value=0.419
Average of congruent response time	0.042- r= p-value=0.706	0.019-r= p-value=0.865
Incongruent testing time	r=0.139 p-value=0.208	r=0.022 p-value=0.842
Incongruent testing error	0.277- r= p-value=0.038	0.039- r= p-value=0.728
Non-responding incongruent	r=0.126 p-value=0.255	0.025 r= p-value=0.818
Incongruent correct answer	r=0.055 p-value=0.621	r=0.122 p-value=0.268
Average of incongruent response time	r=0.256 p-value=0.019	0.017-r= p-value=0.88
Interference score	r=0.171 p-value=0.119	0.038- r= p-value=0.734

Note the descriptions of previous page table that correlation number is always between 1 and -1. Whatever this amount is closer to 1 or -1, this category is a sign of correlation and

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strong relationship close to a linear one. Negative mark shows a reversed relation and positive mark suggests a direct relation. Whatever this amount is close to zero, it indicates no relationship. It is clear that there is no correlation between women and men with under investigation variables and they are almost similar.

Table 5- Investigating the relationship and correlation values between genders by variables of CPT test

Variables group	Man Sample volume 45=	Woman Sample volume = 45
Total of test errors for first 50 stimuli	0.202- r= p-value=0.066	r=0.135 p-value=0.220
Total of non-responding for first 50 stimuli	0.187- r= p-value=0.088	0.113- r= p-value=0.305
Total of correct answers for first 50 stimuli	0.212 r= p-value=0.053	0.056- r= p-value=0.615
Reaction time of first 50 stimuli for correct answer	0.107 r= p-value=0.331	0.024- r= p-value=0.083
Total of test errors for second 50 stimuli	0.275- r= p-value=0.011	0.128- r= p-value=0.247
Total of non-responding for second 50 stimuli	0.082- r= p-value=0.475	0.065- r= p-value=0.558
Total of correct answer for second 50 stimuli	r=0.149 p-value=0.177	r=0.051 p-value=0.644
Reaction time of second 50 stimuli for correct answer	0.166- r= p-value=0.132	0.061- r= p-value=0.583
Total of test errors for third 50 stimuli	0.279- r= p-value=0.01	0.123- r= p-value=0.266
Total of non-responding third 50 stimuli	0.008- r= p-value=0.945	0.069- r= p-value=0.535
Total of correct answer for third 50 stimuli	r=0.089 p-value=0.421	0.070- r= p-value=0.526
Reaction time of third 50 stimuli for correct answer	0.035- r= p-value=0.75	0.061- r= p-value=0.583

Note the descriptions of table 5 that correlation number is always between 1 and -1. Whatever this amount is closer to 1 or -1, this category is a sign of correlation and strong relationship close to a linear one. Negative mark shows a reversed relation and positive mark suggests a direct relation. Whatever this amount is close to zero, it indicates no relationship. It is clear that there is no correlation between women and men with under investigation variables and they are almost similar.

Discussion

Since the hypothesis of this study confirms the role and influence of neuro-cognitive tests in identifying and assessing sustained attention changes in man and woman, the aim of this study was fulfilled through findings. Attention cognitive domains assessment is possible through computerized tests in appropriate conditions. These tests can be used well in situations that error reduction, speed, and efficiency are considered (11). It is worthy noting that these tests are usable as tools with appropriate sensitivity to a wide range of clinical conditions related to cognitive deficits.(16, 41).

In the studies which neuro-cognitive tests have been commonly used, there is an average correlation between variables of computerized tests of CPT (4). In present study there is no significant difference between compared variable averages in computerized tests of CPT in man and woman (table 5). Individual and environmental factors are so important in doing these computerized tests which is a sign of test popularity in researches (24). In the present study the mentioned test measures were evaluated by gender variable. CPT tests are reliably investigated in healthy subjects who are identical in terms of age, gender and race (1). In some studies Stroop and CPT variables did not show a significant difference between man and woman. CPT and Stroop test performance is a little helpful in identifying gender. So the present findings make clear a few limitations in using Stroop and CPT (32, 40). There is no significant relationship between gender variable and CPT test variables. These results have been approved in some studies in which there is no significant relationship between CPT test measures and gender variable. It is clear that there is a similar performance (the more omission and commission errors, the more response time) for all of our subjects. This category is rejected by stimulating effect of gender on attention and information processing. There is no sexual interaction among participants in every functional scale. The mentioned subject is according to the research results (33). There is a minimal relationship between man and woman in all age groups and Stroop test scales in Mcleod study (26) which the result of present study (table 4) indicates no correlation. Although there is a significant difference between two hemispheres in men and women, it does not result in difference in attention domain. Since brain weight in men is more than women's and flow of communication between two hemispheres in women is more freely than men's, they are able to use from two hemispheres during the communication. Selective, sustained attention domain which is in interaction with cortical areas (frontal, temporal, parietal), sub-cortical (limbic, basal ganglia) and functional systems including basal ganglia courses, thalamus and frontal lobes (29, 31) which can be no affected by brain size. The presence of connection paths between two hemispheres in different parts of women's brain can justify attention similarity despite the number of neurons, size and more weight of men's brain. And especially as the left part of IPL in men is bigger than the right one, while it is converse in women which permit the brain processes to get help from input sensory attention and selective perception and previous researches have shown that the right IPL is related to understanding spatial relationships and ability of sense relationships among body organs (14) and it can also indicate interfering processes in developing attention neural paths in women despite size differences. Cognitive functions in man and woman take place in different parts of brain which are different in neural relations. Since cognitive functions in man and woman take place in different parts of brain which are related together, these functions are assessed by different domains such as attention and its assessment in two genders suggests neural function in man and woman. Attention is a cognitive trend which is related to information processing capability (26). This study confirms that mentioned computerized neuro-cognitive tests have many benefits like any other technology in compared with conventional psychological tests and can assess neuro-cognitive function in man and woman (41). It is suggested that future studies can be concentrated on other tests in man and woman about comparative assessment of neuro-cognitive function.

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