



Study of Relationship between Behavioral and Emotional Aspects of Working Memory and Symptoms of Sensory Processing Disorder, Behavioral Disorders and Social Skills

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ABSTRACT

The aim of this study is to examine the relationship between behavioral and emotional aspects of working memory and symptoms of sensory processing disorder, behavioral problems and social skills. This study is descriptive (correlational) in terms of data collection and applied in terms of its objectives. The population consisted of all third to sixth grade female students studying in Tehran primary schools in school year 2012-13. The sample size, which was determined by Morgan Table, comprised of about 200 subjects who were selected through random multistage cluster sampling. Data collection instruments included questionnaires of working memory related behaviors by "Dunn", Sensory Processing Disorder (SPD), behavioral disorders of "Achenbach" and social skills. The results showed that social skills were not related to working memory related behaviors and sensory processing disorder. The relationship between different types of behavior disorder and working memory was significant at the level of 0.01 with the lowest correlation belonging to physical problems and anxiety and the highest correlation belonging to attention deficit hyperactivity disorder and emotional problems. The relationship between sensory processing disorder and working memory related behaviors was significant at the level of 0.01. Sensory processing disorder and self-regulation explained 30% and 35% of variations in working memory behavior. Also, there was no significant difference between age and educational grade of studied students in terms of scores of working memory behaviors and sensory processing disorder.

KEYWORDS: Working memory, Sensory processing disorder, Behavior disorder, Social skills

1. INTRODUCTION

Today, working memory is treated as one of the most important part of memory in many fields of psychology. The cognitive researches in the past 35 years have recognized active memory as one of the most effective cognitive components, which as a system, is simultaneously tasked with temporary maintenance and parallel processing of information. As a cognitive system, working memory is in charge of the temporary storage and processing of information, acting as an integrated system that links the performance and subsystems of short term and long term memory [1]. In recent years working memory has been recognized as a cognitive function, which is especially effective in learning. Moreover, behavioral aspects of working memory have also been the subject of growing attention. For example, Dunne [1] argues that children with working memory disorder may not only experience difficulty in learning, but also have troubles in their everyday behaviors or class activities (e.g. misplacing personal belongings, inattention, etc.). He also proposed different dimensions of working memory behaviors such as class, phonological and pronunciational, visual-spatial and executive working memory. Thus, any flaw or defect in normal functions is externally reflected in behavioral disorders. Emotional and behavioral disorders can coexist with other disabilities. In children and adolescents, these disorders include emotional or conduct disorder, attention deficit and incompatibility [2]. Sensory processing is used to describe how nerve system receives messages from sensors and convert them into appropriate behavior and motor responses. Sensory processing disorder is a condition in which sensory signals are not transformed into appropriate messages and can only influence one or two senses of an individual. Sensory processing disorder is usually diagnosed in children, but individuals who go untreated until adulthood can also experience the symptoms of this disease, which undermines their ability to properly interpret sensory messages. Children with sensory processing disorder often have troubles in motor skills and other abilities needed for success in academic achievements and childhood developments, which explains the reason they become socially isolated, lack social confidence and suffer from a host of emotional problems [3]. Social skills refer to a set of acceptable learned behaviors which enables an individual to establish effective relationship with others and refrain from unreasonable social reactions [4]. Parents can also provide their children with opportunities to play with their peers or with them and foster the necessary communication skills in them. Parents can help their children find the opportunity to play with peers and promote their social skills by discussing the importance of such relationships with their children. In their study of

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behavioral disorders and social corruptions in recent decades, psychologists have concluded that most disorders are rooted in inability to properly analyze oneself and one's status, lack of self-sufficiency and personal competence to deal with difficult situations and lack of knowledge to solve real-life problems properly. Personality development, learning citizenship skills, avoiding violence, learning proper rules of conduct, and interpersonal communication skills in general are essential in today's world. In this regard, WHO and UNICEF have long presented life skills approaches which are divided in three main categories of social, cognitive and coping-emotional skills. Lack of social skills present numerous challenges to children, leading to inconsistency in interpersonal relationships and behavioral disorders that can negatively affect personality growth of the children and their adaptation to the environment [5].

Children with sensory processing disorder may not allow others to touch them or be insensitive to the different sensory stimulations. On the contrary, they may pursue intense activities such as listening to loud music. Behavioral disorders in these children are common and may be symptomatic of depression, anxiety or aggression and difficulty in performing motor skills [3].

The specific objectives of this study are as follow:

- The relationship between working memory-related behaviors and sensory processing disorder
- The relationship between working memory-related behaviors and behavioral disorders
- The relationship between working memory-related behaviors and social skills
- The relationship between symptoms of sensory processing disorder and behavioral disorders
- The relationship between symptoms of sensory processing disorder and social skills

Hypotheses of the study are:

- Working memory-related behaviors are related to social skills
- Sensory processing disorder is related to social skills.
- Working memory-related behaviors are related to behavioral disorders.
- Working memory-related behaviors are related to sensory processing disorder

2. MATERIALS AND METHODS

Given the nature and objectives of the research, a correlation method has been adopted in this study. The population consisted of all third to sixth grade female elementary students in Tehran in school year 2012-13. Using random multistage cluster sampling method, 200 female primary students were selected from two schools in districts 4 and 8. Then, 50 questionnaires were distributed among the students in each grade and their parents were asked to respond to them meticulously. Despite great efforts to ensure the representativeness of the sample population, only 163 questionnaires were answered completely and included in the study for further analysis. Since the present study measures four variables, four questionnaires were used.

A) Working memory related behavior questionnaire

The questionnaire has been adapted from the Dunn [1]. He was the first to emphasize the behavioral aspects of working memory and accordingly presented several interviews and questionnaires to assess behavioral aspects of working memory in his book. In this study, the translation of these questionnaires has been used, which consists of 79 items on the behavioral working memory, 11 items on verbal working memory, and 9 items on executive working memory. To evaluate the internal consistency of the questionnaire, Cronbach's alpha was used. The values of Cronbach's alpha coefficients are presented in the table below.

Table 1. Cronbach's alpha values for the subscales of working memory behaviors

Working memory measures	Cronbach's alpha
Class behavior	0.95
Verbal behavior	0.93
Executive behavior	0.87
Total score of working memory	0.96

B) Sensory Processing Disorder (SPD) questionnaire

This questionnaire was adapted from SPD technical website (www.spd.com). In this website, a variety of long and short questionnaires have been presented to assess various aspects of this disorder, one of which has been selected for the purpose of evaluation in this study. Questions have been designed in fitting with one of the main senses (auditory, visual and tactile senses like heat and cold; various kinesthetic - visceral senses, sense of balance, smell and taste) in a scale between hypersensitivity and hyposensitivity for aforementioned senses.

Sensory processing disorder questionnaire used in this study consists of two parts, one consisting of 68 items that evaluate the above senses in form of processing disorder in sensory types and the other consisting of 31 items that represent the emotional and social issues in form of "sensory processing disorder and self-regulation" in children. The items of the questionnaire are all in form of multiple choices. To evaluate the internal consistency of the questionnaire, the Cronbach's alpha was used, as shown in Table 2.

Table 2. Internal consistency of the questionnaire

Measures of sensory processing disorder	Cronbach's alpha
Processing Disorder in all senses	0.90
Sensory Processing Disorder- self regulation	0.86
Sensory Processing Disorder- total score	0.87

C) DSM-IV behavioral disorders questionnaire of Achenbach – parental form

This questionnaire is composed of three forms for parents’ report, teacher’s report and self-reports that have been developed for three age groups. In Iran, however, it has only been validated and normalized for the age group between 6 and 18 years. Each of these three forms has been designed based on two models, i.e. empirical model and DSM-IV model. Achenbach [6, a, b, c] reported a reliability of 0.46-0.96 using Cronbach's alpha and a validity of 0.52-0.88 using a correlation coefficient with two CBRS scales and Quay-Peterson revised behavior problem scale [7] for the questionnaire. In 1996, this test was validated by Siamak Samani on children of Shiraz Province and a reliability coefficient of 0.59-0.8 was achieved for its subscales. Minaee [8] reported a range of internal consistency 0.95-0.63 for the scales. He also reported the time stability of 0.32 to 0.67 for scales using the test-retest method in a 5-8 week interval. Shahbazi [9] found a Cronbach's alpha of 0.90, 0.93 and 0.82 for three forms of parents, teachers and children respectively. In the present study, only the parent’s form and DSM-IV section of Achenbach’s behavior disorder questionnaire, which consisted of 48 items, have been used. This section measures these scales: emotional problems, anxiety issues, physical problems, ADHD problems, coping behavior and conduct disorder.

D) Social skills questionnaire

Social skills questionnaire consisted of 50 items related to social skills of children in relation to peers, friends, family and society as well as responsibilities and roles of children in the community.

3. RESULTS

Table 3. Results of stepwise regression analysis of working memory related behavior in terms of predictive variables (behavioral disorders)

Statistical index variables	Standard error	R ²	R
Attention Deficit- Hyperactivity	33.76308	.435	.659 ^a
Emotional problems	31.71195	.505	.710 ^b
Conduct disorder	31.26581	.521	.722 ^c

As to the results of stepwise regression analysis of total score of working memory related behavior in terms of predictive variables (behavioral disorders), with the inclusion of predictive variables, i.e. attention deficit-hyperactivity, emotional problems and conduct disorder, the value of R² explained 43%, 50% and 52% of variations in working memory behaviors respectively. To explore the significance of this correlation, variance analysis test was used. The results of variance analysis are shown in Table 4. According to the findings of Table 4, F is significant at significance level of 0.01. Thus, the relationship between working memory behavior and behavioral disorders is confirmed.

As shown in Table 5, t is significant for variables of behavioral disorders.

Table 4. Variance analysis of stepwise regression of working memory related behavior in terms of predictive variables (behavioral disorders)

Step	Source of variation	Sum of squares	Dg	Mean squares	F	Sig.
Step one	Regression	141205.417	1	141205.417	123.870	.000 ^a
	Remaining	183531.233	161	1139.946		
	Total	324736.650	162			
Step two	Regression	163833.057	2	81916.528	81.457	.000 ^b
	Remaining	160903.594	160	1005.647		
	Total	324736.650	162			
Step three	Regression	169306.072	3	56435.357	57.731	.000 ^c
	Remaining	155430.579	159	977.551		
	Total	324736.650	162			

Table 5. Coefficient of stepwise regression analysis of working memory behavior in terms of predictive variables (behavioral problems)

Statistical index variables	B	Standard error	Beta	t	Significance level
Constant	37.880	4.426		8.557	.000
Attention Deficit / Hyperactivity	11.624	1.044	.659	11.130	.000
Constant	31.706	4.357		7.278	.000
Attention Deficit / Hyperactivity	8.153	1.224	.463	6.662	.000
Emotional problems	4.642	.979	.329	4.743	.000
Constant	31.705	4.295		7.381	.000
Attention Deficit / Hyperactivity	7.243	1.266	.411	5.719	.000
Emotional problems	3.521	1.075	.250	3.276	.001
Conduct disorder	3.649	1.542	.175	2.366	.019

Table 6. Results of stepwise regression analysis of working memory behavior in terms of predictive variables (sensory processing disorder)

Statistical index variables	Standard error	R ²	R
Sensory processing disorder	37.50393	.303	.550 ^a
Sensory processing disorder- self-regulation	36.15633	.356	.597 ^b

As to the results of stepwise regression analysis of working memory related behaviors in terms of predictor variables (sensory processing disorder), the value of R² indicates that with the inclusion of predictive variables and self-regulation, sensory processing disorder explains 30% and 35% of variations in working memory behaviors respectively.

According to the findings of Table 7, F is significant at the significance level of 0.01. Thus, the relationship between working memory behavior and sensory processing disorder is confirmed.

In Table 8, the value of t for the variables of total score of sensory processing disorder and self-regulation variables is significant.

Table 6. Variance analysis and stepwise regression analysis of working memory behaviors in terms of predictive variable (sensory processing disorder)

Step	Source of variation	Sum of squares	Dg	Mean squares	F	Sig.
Step one	regression	98282.994	1	98282.994	69.875	.000 ^a
	remaining	226453.656	161	1406.544		
	total	324736.650	162			
Step two	regression	115571.767	2	57785.883	44.203	.000 ^b
	remaining	209164.884	160	1307.281		
	total	324736.650	162			

Table 8. Coefficients of stepwise regression analysis of working memory behavior in terms of predictive variables (sensory processing disorder)

Statistical index variables	B	Standard error	Beta	t	Significance level
constant	33.194	6.048		5.488	.000
sensory processing disorder	1.287	.154	.550	8.359	.000
constant	33.974	5.835		5.823	.000
sensory processing disorder	.813	.198	.347	4.110	.000
Self-regulation	1.381	.380	.307	3.637	.000

As shown in Table 9, the value of F is not significant for any subscales and total score of working memory behavior. Thus, no significant difference is observed between age and grade of students in the scores of working memory behaviors.

The value of F for any subscales and total score of sensory processing disorder was not significant. Thus there was no significant difference between age and grade of students in the scores of sensory processing disorder

Table 9. Results of variance analysis to compare subscales and total score of active memory behavior in each grade

	Source of variation	Sum of squares	Mean squares	df	f	Sig.
Working memory- class behavior	Inter-group	1066.653	355.551	3	1.395	.246
	Intra-group	40536.979	254.950	159		
	total	41603.632		162		
Working memory – verbal	Inter-group	227.180	75.727	3	1.102	.350
	Intra-group	10928.182	68.731	159		
	total	11155.362		162		
Working memory- executive	Inter-group	48.690	16.230	3	.816	.487
	Intra-group	3161.494	19.884	159		
	total	3210.184		162		
Working memory – total score	Inter-group	5814.953	1938.318	3	.966	.410
	Intra-group	318921.697	2005.797	159		
	total	324736.650		162		

Table 10. Results of variance analysis to compare subscales and total score of sensory processing disorder in each grade

	Source of variation	Sum of squares	Mean squares	df	f	Sig.
sensory processing disorder	Inter-group	1892.673	630.891	3	1.748	.159
	Intra-group	57401.094	361.013	159		
	Total	59293.767		162		
Behavior self-regulation	Inter-group	296.016	98.672	3	.994	.397
	Intra-group	15785.653	99.281	159		
	Total	16081.669		162		
sensory processing disorder	Inter-group	5338.037	1779.346	3	1.209	.308
	Intra-group	234057.349	1472.059	159		
	Total score	239395.38		162		

4. DISCUSSION AND CONCLUSION

The main objective of this study was to examine the relationship between behavioral and emotional aspects of working memory and symptoms of behavioral disorders and sensory processing disorder and social skills. The results of data analysis indicated that there was not any relationship between social skills and working memory related behaviors. The results of this study are consistent with the study of Livarjani et al. [10] who found that there was not a significant relationship between emotional intelligence and social skills of academically gifted students. On the contrary, the results are inconsistent with the study of HaidariTafreshi and DelfanAzari [11] who showed that there was a significant relationship between social skills and stress coping skills. Karimi et al. [12] in their analysis of the effects of social skills training on behavioral disorders of primary school children found that social skills training reduced symptoms of behavioral disorder. Zarghami et al. [13] showed that natural and proper lighting, audio-visual communication with the external environment of daycares and preschools, access to open and green space and group games in the outdoor spaces could reduce the symptoms of behavioral disorders in children. Jenaabadi [14] demonstrated that trained students had fewer behavioral disorders than that of untrained students. As a result, the proper and continuous training of social skills, particularly collaboration, assertiveness and self-control, can be a good solution for alleviating behavioral disorders in exceptional children. The reason for the inconsistency of results could be the presence of other effective factors in the relationship between working memory related behaviors and social skills or disparity between the years of study, study population and questionnaires adopted in the study. There is no relationship between social skills and sensory processing disorder. Social skills are a set of acquired behaviors that improve the interaction of an individual with people, helping them to give acceptable responses and establish effective communications. Some children learn social skills naturally as if they have an innate talent in learning such skills, while others need further training and

practice in this regard. They need certain training / therapeutic methods to promote their abilities. Children with certain psychiatric disorders such as sensory processing disorder have severe weakness in communication and social skills and need special treatment because physical problems such as hearing loss and visual and verbal difficulty can negatively affect communication skills. The sooner are physical problems resolved, the faster and better these skills are acquired. As to results of the second hypothesis, we found no relevant findings in this regard. The relationship between different behavioral disorders and working memory behaviors was significant at the level of 0.01 with the lowest correlation belonging to physical problems and anxiety and the highest correlation belonging to hyperactivity and emotional problems. The inclusion of emotional problems and conduct disorder increased attention deficit hyperactivity disorder by 7% and 5% respectively, thus explaining 50% and 55% of variations in working memory related behaviors. The findings of this study are consistent with the results of Dehghan *et al.* [15], which showed perceptual-motor skills reduced behavioral disorders in 5-8 year-old children with hyperactive attention deficit disorder, Abedi and Aghababaei [16], who found working memory training can improve academic performance of students with mathematical learning disabilities and Asadzadeh [17] who showed that there was a significant positive relationship between working memory capacity and academic performance of students in third grade of the middle school. Students with higher working memory capacity had greater academic performance. In the same manner, students with higher academic performance had greater working memory capacity. Muhammad and Gharaei [18] found that there was no significant relationship between behavioral disorders and emotional intelligence and its components, i.e., emotion regulation, emotional expression and evaluation and emotional application. ZadeMohammadi *et al.* [19] showed that music therapy could reduce behavioral disorders in children orphaned or abandoned children in two welfare service centers in Tehran and had a significant effect on subscales of "anxiety", "anti-sociality" and "behavioral disorder". Lagopoulos *et al.* [20] examined frontal lobe areas of depressed patients at the time of implementing working memory tasks, showing that these patients had weaker performance in all components of working memory compared to the control group. Rose and Ebmeier [21], based on their observations, concluded that depression was associated with relatively specific impairments of working memory, especially the central executor. Willcutt *et al.* [22] showed that the most stable and strongest effect of attention deficit hyperactivity in children was on measures of response inhibition, alertness, working memory and designing. Klein and Boals [23] in their study of the effects of emotional writing disclosure on the capacity of working memory showed the capacity of working memory in the experiment group increased remarkably compared to the control group seven weeks after the end of the experiment. Lewis and Doorlag [24] found that children with attention deficit hyperactivity had more trouble in verbal short-term memory than that of working memory disorder. The relationship between sensory processing disorder and working memory related behaviors was significant at the level of 0.01. Sensory processing disorder and self-regulation explained 30% and 35% of working memory behavior respectively. There was a significant relationship between the results of this study and the findings of Adlparvar [25] who found a relationship between sensory processing styles in infants and parenting stress realm, suggesting that avoiding sensory processing style could predict function limitations and low registration sensory processing style could predict sub-scales of receptivity. GhamariGivi and Basharpour [26] showed that there was a significant difference between three groups in terms of components of low registration, sensitivity and avoidance, but this difference was not significant with respect to seeking style. In relation to semantic processing, there was a significant difference in components of evaluation, potency and activity among these three groups, but this difference was not significant with respect to risk factors. Sadoughi *et al.* [27] showed that sensory processing sensitivity was associated with indices of psychological pathology. Aron, Aron and Davies [28] demonstrated that there was a relationship between sensory processing sensitivity and parenting style (low care and over support) as predictors of negative emotions such as shame. There was no significant difference between age and grade of students in the scores of working memory behaviors and sensory processing disorder. The results of this study are consistent with the study of Engrel and Batya [29] who found no significant difference between studied children in terms of sensory processing disorder age. In general, scientific studies face a host of limitations and problems. The main limitations of this study are as follow:

The population consisted of all third to sixth grade female students studying in Tehran elementary schools in academic year 2012-13. Thus, generalizing the results of this study to other grades should be done with caution. Also, when generalizing the results, the gender of participants should be taken into account. Lack of cooperation of some respondents in completing the questionnaire was time consuming. Since this study had four variables and used four questionnaires with numerous items to measure each variable, it took the researcher a long time to distribute and collect questionnaires.

According to the findings of this study, the following recommendations are made:

- To improve verbal memory in children, parents and school officials should encourage them to engage more actively in social activities and read non-school books at leisure.
- To reduce sensory processing disorders in children, it is necessary for parents to consult with a child psychiatrist to learn systematic ways of reducing this disorder, and if necessary, use drug treatment and the occupational therapy.
- Since the strengthening of positive spirit in children increases their happiness and social skills, parents and school authorities are recommended to take necessary measures to improve social skills in children.

- Future research can study the role of genetic and environmental issues in working memory related behavior, sensory processing disorders, behavioral disorders and social skills individually or collectively.

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