

Comparing Explicit and Implicit Learning of Emotional and Non-Emotional Words in Autistic Children

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Article information	Abstract
<p>Article history: Received: 10 Mar 2011 Accepted: 24 Aug 2011 Available online: 28 Oct 2012 ZJRMS 2013; 15(2): 64-67</p> <p>Keywords: Autism Explicit memory Implicit Memory Emotional Words Non Emotional Words</p> <p>*Corresponding author at: Department of Cognitive Neuroscience, Shahid Beheshti University, Tehran, Iran E-mail: vhdnejati@yahoo.com</p>	<p>Background: Explicit and implicit memories have different cerebral origins and learning approaches. Defective emotional words processing in children with autism may affect the memory allocated to such words. The aim of this study was comparing two types of (explicit and implicit) memories during processing the two types of (emotional and non-emotional) words in autistic children and their healthy counterparts .</p> <p>Materials and Methods: The present cross sectional study was conducted on 14 autistic children, who had referred to Autism Medical Treatment Center on Tehran, and 14 healthy children in kindergartens and schools across Tehran. For the explicit memory, a list of words was presented to the subjects of our study and they were asked to repeat the words they heard one time immediately and one time with delay. For implicit memory, the subjects were asked to identify the heard words among the presented words. Statistical analysis was performed using two-way analysis of variance .</p> <p>Results: The results showed that the normal children have higher efficiency in explicit and implicit memory than the children with autism ($p<0.01$). The two-way analysis of memory type and word type showed that the former affects memory significantly ($p<0.05$) while word type had no significant effect.</p> <p>Conclusion: Autistic children suffer from impaired memory. This defect is higher in implicit memory than in the explicit memory. It is recommended to apply rehabilitation, training, learning approaches and also explicit memory for interventions of autistic children.</p> <p>Copyright © 2013 Zahedan University of Medical Sciences. All rights reserved.</p>

Introduction

The preliminary studies on autism were believed that autism, like amnesia syndrome, is a primary disorder of memory. The result was obtained for the first time from behavioral similarities between autistic children and animals with hippocampus and mid temporal damages. In a number of studies, damages to the limbic system and temporal lobe in autism have been demonstrated [1].

In contrast, some studies have shown that the ability of reading a long list by heart and also inclinations of verbal echo of autistic children indicate higher auditory memory than the healthy counterparts. Accordingly, autistic children have normal auditory short-term memory. Autistic children can learn list of paired words like healthy children and better than the mentally retarded children (with higher verbal ability) [2].

Studies on similarities between autism and amnesia point to the superior similarity of recall with better clue than free recall. The autistic children act weaker in the abovementioned two situations as compared with the control group and this shows inadequacy to recall subjects in autistic children and has not any relation to the measurement method [3] The preliminary studies on autism were believed that autism, like amnesia syndrome, is a primary disorder of memory. The result was obtained for the first time from behavioral similarities between

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In general, there are two types of learning: Explicit Learning and Implicit Learning. If the learner is informed on the component, objective, and way of doing assignment or homework, this learning is explicit, while if the learner is not informed on what is supposed to do and/or if learner is not briefed on component, objective or way of doing homework, it is called as implicit learning.

The studies have shown that autistic children act well in learning facts and rules [4]. A group of studies have shown that autistic children are more dependent on declarative/explicit memory [5] and pattern of their recalling words is based on declarative memory [6].

Jennifer showed that autistic children show similar implicit movement sequence with their healthy counterparts in learning process but pattern of their learning process is less affected by the interfering assignment [7]. Vocabulary development is the process of learning vocabulary. Normal children learn their first vocabulary between the ages of 10 to 18 months [8] but autistic children learn vocabulary in 24 months onwards [9]. The aim of this study was to compare the two types of (explicit and implicit) memories and the two types of (emotional and non-emotional) vocabularies in autistic children and healthy counterparts.

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Materials and Methods

The present cross sectional study was conducted on 14 children with autism, who had referred to Autism Medical Treatment Center in Tehran, and also on 14 healthy counterparts at kindergartens and schools of Tehran city. Autistic children from 5 to 10 years old were the subject of this study statistically who had referred to Tehran Autism Medical Treatment Center in Nov. and Dec. 2010. The healthy counterparts of the same children with similar ages were selected in kindergartens and schools of Tehran city. Parents of the subjects allowed their children to take part in this study, consciously. Moreover, subject themselves were satisfied to participate in this study. Children with autism, who were mentally retarded, and also children, who were not able to speak, were excluded from the study. In this study, four 6-vocabulary lists (two lists from emotional vocabularies and two lists from non-

emotional vocabularies) were presented to the samples. After termination of each list, the subjects were requested to repeat the vocabularies of the list. After reading four lists, children were requested to repeat the vocabularies remained from the sour lists.

A list of 48 vocabularies was provided for implicit memory. 24 vocabularies from former lists and 24 new vocabularies were presented to the samples and they were asked to hold up their hand after hearing the vocabulary which has been presented to them previously. The data analysis was conducted using independent *t*-test and two-factorial variance (ANOVA) analysis.

Results

The present study was conducted on two groups of autistic children and normal counterparts with the average age of 6.85 ± 1.38 years. Table 1 shows demographic specification of the two groups and has stated results of independent *t*-Test with regard to these specification. table 2 shows efficiency of autistic children with healthy counterparts in explicit and implicit learning of emotional and non-emotional vocabularies. As it is observed in table 2, autistic children have low efficiency than their healthy counterparts in all cases of explicit and implicit memories with the emotional and non-emotional vocabularies. Table 3 has shown the effect of word type and learning type through two-way analysis of variance. As you see in this table, the effect of the memory type is significant; comparing the average values shows the positive effect of the significance on the explicit memory.

Table 1. Comparison of demographic specifications of two groups

Demographic variable	Autistic Mean±SD	Healthy Mean±SD	<i>p</i> -Value
Age	6.85(1.40)	6.85(1.40)	1.000
Education	1.60(1.34)	2(0.89)	0.568
Number of children	1.60(1.34)	1.72(0.64)	0.800
Gender (F/M)	11 -3	11-3	-

Table 2. Results of independent t-test for efficiency of autistic and healthy children in two types of memory and two types of vocabulary

Groups	Autistic Mean±SD	Healthy Mean±SD	<i>p</i> -Value
Emotional explicit memory	2.46(0.77)	3.89(0.68)	0.0001
Non Emotional explicit memory	2.46(0.81)	4.32(0.46)	0.0001
Delay emotional explicit memory	0.85(0.16)	3.85(1.40)	0.0001
Delay non emotional explicit memory	2.42(1.39)	5(1.10)	0.0001
Emotional implicit memory	3.50(3.13)	8.85(1.74)	0.0001
Non Emotional implicit t memory	4.35(3.54)	9(1.66)	0.0001

Table 3. Two-way analysis of Variance for evaluating the efficiency of autistic children in explicit and implicit memory of emotional and non-emotional vocabularies

Sources changes	<i>p</i> -Value
Corrected model	0.004
Intercept	0.0001
Type of word(emotional -non emotional)	0.079
Type of memory(explicit/ implicit)	0.001
Type of word-type of memory	0.600

Discussion

The results of the present study showed that autistic children have low efficiency in contrast to their healthy counterparts regarding the performances of explicit and implicit memory of emotional and non-emotional vocabularies. Unlike the previous studies, the recent studies in autistic children showed that autism is not a primary disorder of memory; rather, most patients have problems at the encoding and reorganizing stage. Accordingly, autism may be called as a complicated disorder of processing data. That is to say that defect in autism is contrasted between types of the data which are processed. Autism nervous-behavioral hypotheses also indicate disorder of processing data. Kanner succeeded to describe a series of abnormal memories in autistic children. Some autistic children have abnormal abilities. In contrast, there are some evidences that high performance of memory in some patients emerge in the form of amazing capabilities such as ability of reading by heart, calculation, identifying different music rhythm which can be caused by the high efficiency of hippocampus [10].

The present study showed that autistic children have less efficiency than their normal counterparts in identifying and reminding emotional vocabularies. The difference of two groups in emotional vocabularies is more than non-emotional vocabularies. Defect in recognizing excitements is the most salient features of autistic children and is considered as one of the main obstacles in establishing an intimate and friendly relationship with others as well as establishing social relationships [11, 12].

Emotions play a salient role in behavior especially social cognition. Social cognition is meant the process which evaluates and processes any information with regard to the guidance of social behavior. According to Adolphs [13], social cognition includes perception, attention, reminding and contemplating and thinking with regard to others as well as motivational and/or excitement processes. Emotion processing process starts with facial observation and then, individual tries to infer social meaning of received information from the facial features [14].

Emotions play an important role in social relationships. As it was mentioned in above, autism disorder includes the disorder which optimal social interaction has been disrupted in them [15]. Since there are not certain evidences with regard to the ability of autistic children in comprehension and understanding of exciting data, many studies have shown that these children are interested in inanimate stimulants more than social stimulants. Results of the present study showed that implicit memory of autistic children is more than their explicit memory. Performances of implicit memory are known as right hemisphere and this finding is consistent with right-hemisphere disorder hypothesis in autistic children [16, 17].

In autistic children, verbal memory is completely disruptive with regard to the subjects who have been reorganized semantically [18, 19]. These children have

defect in cases which require encoding for recalling, so that these patients [9], who are able to recollect subjects accidentally, can remind significant sentences [3]. Weakness in implicit memories of autistic children with the defect in cognitive and behavioral performances requires implicit memory such as processing sentimental modes, generalization, classification and social interactions [20].

Implicit learning is the result of former experiences on the future behaviors [21]. Autistic children have problem in implicit learning due to the deficiency of establishing relationship between stimulant and response [4, 22]. According to Klinger results, defect in implicit learning in autism is caused by the defect in recognizing communications created in experience which is led to the inability in forming general information from partial information.

Inability to generalize learned information to the new conditions is one of the defects observed in autistic children which are among the important extraordinary cases for life interactions [23]. Implicit learning, without consciousness is infrastructure of learning language and motor [24] and social skills [25]. Since lingual delay, repetitive movements and failure in establishing social interaction are the primary symptoms of autism. It seems that autistic children face severe defect in implicit learning. Implicit learning causes disorder in comprehension of social stimulants, and unnatural recognition of environment.

Barnes et al. reported that implicit learning remains unchanged and intact in spatial tissue and chronology sequence in autistic children [26]. Watanabe et al. showed that explicit learning of visual-motor sequence is found sound and safe in autistic children. In this study, despite dire need to longer time for the completion of sequence, degree of progress has been reported healthy in similar speed and accuracy of children. Klinger et al [27]. Showed that assignment of artificial grammar, as an implicit learning assignment, has less efficiency in autistic children [28]. Since autistic children have problem in reminding emotional sentences, necessary steps should be taken in treating them. Lack of similar studies in background of research and possibility of comparing results in Iran are consideration as limitations of the present study.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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References

1. Neumann D, Spezio ML, Piven J and Adolphs R. Looking you in the mouth: Abnormal gaze in autism resulting from impaired top-down modulation of visual attention. *Soc Cogn Affect Neurosci* 2006; 1(3): 194-202.
2. Bishop DV, Whitehouse AJ, Watt HJ and Line EA. Autism and diagnostic substitution: evidence from a study of adults with a history of developmental language disorder. *Dev Med Child Neurol* 2008; 50(5): 341-5.
3. Schultz RT, Cauthier I, Klin A, et al. Abnormal ventral temporal cortical activity during face discrimination among individuals with autism and Asperger syndrome. *Arch Gen Psychiatry* 2000; 57(4): 331-340.
4. Larson-Gidley J, Mostofsky S. Motor deficits in autism. In: Tuchman R, Rapin I. *Autism: A neurological disorder of early brain development*. London: MacKeith Press; 2006.
5. Klinger L, Dawson G. Prototype formation in autism. *Dev Psychopathol* 2001; 13(1): 111-124.
6. Walenski M, Mostofsky S, Gidley-Larson J and Ullman MT. Brief report: Enhanced picture naming in autism. *J Autism Dev Disord* 2008; 38(7): 1395-1399.
7. Gidley-Larson JC, Mostofsky SH. Evidence that the pattern of visuomotor sequence learning is altered in children with autism. *Autism Res* 2008; 1(6): 341-353.
8. Fletcher BM, MacWhinney B. Early lexical development. *Handbook of child language*. Cambridge, MA: MIT Press; 1995: 362-392.
9. Lord C, Paul R. Language and communication in autism. In: Cohen DJ, Volkmar FR. *Handbook of autism and pervasive developmental disorders*. 2nd ed. New York: Wiley; 1997: 195-225.
10. Kaplan HI, Sadock BJ, Grebb JA. *Behavioral sciences clinical psychiatry*. 10th ed. London: Williams & Wilkins; 2007.
11. Kahana-Kalman R, Goldman S. Intermodal matching of emotional expressions in young children with autism. *Res Autism Spect Disord* 2008; 2: 301-310.
12. Domingo GV, Johannes R, Zaja RH and Jodra. M. Facial emotion processing and social adaptation in adults with and without autism spectrum disorder. *Res Autism Spect Disord* 2010; 4(4): 755-762.
13. Adolphs R. Social cognition and the human brain. *Trends Cogn Sci* 1999; 3(12): 469-479.
14. Tso IF, Grove TB, Taylor SF. Emotional experience predicts social adjustment independent of neurocognition and social cognition in schizophrenia. *Schizophr Res* 2010; 122(1-3): 156-163.
15. Farran EK, Branson A, King BJ. Visual search for basic emotional expressions in autism; impaired processing of anger, fear and sadness, but a typical happy face advantage. *Res Autism Spect Disord* 2011; 5(1): 455-462.
16. Lazarev VV, Pontes A, deAzevedo LC. EEG photic driving: Right-hemisphere reactivity deficit in childhood autism. A pilot study. *Int J Psychophysiol* 2009; 71(2): 177-183.
17. Orekhova EV, Stroganova TA, Prokofiev AO, et al. The right hemisphere fails to respond to temporal novelty in autism: Evidence from an ERP study. *Clin Neurophysiol* 2009; 120(3): 520-529.
18. Williams DL, Goldstein G, Minschew NJ. The profile of memory function in children with autism. *Neuropsychology* 2006; 20(1): 21-9.
19. Toichi M, Kamio Y. Long-term memory in high-functioning autism: Controversy on episodic memory in autism reconsidered. *J Autism Dev Disord* 2003; 33(2): 151-161.
20. Chan A, Agnes S, Yvonne MY, et al. Disordered connectivity associated with memory deficits in children with autism spectrum disorders. *Res Autism Spect Disord* 2011; 5: 237-245.
21. Dienes Z, Seth A. The conscious and the unconscious. In: Koob G, Thompson RF, Moal ML. *Encyclopedia of behavioral Neuroscience*. London: Elsevier; 2010.
22. Klinger LG, Klinger MR, Pohlig RA. Implicit learning impairments in autism spectrum disorders: Implications for treatment. In: Perez JM, Gonzalez PM, Comi ML, editors. *New developments in autism*. London: Jessica Kingsley Press; 2006.
23. Betz AM, Higbee TS, Pollard JS. Promoting generalization of mands for information used by young children with autism. *Res Autism Spect Disord* 2010; 4(3): 501-508.
24. Perruchet P, Pacton S. Implicit learning and statistical learning: One phenomenon, two approaches. *Trends Cogn Sci* 2006; 10(5): 233-238.
25. Lieberman MD. Intuition: A social cognition neuroscience approach. *Psychol Bull* 2000; 126(1): 109-137.
26. Barnes KA, Howard JH, Howard DV, et al. Intact implicit learning of spatial context and temporal sequences in childhood autism spectrum disorder. *Neuropsychology* 2008; 22(5): 563-570.
27. Watanabe K, Ikeda H, Miyao M. Learning efficacy of explicit visuomotor sequences in children with attention-deficit/hyperactivity disorder and Asperger syndrome. *Exp Brain Res* 2010; 203(1): 233-239.
28. Klinger LG, Klinger MR, Pohlig R. Implicit learning impairments in autism spectrum disorders: Implications for treatment. In: Perez JM, Gonzalez PM, Comi ML, editors. *New developments in autism: the future is today*. London: Jessica Kingsley Press; 2007.

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