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Effectiveness of Cognitive Factors on Dyslexia and Speech Delay among Children with Autism Spectrum Disorders

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***Abstract**: Autism as a developmental disorder of the brain is characterized by difficulties in social interaction, verbal and nonverbal communication and stereotyped or repetitive behaviors and in some cases, cognitive delays. Speech problems and speech delays are prevalent in almost one fourth of autistic children due to other factors such as neurological and physiological problems. Furthermore, there may be some other language disorders like dyslexia and speech sound disorder affecting speech delays among children with autism spectrum disorder and receptive language may lag behind expressive language development in ASD. Definitely, it seems that there is a relationship between these two language disorders which can be studied cognitively. Consequently, this research was conducted to investigate the relationship between these disorders from cognitive perspective and examine the underlying factors that contribute these difficulties. Our findings indicate that cognitive deficits such as inadequate phonological processing, inefficiency in the working or short-term memory system, difficulties with automatizing skills and Problems connected with visual processing in autism boys affect reading process and then comprehension generally and consequently cause early speech and language delay.*

***Key Words:** Cognitive factors, Dyslexia, Speech delay, Autism*

Introduction

Autism Spectrum Disorder (ASD) is a developmental disorder of the brain that is strongly associated with deficits in language and communication. Some children with autism spectrum disorder have problem with speech delay. Children with autism spectrum disorders (ASD) are characterized as having limitations in social interactions and communication, as well as restricted interests and stereotyped or repetitive behavior patterns (APA, 2013). In recent years, reported

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frequencies for autism spectrum disorder across US and non US countries have approached 1% of the population.

Disorders of communication include deficits in language, speech and communication. Speech is the expressive production of sounds and includes an individuals' articulation, fluency, voice and resonance quality. Communication includes any verbal or non-verbal behavior (whether intentional or unintentional) that influences the behavior, ideas, or attitudes of another individual. Language disorder, specifically expressive deficits may co-occur with speech sound disorder. Language disorder emerges during the early developmental disorder and is strongly associated with other neurodevelopmental disorders such as ASD.

The language difficulties are manifested by abilities substantially and quantifiably below that expected for age and significantly interfering with academic achievement, occupational performance, effective communication and socialization. Speech delay or lack of language development is one of the diagnostic signs of Autism disorder. Symptoms are often marked in early childhood and early school years with developmental gains typical in later childhood in at least some areas (increased interest in social interaction). Autism spectrum disorder is frequently associated with intellectual impairment and structural language disorder (i.e., inability to comprehend and construct sentences with proper grammar). Furthermore, abnormalities of attention (overly focused or easily distracted) are common with children with autism spectrum disorder as in hyperactivity. First symptoms of autism spectrum disorder frequently involve delayed language development often accompanied by lack of an unusual communication patterns (knowing the alphabet but not responding to own name). Loss of language and language in a child younger than 3 years may be a sign of autism spectrum disorder with developmental regression or a specific neurological condition, such as Landau-Kleffner syndrome. Some children with ASD also have intellectual impairment and language impairment such as slow to talk and language comprehension problems behind production. Additionally, difficulties in reading comprehension are frequently seen among children with receptive language impairments. As an example, in a study on 577 children aged 1.5 to 6, Ellis and Thal (2008) suggested that early delays to comprehension and/or expression convey a greater risk for future impairment, with comprehension delays potentially being a stronger predictive marker.

Delays in speech and language development affect approximately 5-8% of preschool-aged children and are one of the most frequent reasons for referral to speech and language services (Rescorla, 2011). Difficulties associated with early communication delays may or may not persist into later ages as language development varies with both the timing and level of acquisition (Dale et al., 2003). Similarly, expressive disorder is among developmental disorders in which speaking abilities appears slowly than normally. However, usually, speech delay is one of the remarkable characteristics in mental disability. In most cases, autism spectrum disorder is accompanied by mental disability and language structure disorder. Generally, in 1970s, psychologists and clinicians paid attention to cognitive justifications and regarded autism disorder as language disorder, attention-deficit disorder and perception disorder (Rutter, 1984). Cognitive disorders occurring with language disorders include some children with mental retardation, most children with autism, and some children with learning disabilities. Children with autism spectrum disorder have abnormal behavior in communicating verbally and non-verbally. Most children with ASD are unable to speak or have delay in learning language and

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speech (APA, 2000). Speech delay may have various reasons such as reading disorder, (dyslexia), hearing disorder, motor disorder, neurological factors, Speech sound disorder, genetic and physiologic factors and pervasive developmental disorder.

Autism spectrum disorder includes a range of behaviors which were classified separately before change in DSM-5. But nowadays, these are not listed individually in DSM-5. However, International classification disease-10th (ICD-10) has separate diagnostic features for Rett syndrome, childhood-disintegrative disorder, Asperger disorder and pervasive developmental disorder. A structural MRI study reported atypical volumes of language areas in the brains of individuals with autism who have language impairments, but not in those who do not (De Fosse´ et al., 2004).

In a study on 1,880 single- born children with the aim of comparing the language outcomes at age 7 for 'late talkers' versus children with TLD, Rice et al (2008) asserted that 'late talking' children go on to develop language within normal limits by 7 years of age. Not all children with early language delay (late talkers) have significant language problems when they reach school age (Rescorla, 2002), making it difficult to diagnose a language disorder before the age of about 3 years (Leonard, 1998). However, given the risk that language disorders pose for students, children need to be assessed for language difficulties early and monitored periodically at critical educational stages (e.g., in preschool; then in kindergarten, second grade, and third grade; early middle school; and high school) to track language development and identify any problems that might arise. Although children may acquire new vocabulary or improve their use of grammatical forms following language intervention, they may not actually catch up to their peers. A language disorder can be defined as a significant delay in the use and/or understanding of spoken or written language (Clark & Kamhi, 2010). Children who are late talkers develop normal language skills during their early school years. Auditory perception is important for human beings primarily because we talk and listen. But as with perception in general, speech perception in particular has been studied within the conceptual framework of cognitive science (Schlinger, 2010*).*

Children with severe autism spectrum disorder have significant difficulty putting meaningful sentences together, even when they have large vocabularies. When children with autism spectrum disorder whose language was delayed do learn to converse fluently, their conversations may impart information without typical prosody or inflection. However, unlike most young children who generally have better receptive language skills than expressive ones, children with autism spectrum disorder may express more than they understand.

Words and even entire sentences may drop in and out of a child's vocabulary. It is atypical for a child with autism spectrum disorder to use a word once and then not use it again for a week, a month, or years. Children with autism spectrum disorder may exhibit speech that contains echolalia, both immediate and delayed, or stereotyped phrases that seem out of context. These language patterns are frequently associated with pronoun reversals. A child with autistic disorder might say, "You want the toy" when s/he means that s/he wants it. Difficulties in articulation are also common and about 50 % of autistic children never develop useful speech (Sadock et all, 2015).

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Cognitive views on dyslexia

There are two broad subtypes of dyslexia: auditory dyslexia and visual dyslexia. The visual dyslexic tends to have problems with visual discrimination, visual memory, visual sequencing, left-right scanning and in rapid visual recognition of words. The auditory dyslexic tends to have problems with discriminating speech sounds, in sound blending, auditory sequencing and serial memory, and in phonological awareness. Dyslexia is a variable condition and not all people with dyslexia will display the same range of difficulties or characteristics. Nevertheless, the following characteristics have been widely noted in connection with dyslexia (Singleton et all, 2006).

Inadequate phonological processing abilities, which affects the acquisition of phonic skills in reading and spelling so that unfamiliar words are frequently misread, which may in turn affect comprehension. Not only has it been clearly established that phonological processing difficulties are seen in the majority of children with dyslexia.

A marked inefficiency in the working or short-term memory system, which can affect many aspects of speaking, reading and writing. These difficulties can include problems in retaining letter-sound associations, errors in the processes of accessing the mental lexicon or delays in access to the mental lexicon. Memory problems may also cause problems in retaining the meaning of text, failure to organize learned facts effectively in examinations, disjointed written work or in omission of words and phrases in written examinations, because the individual has lost track of what s/he tries to express.

It has been found that dyslexics do not tend to automatize skills very well, with the result that a high degree of mental effort has to be expended by the dyslexic when carrying out skilled tasks that non-dyslexic individuals generally find requires little effort. This is particularly the case when the skill is composed of several subskills (e.g. reading, writing, driving).

Problems connected with visual processing, which can affect reading generally, but especially when dealing with large amounts of text. Problems can include binocular instability and susceptibility to visual discomfort. Movement and color illusions can be perceived, or the text may appear unstable or obscured. Reading for any length of time may cause headaches and eyestrain, and so can be done only in short bursts, which can disrupt the comprehension process.

Researchers have generally agreed on the importance of the roles of phonological processes and memory in dyslexia, for some years the issue of subtypes of dyslexia has been the subject of controversy. This study aims to investigate the relationship between these disorders from cognitive perspective and examine the underlying factors that contribute these difficulties in order to help these children overcome their inability and develop in learning and communication. Then, these questions should be answered scientifically.

1-Is there any relationship between dyslexia and speech delay among children with autism cognitively?
2-What cognitive factors does influence dyslexia and speech delay among children with autism disorder?
3-To what extend does the identification of dyslexia factors contribute to develop speech and language in children with autism disorder?

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Method

Participants

12 boys with ASD and 12 matched typically developing boys (aged 6–12) participated in this study (Table 1). We focused on boys because ASD has a much higher prevalence in boys (Lord & Spence, 2006). No children had an identifiable cause of ASD such as presence or history of a definitive neurologic disorder including seizures, tumor, severe head injury, stroke, lesion, or disease; presence of a severe chronic medical disorder; a major visual impairment; or childhood schizophrenia or psychosis. They have no hearing disorder and their intelligence level was normal. Participants with diagnoses of disorders that are common comorbidities with ASD were not included in the study. In addition to the participants with ASD, we tested 12 typically developing (TD) control boys selected for similar handedness, age, education, IQ scores, and reading ability (Table 1). Note that the two groups differed nonetheless on education and IQ scores; see below for discussion of statistical control of these and other variables. The control participants were free of any language, developmental or psychiatric disorders and did not have immediate family members with ASD.

Table1. Participants characteristics

	ASD	Typically developing (TD)	Group differences
N	12	12	
Sex	All male	All male	
Handedness	11R (4L/2 M)	13R (2L/1M)	
Age(years)	10.8 (1.8)	10.3 (1.3)	t(43) = 1.11, p = 0.27
Education(years)	5.57 (1.5)	4.5 (1.30)	t(32) = 2.24, p = 0.03
FSIQ	107.0 (14.8)	117.5 (10.7)	t(43) = 2.76, p = 0.008
Verbal IQ	111.0 (19.5)	119.2 (16.5)	t(42) = 1.63, p = 0.11
Performance IQ	104.8 (16.3)	114.7 (11.5)	t(42) = 2.36, p = 0.02

All participants were native Persian speakers, aged 6–12. The majority were right-handed, with a few left or mixed (M) handed participants (Table 1). Due to the high prevalence of left- and mixed-handed individuals in ASD, non-right-handedness was not an exclusionary criterion. Children with ASD were recruited from the Bandar Abbas Aramesh Autism Spectrum Disorder Center. Control children were recruited through community wide service groups and volunteer organizations (e.g., Sport and Youth organization), through parents of those already participating, and through cooperation of staff members at the Autism Spectrum Disorder Center. The general rehabilitation organization of Hormozgan provided approval for this study.

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Instruments

Diagnosis of ASD was based on DSM-5 criteria and confirmed using the Autism Spectrum Quotient-Children's Version (2008), The Revised-interview Biagnosis Autism (R-ADI) and Autism Diagnostic Observation Schedule-Generic (ADOS-G). To ensure that participants have a normal intelligence level, IQ for all participants was assessed using the Wechsler Intelligence Scale for Children. Moreover, reading level was assessed using the Wechsler Individual Achievement Test, Revised (WIAT-R). Moreover, Addenbrook's Cognitive Examination-R (ACE-R), used to identify and determine cognitive malfunctions and factors affecting dyslexia resulting in speech delay on children with ASD.

Discussion

In order to provide a primary diagnosis, Participants' behavior and personality questionnaire was filled by their parents separately. Then, to ensure that participants have dyslexia, two methods were used. First, General Reading level was assessed using the Wechsler Individual Achievement Test, Revised (WIAT-R). Their scores were above 80. So their word reading was in a good level. Furthermore, in order to assess and measure the rate of reading ability, two texts were prepared. Children were requested to read a text aloud and answer the questions below the text, and read silently other text and answer the questions. The selection of texts depends on the educational level based on psychometric principles. After reading the texts, Children are evaluated in one level out of the three following levels:

1-Independent reading level; in this level, the rate of word recognition in text is 99 percent and that of reading comprehension is 90 percent or more.
2-Educational reading level; the rate of word recognition is about 95 percent and that of reading comprehension is approximately 90 percent.
3-Inadequate level; the rate of word recognition is less than 90 percent and that of reading comprehension is less than 50 percent.
According to Table 2, results showed that children with ASD are in an inadequate level in reading with accompanying reading disorder. While control group boys had a good performance and educational reading level.

Table 2. The rate of word recognition and reading comprehension

	Word recognition	Reading comprehension
ASD boys	82	35
Control boys	93	89

After determining the level of reading between boys with ASD and typically developing control boys, cognitive features such as Phonological processing, working or short-term memory system, automatizing skills and visual processing were examined and measured by analysis of the text reading done by the ASD and control groups as shown in Table 3.

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Table 3. The rate of cognitive features

	ASD children	Control boys
Phonological processing	45 %	89 %
Working or short-term memory system	42 %	93 %
Automatizing skills	35 %	92 %
Visual processing	50 %	95 %

Table 3 indicates that inadequate phonological processing, inefficiency in the working or short-term memory system, difficulties with automatizing skills and Problems connected with visual processing in autism boys affect reading process and then comprehension generally and consequently cause early speech and language delay. Although many dyslexic children are fairly articulate, others demonstrate a lack of logical structure in speech as well as in writing. Oral skills can be further compromised by difficulties in word retrieval or by mispronunciation and spoonerisms. A delay in producing a response may actually be due to a slight lapse between hearing what is said and understanding it. An inefficiency in aural processing possibly connected with the working memory system.

Furthermore, there were other difficulties in reading such as extracting the sense from written material without substantial re-reading, slow reading speed, inaccurate reading, omission of words, frequent loss of the place when reading, an inability to skim through or scan over reading matter, a high degree of distractibility when reading, perceived distortion of text (words may seem to float off the page or run together) a visually irritating glare from white paper or white-boards.

Children with ASD have no good phonological awareness (i.e. are not aware of syllables and cannot detect rhyme and alliteration. These autism boys with difficulty in carrying out these types of phonological tasks are most likely to have difficulties with learning to read even though they may overcome their difficulties with speech sounds as such. In general, it is argued (a) that phonological processes underpin the development of a phonological decoding strategy in reading, and (b) that working memory plays a significant role in this strategy, enabling constituent sounds and/or phonological codes to be held in short-term store until these can be recognized as a word and its meaning accessed in long-term memory. Dyslexics, who tend to have weaknesses in phonological processing and short-term memory, will thus tend to have speech delay and language problems.

Conclusion

In this research, dyslexia presupposes the existence of certain cognitive deficits that are believed to underpin the condition. Such cognitive deficits (e.g. in phonological processing, memory, visual processing, or motor co-ordination) are believed to be either inherited or due to neurological anomalies which have arisen before (or during) birth or in early childhood. These

deficits gradually affect comprehension and then delays in the development of speech and language.

In addition, difficulties in reading simple patterns of sequential activity, such as remembering the order of simple narration or reproducing a pattern of texts, difficulties of fine or gross motor co-ordination, high distractibility and poor concentration were common among the ASD boys.

Finally, the results suggest that even when children with ASD match their typically developing peers in response accuracy in reading test, such that their language appears normal (e.g., on diagnostic instruments), the processes and/or brain structures underlying such apparently typical language may yet be atypical in the disorder. Moreover, although ASD boys' word reading subtest scores were good, their reading performance and ability were weak and they had difficulties in reading which demonstrates that they had dyslexia and delay in speech and language.

The results of this study have important clinical implications. First, both parents and clinicians should be comforted to note that most children with early delays will go on to develop language abilities within normal ranges. Second, these findings are only applicable to language delayed children without a primary condition. Therefore, the importance of early language screening and/or assessment remains and should not be devalued because the identification of language delays may be indicative of a primary condition. Third, although children with early language delay go on to perform within normal ranges, they nonetheless perform at levels below those with TLD. The language weaknesses present in this group cannot be ignored and these children should be considered for services and programming that may serve to improve their abilities.

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