

## Research Article

# Theory of Mind Ability in Youth with Autism Spectrum Disorder using the Farsi Version of the Strange Stories Test

Mehdi Tehrani-Doost<sup>1,2,3</sup>, Fatemeh Ranjbar Kermani<sup>1</sup>, Zahra Shahrivar<sup>1,3\*</sup>, Elham Shirazi<sup>4</sup>, Yasaman Fathollahi<sup>1</sup>, Azar Mohammadzade<sup>1</sup>

<sup>1</sup>Department of Psychiatry, Tehran University of Medical Sciences, Tehran, Iran

<sup>2</sup>Institute for Cognitive Science Studies, Tehran, Iran

<sup>3</sup>Research Center for Cognitive and Behavioral Sciences, Tehran University of Medical Sciences, Iran

<sup>4</sup>Department of Psychiatry, Iran University of Medical Sciences, Tehran, Iran

\*Corresponding author: Zahra Shahrivar, Department of Psychiatry, Tehran University of Medical Sciences, Tehran, Iran

**Citation:** Tehrani-Doost M, Kermani FT, Shahrivar Z, Shirazi E, Fathollahi Y, et al. (2020) Theory of Mind Ability in Youth with Autism Spectrum Disorder using the Farsi Version of the Strange Stories Test. Int J Autism & Relat Disabil: IJARD-134. DOI: 10.29011/2642-3227.000034

**Received Date:** 02 March, 2020; **Accepted Date:** 08 April, 2020; **Published Date:** 15 April, 2020

### Abstract

**Objectives:** Children and adolescents with Autism Spectrum Disorder (ASD) have impairment in interpreting behaviors in terms of mental states. This study evaluated the theory of mind ability in youth with ASD compared to their typically developing counterparts using the Strange Stories Test.

**Method:** A total number of thirty 7-15 years old youth with ASD were compared with 30 Typically Developing (TD) youth matched on age and verbal intelligence quotient, using the Wechsler Intelligence Scale for children- Version III-Revised and Farsi translation of the Strange Stories. Individuals with ASD were also evaluated by the Kiddie- Schedule for Affective Disorders and Schizophrenia-Present and Lifetime version, Childhood Autism Rating Scale and Asperger Syndrome Diagnosis Scale to confirm the diagnosis.

**Results:** The group with ASD performed poorer than the TD group on all the stories ( $P < 0.001$ ). Age in the two group were significantly related to all types of the stories ( $P < 0.05$ ). Verbal intelligence quotient was associated with all stories in the ASD group whereas it was related to only mental and human stories in the TD group ( $P < 0.05$ ).

**Conclusion:** The participants with ASD performed worse than the TD group on mentalizing ability. Their poor performance on control stories needs additional studies.

**Keywords:** Autism spectrum disorder; Mentalizing; Strange stories; Theory of mind; Youth

### Introduction

Autism Spectrum Disorder (ASD) is one of the prevalent neurodevelopmental disorders characterized by social communication impairment, and repetitive patterns of behaviors and interests [1].

The ability of relating to others depends on understanding people's thoughts, feelings, desires, and intentions. This ability is

named as Theory of Mind (TOM) [2]. Theory of mind deficit is one of the proposed underlying mechanisms explaining the social impairment found in individuals with ASD. Based on this theory, children with ASD are not able to perceive others' thoughts and feelings; therefore, they cannot predict people's behavior and act upon it [3,4].

In line with growing evidence on TOM hypothesis in cognitive domain, there have been several tests designed to measure this ability. One group of the most studied and well known tools of this type is the "false belief" tasks. These tasks are based on

realizing people's false beliefs which are different from real world [5-8]. However, although the false beliefs tests reveal the ability to considering a mental world which is different from physical world, they do not touch more complex social and emotional components of interpersonal relationships [9]. As a result, the false belief tasks face problem in discriminating the individuals with ASD from healthy children [10].

Recently, some advanced tests have been developed to capture mental attributions of people in real social life. Among them, the Strange Stories Test evaluates more complicated mental conditions and higher levels of reasoning [10]. Appropriate answering to the test questions regarding the stories needs understanding the sentences, memorizing the stream of the story, unifying the information and notions, and recognizing the mental states of the story characters [11]. The test consists of 4 types of stories and a composition of unlinked sentences. The stories have been categorized as the "mentalizing", "physical-human", "physical-animal", and "nature" groups. In the mentalizing, human, and animal groups, the ability of mentalizing is needed to explain the stories since they involve understanding of the agents. However, the nature and unlinked sentences rely on the ability of text comprehension. There are studies which have used the Strange Stories to compare mind reading of the individuals with autistic problems and normal groups. Based on the results, children and adults with ASD perform poorer on the stories which evoke mentalizing compared to the typical people, while they show minor if any difference on other types of stories [9,12-16].

Cultural issues have been suggested to influence the trajectory of mentalizing [17]. This notion underscores the importance of considering the cultural aspects in evaluating TOM. When using the tests which rely on level of verbal ability and literacy, there is a need to examine their validity in the target community. Therefore, in another community-based study, the authors evaluated the psychometrics of the Strange Stories test as a language-based instrument in Farsi speaking school-aged children. The results supported the test as a reliable and valid tool [18].

As individuals with autistic features are proposed as prototype of TOM impairment, the mentalizing tests should capture the competency of mind reading and related aspects compared to normal developing people. Therefore, we hypothesized that these children perform poorer than their typically developing counterparts on the mentalizing and physical stories. This study aimed to compare a group of children and adolescents with ASD and a typically developing group based on their performance on the Farsi version of the Strange Stories test.

## **Method**

### **Participants and Procedure**

In a cross-sectional study, among referrals to a child and

adolescent psychiatry clinic, thirty individuals with ASD aged 7-15 years were compared with 30 Typically Developing (TD) youth matched on age and verbal intelligence quotient (VIQ). The clinical diagnosis was made by a board-certified child and adolescent psychiatrist based on the DSM-IV-TR criteria. The Childhood Autism Rating Scale (CARS) and Asperger Syndrome Diagnosis Scale (ASDS) were used to confirm the diagnosis and assess the severity of the symptoms. The Typically developing children were recruited from mainstream schools in Tehran. All typically developing children and the participants with ASD were evaluated using the Kiddie- Schedule For Affective Disorders And Schizophrenia-Present And Lifetime Version (K-SADS-PL), the Wechsler Intelligence Scale for children- Version III-Revised (WISC-III-R) and the Strange Stories test. The Kiddie- Schedule for Affective Disorders and Schizophrenia-Present and Lifetime version was administered to confirm the diagnosis and to find the co morbidities. The VIQ of the participants was assessed using the WISC-III-R. The Strange Stories test was administered to evaluate mentalizing for all participants, as well.

Total duration of the test was 45 minutes and the participants had a short rest in the middle of the test. The study protocol was approved by the Ethics Committee of the Faculty of Medicine of Tehran University of Medical Sciences. Written consent forms from parents and assent from the participants were received.

### **Measures**

#### **The Kiddie- Schedule for Affective Disorders and Schizophrenia-Present and Lifetime version (K-SADS-PL)**

This semi-structured diagnostic interview is used to assess psychiatric diagnoses based on the DSM-IV\_TR in 6-18 years old [19]. The interview was conducted with the participants and their parents and the items were scored between the 0-3 based on the interviewer's judgment. Psychometric properties of the Persian-version of the K-SADS-PL has been reported as good and excellent [20].

#### **Childhood Autism Rating Scale (CARS)**

The Childhood Autism Rating Scale (CARS) is a measure with 15 items to assess social, emotional, and sensory symptoms of autistic disorder [21]. The Farsi translation of the CARS (Tehrani-Doost, et al, unpublished) was completed by a trained psychologist while observing the child and interviewing with parents. The items are scored in a Likert from 1 (no abnormality) to 4 (severe abnormality).

#### **Asperger Syndrome Diagnosis Scale (ASDS)**

Asperger Syndrome Diagnostic Scale (ASDS) is a 50-questionnaire, and used to identify 5-18 years old youth with Asperger syndrome. This questionnaire which can be completed by a caregiver, covers different domains including cognition,

language skills, social interactions, sensorimotor, and maladaptive behaviors [22]. The Farsi versions of these two questionnaires (CARS and ASDS) were translated and validated for clinical use and research purposes by Tehrani-Doost (unpublished).

**Wechsler Intelligence Scale for Children (WISC-III-R)**

The Wechsler Intelligence Scale for Children- third edition is used for children between the ages of 6 and 16 [23]. It takes 45–65 minutes to administer and generates a Full Scale IQ representing a child’s general intellectual ability. Showed good results for reliability and validity of the Farsi version of the test [24].

**The Strange Stories test**

A set of 40 short vignettes of the Strange Stories were chosen to be applied in the study using the E-Prime software.

The stories consisted of three blocks need mentalizing (mental, human-physical, animal-physical) and two blocks of control stories including nature and unlinked sentences. The mental block included stories required understanding of lie, white lie, double bluff, misunderstanding, and persuasion. Each block included 8 stories; the stories were randomly presented on the screen for 30 seconds while they were listening to a narrator’s recorded voice. After a 500ms period, a question related to the content of the story was presented on the screen to be answered by the participant. The answer was recorded and scored by a rater who was unaware of the diagnosis in a 0-2 Likert scale based on the scoring method [11]. The rater was one of the experienced psychologists who performed the ratings of the test during a

psychometric study on normal child population with good inter-rater reliability [18]. The score was zero when the answer was: “I do not know” or describing the physical aspects of the story. The child achieved a full score of two when the answer was accurate and included mental attributions like ideas, emotions, attitudes, etc. Score one was for partial mentalizing answers. The psychometric properties of the Farsi translation of the Strange Stories test had been studied before in an Iranian population (no=399) of 7-11 years old students [18]. Results showed that the construct validity, the internal consistency and the test-retest reliability of this test were good.

**Statistical analysis**

We analyzed the data using the SPSS 18. The independent t test was used to compare the descriptive data between the two groups. The chi square test was conducted to compare the groups based on the gender. A multivariate analysis (Wilks’ λ test) was done to compare the two groups in terms of the story types. A repeated measure analysis of variance was used to find the effect of the story types and the groups on the participants function. To find the predictive value of the verbal IQ and age on participants functions in each block, regression analysis was done.

**Results**

The demographic characteristics of the two groups are shown in (Table 1). The two groups did not have any significant difference in terms of age, gender, and verbal intelligence. Among the group with ASD, 21 participants were diagnosed as Asperger syndrome and 9 as autistic disorder.

	ASD Group N=30	TD group N=30	P
Gender (boy)	25	28	0.428
Age (mean +SD): year Min-Max	11.16 (1.89) 7.5-14	11.16 (1.89) 8-14.5	0.98
Verbal IQ(mean+ SD) Min-Max	94.13 (14.21) 72-126	95.87 (12.88) 73-129	0.62

**Table 1:** Demographic Characteristics of the Two Groups.

ASD (autism spectrum disorder); TD (typically developing); independent t test was used to compare based on age and IQ; chi square test was used to compare based on the gender.

According to the results of the K-SADS-PL interview, 27 individuals (90%) of the ASD group had at least one co morbid condition. The most prevalent co morbidities included attention deficit symptoms (n=15), hyperactivity –impulsivity symptoms (N=11), specific phobia (n=8), tic (n=3), and obsessive compulsive symptoms (n=2). Comparison of the mean scores of the Strange Stories between the groups based on the multivariate analysis is shown in (Table 2). The mean scores of all blocks were significantly lower in the ASD group except for the unlinked sentences. The highest score in the TD group was seen in the human stories followed by the mental group. However, the ASD group achieved the highest score on the unlinked sentences.

Observed power	Partial eta squared	P	F	ASD Group	TD group	Story
				N=30	N=30	
				Mean (SD)	Mean (SD)	
				4.63 (4.57)	8.30 (3.57)	
0.92	0.17	0.001	11.96	4.63 (4.57)	8.30 (3.57)	Mental
0.99	0.26	0	20.34	4.37 (4.12)	9.27 (4.29)	Human
0.91	0.16	0.001	11.37	4.37 (3.81)	7.73 (3.92)	Animal
0.99	0.28	0	22.56	3.67 (3.44)	7.87 (3.40)	Nature
0.19	0.02	0.273	1.22	6.53 (3.06)	7.50 (3.67)	Unlinked Sentences

**Table 2:** Comparison of the Strange Stories Scores between the Two Groups.

ASD (autism spectrum disorder); TD (typically developing); a multivariate analysis was used Using the repeated measures analysis of variance (ANOVA), the effect of the story type, group, and the story type \* group interactions on the participants' performance were evaluated.

The results showed a significant difference among the types of the story regardless the group ( $F= 2.673, p=.045$ ). The individuals with ASD had poorer performance compared to the TD group regardless the type of the story ( $F= 18.114, p=0.001$ ). The effect of the story type \* group interaction was also significant ( $F= 5.499, p=0.001$ ) (Table 3).

Observed power	Partial eta squared	P	F	Source
0.664	0.044	0.049	2.673	Story (Greenhouse Geiser)
0.946	0.087	0.001	5.499	Story * group (Greenhouse Geiser)
0.987	0.238	0	18.114	Group

**Table 3:** Results of the Repeated Measures Analysis of the Strange Stories Scores between the two groups.

ASD (autism spectrum disorder); TD (typically developing)

Then we conducted an independent T-Test between the two groups in terms of the strange stories scores. The results showed significant differences between the groups in terms of all scores expect for “unlinked sentences” (Table 4).

Mean difference	p	t	Source
3.667	0.001	3.46	Mental
4.9	0	4.51	Human
3.367	0.001	3.373	Animal
4.2	0	4.75	Nature
0.967	0.273	1.107	Unlinked sentences

**Table 4:** Results of the Independent T-Test of the Strange Stories Scores between the two groups.

The repeated measure analysis was also done in each group separately to evaluate the group performance in terms of the story type. The results showed no significant difference in the TD participants in terms of story type ( $F= 2.222, p=0.090$ ). However, the ASD group performed differently based on the story type ( $F= 6.289, p=0.001$ ). used on Bonferroni post hoc analysis in the ASD group, it was revealed a significant difference between the unlinked sentences and other stories ( $p<0.05$ ).

To evaluate the predicting value of the age and verbal IQ on the participants' function in terms of story type, the linear regression analysis was used in each group separately. In the TD group, the significant predicting value for IQ was found only for the mental and physical stories. However, verbal IQ could predict the ASD participants' performance in all story types except for the unlinked sentences ( $p=0.132$ ).

Moreover, age was predictive of performance for all types of stories ( $p=.05$ ) in the ASD group. It was the same in the TD participants except for the unlinked sentences. The highest predicting value of age was seen for the mentalizing ( $p=.004$ ) and human ( $p=.000$ ) stories in the ASD and TD groups, respectively (Table 5).

Verbal IQ				Age				
TD group		ASD Group		TD group		ASD Group		
N=30		N=30		N=30		N=30		Stories
P	B	P	B	P	B	P	B*	
0.023	0.115	0.032	0.127	0.018	0.808	0.004	1.232	Mental
0.035	0.128	0.045	0.107	0	1.49	0.006	1.057	Human
0.096	0.094	0.008	0.127	0.026	0.84	0.016	0.874	Animal
0.085	0.084	0.021	0.102	0.007	0.868	0.005	0.909	Nature
0.17	0.073	0.132	0.061	0.522	0.236	0.094	0.502	Unlinked Sentences

**Table 5:** Results of the regression analysis between the story type and independent variables of age and verbal IQ.

ASD (autism spectrum disorder); TD (typically developing); \*=unstandardized coefficient

## Discussion

The aim of this study was to compare the ability of understanding others' mind using the Farsi translation of the Strange Stories test in a clinical sample of children and adolescents with ASD compared to a TD group.

Our findings showed that children and adolescents with ASD had poorer performance than the TD group on all types of the stories including mental, human, animals, and nature. White et al. [11] reported that the ASD group performed similar to the normal participants on nature stories and unlinked sentences while they answered poorer on other stories. They concluded that individuals with ASD had no problem in understanding the text and answered correctly to the questions related to the stories in which there were no agents or mental attributions. However, in our experiment, the two groups were different in responding to the questions of all types of stories including nature. Therefore, participants with ASD were able to understand the phrases separately. However, they were poor on combining sentences to understand a general concept. We also found significant differences between the unlinked sentences and the other types of stories in the ASD group. This difference was not shown in the TD group. Based on these findings, it seems that the poor performance of the individuals with ASD was related

to their inability to comprehend the global meaning of the stories [25-27], not due to mentalizing deficits. These results can also be explained by influence of cultural or translational aspects on comprehending the stories, mentalising and its measurement. However, our previous study (18) using the Strange Stories on a large community group of typically developing school-aged children showed consistent results to others' derived from the original stories in English [11]. Therefore, this misunderstanding of the tasks can be caused by the main cognitive deficits seen in individuals with ASD.

A meta-analysis confirmed a significant moderate to large effect size for correlation between TOM and verbal ability in children under age 7, after controlling for age [28]. It has also been reported in other studies a positive relationship between Verbal Intelligence Quotient (VIQ) and performance on the false belief tasks in children with autism [29-31]. Kaland et al. [15] used a collection of the Strange Stories in children with Asperger syndrome compared to a normally developing group. The group with Asperger syndrome performed significantly poorer than the control group on mental stories, not physical control ones. This performance was related to VIQ just in children with Asperger syndrome. Another study used 12 mentalizing stories of the test



in a group of 6-12 years old with ASD compared to TD children and showed poorer results for the group with ASD in all the stories [32]. They found a significant negative correlation between the test scores and IQ only in the experimental group. In the group with ASD in our study, VIQ was predictive in all types of the stories. However, in the TD group, VIQ predicted the performance of individuals only in mental and human stories. To explain this difference, it can be said that VIQ can influence understanding mental states in typically developing children, however since children with ASD have a general cognitive deficit, it seems that VIQ can affect understanding all types of the stories including the mentalizing.

Using the regression analysis, we found that age was predictive of our participants' performance on all stories (except for unlinked sentences in the TD group). Thus, it can be concluded that the ability of text comprehension as well as mentalizing is improving with age in children. Our findings in the TD group are in line with Happé [29], O'Hare et al. [33] and Shahrivar et al. [18] results which showed a significant association between age and TOM ability in healthy children using the Strange Stories [29-33,18]. In another study comparing a group with Asperger syndrome and a healthy group using the Strange Stories, mentalizing ability was significantly related with age in healthy group [15]. This finding was also repeated by Velloso et al [32]. It was not found any significant association between the age and performance of the group with Asperger syndrome on mentalistic task.

### Strengths and limitations

This was the first study done in a group of children and adolescents with ASD using the Farsi translation of the Strange Stories. Our findings should be considered with caution because of rather low sample size and wide range of the participants' age.

### Conclusion

This study showed that children with ASD performed poorer on the Strange Stories test compared to their TD counterparts. However, the differences between the groups were related to both mentalizing and control stories. Therefore, we cannot attribute this discrimination to the mentalizing impairment seen in individuals with ASD. Future research with larger sample size and using structured diagnostic tools for ASD is needed to evaluate the validity of the stories to discriminate the youth with ASD from typically developing group.

### Summary

To evaluate the ability of children and adolescents with ASD in understanding other people's mentalizing in comparison with their typically developing counterparts, we used the Strange Stories, an advanced test for theory of mind (ToM). The 7-15 year old participants in the two groups (n=60) were matched on age and

verbal intelligence quotient. The study showed significant poorer performance of the participants with ASD groups in all type of the Strange Stories, mentalizing and controls. The results could not differentiate the two groups based on the mind reading ability in the participants. Further studies are needed to confirm the findings.

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