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Review Article

Vocabulary and Syntax Reception in Children with Down Syndrome

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ABSTRACT

Introduction: Intellectual disability and specific cognition in down syndrome (DS) affect language development and processing. We assessed vocabulary and syntax reception among children with DS with typically developed (TD) Persian-speaking Iranian children. We also investigated the association between vocabulary and syntax reception in children with DS.

Materials and Methods: Using the Stanford–Binet intelligence scales test, 18 TD children (4-6 years old) and 18 DS children were matched based on non-verbal mental age. Vocabulary reception was assessed using the receptive picture vocabulary test (RPVT) and syntax reception by the Persian syntax comprehension test.

Results: Mean total vocabulary reception was lower in children with DS (P<0.001). Syntax reception was also impaired in children with DS compared to the normal values of the test. Among children with DS, vocabulary reception was positively correlated with syntax reception. Every unit increase in total vocabulary reception score was associated with 0.08 (95% confidence interval, CI: 0.04-0.12) improvement in syntax score in children with DS.

Conclusion: Vocabulary and syntax reception in DS children, especially complex syntax structures, was impaired. The observed association between vocabulary and syntax reception shows that vocabulary reception improvement might result in progressing syntax reception in children with DS.

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1. Introduction

Down syndrome (DS) or Trisomy 21 is a genetic disorder that is among the most common causes of intellectual disabilities affecting about 1 in every 700 births [1]. Patients show different degrees of intellectual disability ranging from mild intelligence quotient (IQ) to severe intellectual disability; most cases have moderate intellectual disability [2, 3].

Intellectual disability in DS affects language development and processing [1, 4] but all aspects of language are not affected to the same level [5, 6]. Among children with DS, expressive language is more impaired than receptive language [1, 7] and there are various issues with syntax and phonology; these two aspects are more impaired than vocabulary [6, 7]. Receptive vocabulary skill is relatively stronger, although there are also deficits in this aspect [8, 9]. Receptive vocabulary refers to comprehension and responses of words, regardless of word production capabilities in individuals [10]. Reports on receptive vocabulary skills in children with DS are conflicting [7]. Some studies show that the receptive vocabulary of DS children is at the same level as their mental age. For example, a study on verb reception and expression in children and adults with DS showed that individuals with DS were similar to their mental age-matched typically developed (TD) children in name and verb reception [11]. Lovell et al. also showed no difference in receptive vocabulary skills between children with DS and mental aged-matched TD children [6]. Additionally, Robin did not find any difference in vocabulary reception between children with DS and TD children [12].

However, some studies have shown delayed receptive vocabulary skills in children with DS compared to mental age-matched TD children. For instance, a longitudinal study showed that children with DS were similar to mental age-matched TD children in receptive vocabulary skills at their first assessment while there was an opening gap between them during follow-up [13]. Also, Bello et al. showed a general disability in vocabulary reception and expression in children with DS [14, 15].

On the other hand, some studies have shown better performance in vocabulary reception among children with DS. In a study on language capabilities in children with DS by Lazaro et al. in 2013, these children had a lower performance in vocabulary reception relative to their chronological age but a better performance relative to their mental age. Also, using the MacArthur-Bates communicative development inventories test to assess vocabulary reception, Spanish children with DS showed a better performance in vocabulary comprehension than their age-matched TD children [16].

Syntax can also be considered a challenging aspect of language and weakness in this skill is the most pronounced language problem in DS. Syntax reception is the final recognition of the meaning of a sentence beyond each word and based on its organization [17]. Some studies show that syntax comprehension and expression are more impaired than vocabulary in children with DS [7, 18-20]. Syntax development is slower in these children and declines even in late adulthood [1, 21]. Children with DS make fewer short, simple, and negative sentences and questions than their nonverbal age-matched TD children [1, 22]. Therefore, it can be deduced that children with DS have more severe syntactic disabilities than other individuals with intellectual disabilities and resemble children with specific language impairments [1, 23]. Compared to syntax expression, there are few studies on syntactic reception in children with DS.

A study on understanding complex syntactic structures (relative, adverbial, and complement clauses) found that individuals with DS performed worse than TD children and children with cognitive impairment [3]. In another study by Witecy et al., syntactic reception declined with an increase in sentence length in individuals with DS [24]. In addition to sentence length, other language elements like grammatical structure affected syntax reception in DS. Understanding the present tense was more difficult than plural nouns and understanding grammatical morphemes (like s for third person) was more difficult for individuals with DS. Also, sentences with negative components were more easily understood than relative clauses. Syntax reception in individuals with DS developed throughout childhood and adolescence and afterward a plateau was maintained [24]. Another study showed that understanding passive sentences in children with DS was weaker than in TD children of their age [25].

To add, children with DS had a weaker performance than TD children in both skills in a study on vocabulary and syntactic skills [22]. However, another study on vocabulary and syntactic understanding development found no meaningful difference between children with DS and their nonverbal age-matched TD children [12].

Given the information above, there is no consensus among researchers on vocabulary reception. Also, data on syntax comprehension in children with DS is scarce. Also, among the Iranian DS children, there hasn't been any detailed vocabulary and syntax comparison with TD children which could help the speech-language pathologists to plan their treatment based on it.

Thus, we aimed to investigate vocabulary comprehension in children with DS and compare it with their same non-verbal mental age-matched TD children. Second, we assessed syntax comprehension (simple, intermediate, and complex syntax structures) in children with DS. Finally, we studied the association between vocabulary and syntactical reception in children with DS.

2. Materials and Methods

Study design and participants

In this cross-sectional study, 18 children with DS and 18 TD children were recruited (Table 1). Children with DS were chosen from special-care schools in simple random manner which is located in three different geographical and also economic parts of Tehran (districts 2, 3, and 4 of Tehran), and TD children were also chosen from kindergarten from the same three districts. The inclusion criteria for children with DS included being monolingual, having the ability to use hands to choose between images for tests, and having a mental age of 4-6 years based on the Stanford-Binet intelligence test. The inclusion criteria for TD children also included being monolingual and being 4-6 years old. The exclusion criteria in both groups were a history of repeated infections of the middle ear or use of a hearing aid, previous history of seizure, epilepsy or head trauma, any psychological disorders (example: autism), and visual impairments which could not be corrected with aid. Additionally, TD children were excluded in case of severe delay in psycho-motor milestones. Children with DS and TD children were matched based on non-verbal mental age, using the Stanford-Binet intelligence scales test. All children completed the test and were included in the study analysis.

Study instruments

Stanford–Binet intelligence scale is a test used between 2-85 years of age that identifies individuals ranging from intellectual disability to genius. Distinguishing characteristics of this instrument is its reliable cognitive aspect to measuring five characteristics including fluid reasoning, knowledge, quantitative reasoning and spatial processing, short-term memory, and verbal and non-verbal memory. In total, 8 IQs can be drawn out of this test. Although, the majority of psychologists use IQ to identify children's mental abilities. In addition to calculating IQ, this test provides the possibility of calculating the equivalent of age and mental age.

Reliability concerning the internal consistency ranges from 0.95 to .98 for the full-scale IQ, from 0.90 to 0.92 for each of the five-factor index scores, and from 0.84 to 0.89 for the 10 subtests. In addition, using the split-half method and Spearman-Brown correction formula, the reliability coefficient is reported as 0.98 for full-scale scores, 0.95 for non-verbal scores, 0.96 for verbal scores, and 0.91 for abbreviated-test scores. Test-retest and inter-rater reliability studies indicate good stability and consistency of the scale (all coefficients are higher than 0.75) [26].

We used this test for nonverbal mental age score since its subtests include a short-term memory assessment (i.e. Bead Memory). According to Chapman et al. (1991), short-term memory is important for language comprehension and, therefore, it should be represented in any measure used for matching in studies of receptive language, although it is not included in many popular tests of nonverbal intelligence [12]. The test has standard scores and age-equivalent scores. Therefore, raw scores are converted to standard scores with an average of 100 and a standard deviation of 15. After performing the test, the raw scores are converted to standard scores, and based on the existing norms and classifications, the subject's intelligence class is determined [27].

Table 1. Characteristics of children with DS and TD children (n=18)

Variables	Features	Children with DS	TD Children
Gender	Girl	10	10
	Boy	8	8
Chronological age	Mean±SD	11.31±2.09	4.94±0.56
	Range	7.3-14.4	4-5.9
Mental-age	Mean±SD	5.21±0.57	5.06±0.61
	Range	4.1-6	4.5-6

Abbreviations: DS: Down syndrome; TD: Typically developed; SD: Standard deviation.

Receptive picture vocabulary test (RPVT) is a test that can be performed on children between 30-71 months old in 7 age groups, evaluating 15 vocabulary reception categories [28]. The vocabulary categories are tools, objects, body parts, verbs, clothes, edibles, animals, means of transportation, adjectives, occupations, animals, body parts, places, plant components, colors, and nature. This is a computer-based test in which a screen with four images is shown to the individual. In this way, a page is displayed to the subject that contains 4 images, and 2 images out of 4 images on each page are randomly asked by the examiner and then the page is changed. This reduces the chance of a random response. The maximum test score is 240 in total and 16 for each category. The content validity of the test is 1. The correlation between the two halves of the test is 0.89 and the Cronbach alpha coefficient for the overall test is 0.95 [28].

Persian syntax comprehension test (PSCT) can be used in TD and intellectual disability children between 4-10 years of age and has been previously standardized for the Persian language in 788 TD children (436 children aged 4-6 and 352 children aged 6-10 years old [29]. This test evaluates 24 structures of the Persian language using 96 items. Syntax structures of this test have been divided into three groups of simple, moderate, and complex [30] (Appendix 1). Simple structures include reversible subject-object-verb (SOV), intransitive basic sentences, simple negative sentences, and prepositional phrases. Moderate structures include subject relative clauses, direct object relative clauses, sentences with noun coordinated phrases, transitive active simple sentences, comparative adjectives, passive sentences, the omitted object in compound sentences, and negative conjunction in compound sentences. Finally, complex structures include free pronouns, omitted subject in compound sentences, A phrase not B phrase, locative adverbs, positive conjunction in compound sentences, tense-aspect-mode of verbs, adjective genitive sequences, object deletion, superlative adjectives, and subject-verb agreement [31]. Each item has four sentences with different structures and comes with four images each describing one of the sentences. The examiner makes the sentence and the child should choose the image closer to the sentence. The total PSCT score is from 0 to 24. The content validity of the test is 0.81 [31]. The internal consistency of the test is reported as 0.89 an intra-reliability of 0.56 between the two rounds The PSCT has standard scores for 4-10-year-old Persian children. The standard score is more useful in a research context. The standard scores have an almost normal distribution; Therefore, in addition to clinical settings, they are useful in research and statistical analysis [29].

Study procedure

At first, we led children with DS to a quiet room and a psychologist ran the Stanford-Binet-test evaluating their mental age with a standardized Persian version. All 18 participants with 4-6 years of mental age entered the study and then a speech and language therapist ran a RPVT and PSCT on them. Each test was conducted on a separate day. A break was given to the participant if needed. The same procedure was conducted for the TD children except for the PCST-test. This procedure started in October 2019 and finished by the end of November 2019. Their scores were recorded and added to the SPSS software.

Statistical analysis

Characteristics of children in the study were presented as Mean±SD for continuous variables, and No. (%) for dichotomous variables. RPVT scores between children with DS and TD children were compared using independent t-test or Mann-Whitney U tests based on their distribution. We then explored the differences in each score category between the two groups. The total score for syntax reception (based on PSCT) in children with DS was calculated and the scores were compared to the validated normal values of the test for the same mental age. To investigate the correlation between vocabulary and syntax scores in children with DS, we performed the Spearman correlation coefficient-test. Afterward, we performed univariate linear regression analysis to evaluate the association between vocabulary and syntax reception. As a sensitivity analysis, we additionally adjusted the analysis with the age of individuals. A $P<0.05$ was considered significant in analyses. Due to the number of additional tests when comparing vocabulary test categories, a more conservative Bonferroni-corrected $P=0.0033$ was considered. All analyses were performed using SPSS and R software version 3.2.5.

3. Results

Characteristics of the children with DS and their mental age-matched TD children are presented in Table 1. The Mean±SD of mental age was 5.06±0.61 among TD children and 5.21±0.57 among children with DS and 65% of both children with DS and mental age-matched TD children were girls. Based on the normal distribution of mental age, students' t-test was used to compare the mean of non-verbal mental age scores. Mental age did not differ between the two groups (P=0.555)

Appendix 1. Classification of syntax structures in the PSCT

	Simple Structures	Examples
1	Intransitive basic sentences	The toothbrush is green.
2	Simple negative sentences	The cow doesn't run.
3	Positive conjunction in compound sentences	Both the book and the ball are blue.
4	Transitive active simple sentences	The girl pushes the pot.
5	Prepositional Phrases	The chicken is on the ball.
6	A phrase not B phrase	The glass is green, not the spoon.
	Moderate structures	**Examples**
7	Superlative adjectives	The smallest book is green.
8	Sentences with noun coordinated phrase	The boy has a long pencil and a blue ball.
9	Passive sentences	The boy is being pulled.
10	Reversible SOV	The girl caresses the man.
11	Pronoun binding	The girl sees that the woman is pointing at her.
12	Locative adverbs	The pencil is below the toothbrush.
	Complex structures	**Examples**
13	Comparative adjectives	The pencil is longer than a knife.
14	Subject relative clauses	The girl that is jumping points at the man

PSCT: Persian syntax comprehension test

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The vocabulary reception score was 224.3(12.26) among TD children and 196.9(23.06) among children with DS. Mann-Whitney U test was used to compare vocabulary reception (non-normal distribution) between the two groups (Table 2). The mean of total vocabulary reception score was significantly higher in children with TD (U=35.5, P<0.001).

All vocabulary categories except the color category had a non-normal distribution, thus t-test was used to compare the means of the color category, and other categories were compared using the Man-Whitney U test. Among children with DS, scores of animal body parts (Mean±SD 10.22±3.05) were the least and the score for objects was the highest [15.83(0.51)]. In TD children, the color category had the least score [13.05(1.45)] and objects had the highest score [15.94(0.23)]. The mean score for categories differed between TD children and children with DS in all categories except for edibles (P=0.562), body parts (P=0.233), and objects (P=0.531) (Table 2). Using more stringent corrections, tools (P=0.027), clothes (P=0.005), occupation (P=0.005), and nature categories (P=0.005) were also considered insignificant. The largest difference between the two groups was observed in the reception of animal body parts (Mean±SD 10.22±3.05 in children with DS and 13.72±2.71 in TD children P=0.002) category and the least difference was between the objects (Mean±SD 15.83±0.51 in children with DS and 15.94±0.23 in TD children P=0.531) (Table 2).

Overall, children with DS had a lower syntax reception performance than the normal values of the PSCT-test. The mean of total syntax score was 3.5 (out of 24) in these children. Of 18 cases, 4 had scores in the normal range and 8 were only 1 SD away from the mean. Among 10 girls with DS, only 1 had performed within the normal range (10%) and the rest had a lower performance than the normal range. Among 8 boys with DS, 3 performed in the normal range (37.5%) and 5 received lower scores than the normal range. Scores of syntax structure items of children with DS were also separately calculated for simple, moderate, and complex structures. To do this, the frequency of correct answers to simple,

Table 2. Groups Mean±SD scores in the RPVT

Vocabulary Categories	Mean±SD		Range	Mann-Whitney U	P
	Children With DS	TD Children			
Tools	12.22±2.43	13.83±2.28	7-16	93.50	0.027
Objects	15.83±0.51	15.94±0.23	14-16	152.5	0.531
Body Parts	14.11±1.67	14.77±1.21	9-16	121.5	0.186
Verbs	14.05±1.86	15.83±0.38	10-16	51.00	<0.001
Clothes	14.33±1.60	15.61±0.77	11-16	82.50	0.005
Edibles	15.55±1.24	15.88±0.32	8-16	151.0	0.562
Animals	13.38±2.25	15.44±0.61	7-16	62.00	0.001
Means of transportation	14.05±2.07	15.77±0.54	8-16	46.00	<0.001
Adjectives	12.88±2.13	14.88±1.52	8-15	70.00	0.003
Occupations	12±2.49	14.27±1.60	5-16	75.00	0.005
Animal body parts	10.22±3.05	13.72±2.71	10-16	63.00	0.002
Places	13.55±1.94	15.83±0.38	4-16	37.00	<0.001
Plants components	11.83±3.22	14.66±1.45	2-16	62.00	0.001
Nature	12.11±3.46	14.55±1.44	8-14	75.00	0.005
Colors	10.50±1.65	13.00±1.45	136-239	-	<0.001**
Total Score	196.9±23.06	224.3±12.26	239-136	35.50	<0.001

Abbreviations: DS: Down syndrome; TD: Typically developed.

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* Results of the visual vocabulary reception test, **Independent t-test was used due to the normal distribution of colors.

intermediate, and complex syntax structures was summarized and the proportion of correct answers in each category was calculated (Table 3).

Among children with DS, 40% of correct answers were given to simple syntax structures, 40% to intermediate structures, and 15% to complex syntax structures (Table 4).

Finally, the spearman correlation between syntax and vocabulary reception was 0.78 (P<0.001) among children with DS (Figure 1). Every unit increase in vocabulary reception score was associated with 0.08 (95% confidence interval, CI: 0.04-0.12) increase in total syntax score in DS children in the univariate analysis. After additional adjustment with chronological age, the association remained significant [β (95% CI): 0.08 (0.03-0.14].

4. Discussion

Children with DS performed more poorly compared to mental age-matched TD children in the overall RPVT. Among children with DS, syntax reception was weaker than normal values of the test. There was a high association between vocabulary and syntax reception in children with DS.

Impairment in vocabulary reception in children with DS can be due to intellectual impairment resulting in delayed semantic representation and vocabulary development [14]. Weakness in semantic representation in children with DS might make it difficult for them to access and retrieve vocabulary. A low intellectual level or impaired intellectual performance in children with DS may result in impaired vocabulary representation which can also lead to impairment in sorting and the ability to categorize objects and actions [14]. Investigations have

Table 3. Down syndrome children's Mean±SD scores in syntax reception

Syntax Structures	Mean±SD	Correct Answer (%)
Intransitive basic sentences	3.83±0.38	83
Simple negative sentences	2.83±1.24	38
Transitive active simple sentences	3.33±0.97	55
Positive conjunction in compound sentences	2.05±1.21	16
Prepositional phrases	2.38±1.64	33
A phrase not B phrase	1.94±1.83	27
Superlative adjective	1.94±1.10	5
Reversible SOV	2.77±1.26	33
Sentences with noun coordinated phrase	1.94±1.83	22
Passive sentences	0.88±1.13	5
Locative adverbs	1.00±1.18	5
Pronoun binding	0.33±0.97	5
Comparative adjectives	0.77±1.10	0
Subject relative clauses	1.11±1.04	5

Abbreviations: DS: Down syndrome; SOV: Subject-object-verb.

Table 4. The proportion of correct responses for each syntax structure

Syntax Structures	Correct Response (%)*
Simple Structures	42.8
Moderate Structures	42.8
Complex Structures	14.2

* Number of correct answers to simple, moderate, and complex syntax structures was summarized and the proportion of correct answers in each category was calculated.

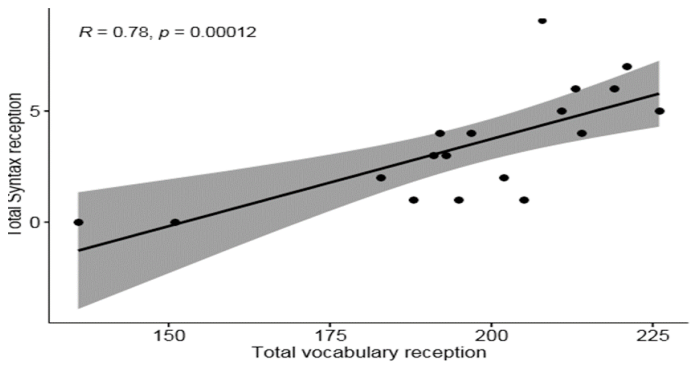

Figure 1. Correlation between the vocabulary reception and the syntax reception in DS children

shown an association between semantic representation and successful vocabulary retrieval and thus, since children with DS semantic representation is impaired, they may have difficulty in retrieving vocabulary [32]. Our observation on vocabulary expression is in line with some of the previous studies [13, 22]. However, our results are in contrast with some studies showing similar vocabulary reception in children with DS and TD children [6, 11, 12] or studies reporting a higher total vocabulary reception in children with DS than TD children of the same age [15, 16]. Differences in the results could be due to variability in chronological age, the language of the participants, different matching criteria, or tests used in the assessment.

In addition, we explored different vocabulary categories in the two groups. Among the tested vocabulary categories, reception of animal body parts (wing, tail, feather, etc.) was more difficult than other categories for children with DS while TD children had more trouble understanding colors. Both groups had their best performance with objects. Among the 15 categories, there was a significant difference between the two groups in 8 categories. However, in seven categories (body parts, edibles, clothes and tools, occupations, and nature and objects), the two groups performed similarly.

Researchers state that TD children begin vocabulary reception of familiar words like their names, their food names, and their body parts around 4-6 months old [33]. Visibility and the frequency of the use of words related to body parts might be the reason for this. TD children learn the names of body parts early and can name their limbs at an early age, this can also be attributed to children with DS due to being chronologically older. As a result, it is also easy for children with DS to learn such words. Edibles and objects are also among the visible and frequently used words that are often dealt with. Words of these three categories are among the first vocabulary to be received in children and thus, understanding them is easier for both groups. Moreover, studies show that visible words are best received both in children and adults [34].

As for verbs, an important vocabulary category, there was a great difference between the two groups. For this category, TD children performed well and most of them got complete points but children with DS had a weaker performance. Overall, verb reception develops later and takes more time than nouns during normal growth because verbs are labels for dynamic events that link different inputs together. When learning verbs, the newly heard verb can be attributed to various parts of an event, like the direction of movement or the style of movement [33]. Due to these complexities, it seems that learning verbs are more difficult than nouns for TD children, and so, even more difficult for children with DS [6].

We also showed that children with DS had a much weaker performance in syntax reception than TD children. Our results support previous research showing very low performance of children with DS in syntax reception [3, 24]. To note, we observed that children with DS had a weaker performance in verb reception than TD children of the same age. Some studies state that difficulty in learning verbs has a great role in delaying syntax development [6, 35]. Therefore, poor verb reception might be a reason for impaired syntax reception in these children.

Among syntax structures, passive sentences, sentences with superlative or comparative adjectives, sentences with locative adverbs, subject relative clauses, and pronoun binding had the lowest means and were difficult to understand for children with DS while more than half of these children gave correct answers to intransitive basic sentences and intransitive active simple sentences. About 30% of these children understood reversible SOV and prepositional phrases. Intransitive basic sentences were the easiest structure for children with DS to understand.

Most children with DS could comprehend all simple syntax structures of the test. Among simple structures, intransitive basic sentences were better understood than transitive active simple sentences, and the latter was better understood than negative sentences. Sentences with prepositional phrases were better understood than positive conjunction in compound sentences.

Among moderate structures, reversible SOVs were best comprehended. Reception of sentences with comparative and superlative adjectives was difficult for these children although, in Persian language, sentences with superlative adjectives are among intermediate syntax structures. The passive sentence was one of the moderate structures difficult for children with DS to comprehend, although research indicates that the passive structure emerges late in the language development in TD children (about 5 years old) [36-38], only 5% of DS children comprehend these structures.

Children with DS perform close to TD children in simple syntax structure reception but with increasing complexity, by adding grammatical morphemes (prepositions, pronouns, conjunctions, and relative clauses) the receptive ability of children with DS declines. As a result, these children are unable to understand complex syntax structures. Of course, due to the development of

language skills with increasing age, improvement in syntax comprehension, especially for complex structures, is expected in these children in adolescence and adulthood. This can be prospectively studied further.

There was a high correlation between vocabulary and syntax reception. In TD children, vocabulary reception starts at about 4 months of age and accelerates with increasing age [33]. Words are units of language that are made up of [39, 40], and vocabulary size and syntax development are associated, and developing syntax skills are directly influenced by vocabulary size in individuals [40]. As shown here, this correlation is still present between vocabulary and syntax reception in children with DS.

Research shows that IQ is not the only factor influencing syntax reception and impairment in other skills like short-term auditory memory, working memory, attention, and focus can lead to weakness in syntax reception [3, 20].This could be because syntax reception is more dependent on working and long-term memory [20, 41]. Children with weaker working memories have more difficulty understanding simple or complex sentences [3, 20]. However, the role of these cognitive skills on syntax reception has not been investigated in this study.

This is the first study to assess vocabulary and syntax reception in an Iranian population. We investigated vocabulary reception in more detail for each semantic category. This study has some limitations. First, since there were normal values for the syntax reception test, this test was not carried out on the TD children, and thus, we could not have a head-to-head comparison of syntax reception in TD children and those with DS. Also, we could not investigate the correlation between vocabulary reception and syntax reception in TD children. Second, children with DS have problems with memory skills, especially in working memory. Memory seems to affect vocabulary reception and especially syntax reception [7, 20, 42] and children with better working memory perform better in understanding complex sentences [43]. One of the factors that determine the diversity of perception in children is their working memory capacity. However, it was not measured in this study. It is suggested that in future research working memory be evaluated when syntax comprehension is assessed.

5. Conclusion

Children with DS had a weaker vocabulary reception performance than their mental age-matched TD children. Among 15 categories assessed for reception in children with DS, their performance was assessed for edibles, body parts, objects, tools, clothes, occupation, and nature. Possibly, the more visible and frequent the words are, the easier it is for children with DS to understand them.

Syntax reception in children with DS was weaker than normal values of the test. There was a high correlation between vocabulary and syntax reception in children with DS. The higher the vocabulary reception, the stronger the syntax reception was in children with DS. Future studies should investigate the effect of sex on vocabulary and syntax reception and also their association with each other.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them.

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Authors' contributions

Conceptualization and Supervision: Reyhane Mohamadi; Methodology: Mahboobeh Rasouli; Investigation, writing-original draft, and writing-review & editing: Fatemeh Ashrafi, Bahar Arshi, Reyhane Mohamadi and Bentolhada Zarei Faskhodi; Data collection: Fatemeh Ashrafi and Bentolhada Zarei Faskhodi; Data analysis: Fatemeh Ashrafi and Bahar Arshi

Conflict of interest

The authors declare no conflict of interest.

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