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Receptive Language Skills among Younger, Adolescent, and Adults with Down Syndrome: The Use of the Growth-Scale-Vocabulary as a Measure

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Abstract

Individuals with Down syndrome (DS) demonstrate strength in receptive vocabulary. Most investigators, however, have used either standard scores or age equivalent scores to compare groups with DS. The current study reports on the use of the PPVT Growth-Scale-Vocabulary scores as a measure of comparison. Three groups of individuals with DS were compared on their PPVT GSV scores as well as on the Oral Written Language Scale (OWLS) and Listening Comprehension Scale. Findings indicated the adolescent group of individuals with DS had higher GSV scores than did either the younger age group or the adult group. Furthermore, the OWLs raw scores were not different across the three age groups. Vocabulary comprehension is the strength among individuals with down syndrome.

Keywords: Down syndrome; Language skills; Vocabulary; GSV

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Introduction

Down syndrome (DS) is the most common genetic cause of intellectual disability, affecting 1 in every 691 live births [1-3]. According to Chapman [4], studies have identified a specific behavioral phenotype marked by deficits in expressive language, especially in speech intelligibility, syntax, and morphology, accompanied by deficits in phonological working memory and strengths in vocabulary comprehension [5,6]. Vocabulary strengths appear to increase in adolescence but research support is ambiguous [7,8]. Chapman [4] found that the performance on the PPVT-3 [9] test was significantly greater than performance on the Test of Auditory Comprehension of Language-3 [10]. Similarly, Phillips, Loveall, Channell, & Conners [11] found the relationship between PPVT-4 [1] and the Leiter-R [12] were similar between groups of individuals with Down syndrome, Intellectual Disabilities (ID), and those who were Typically developing (TD).

A few studies have recently investigated the receptive vocabulary skills among individuals with DS. One study investigated the receptive language of adolescents and young adults with DS [6]. They compared receptive language skills between typically developing, Fragile X, and Down syndrome individuals. The individuals with Down syndrome performed less well than the individuals with Fragile X and younger typically developing individuals.

Another study, Deckers, Zaalen, Balkom, and Verhoeven [13] determined, through a longitudinal design in young children with DS, that receptive vocabulary was the best predictor of an adaptive level of function and early receptive vocabulary skills. Facon, Nuchadfee & Bollengier [14], in addition, used an item analyses to view the general receptive vocabulary of older children and adolescents with DS. They found the two groups were not qualitatively distinguishable. Law, Briscoe, Ang, Brown, Hermena, and Kapikian [15] further considered receptive vocabulary between individuals with DS, children with specific language impairment (SLI), and younger children with typical development (TD). Rather than use only raw scores for comparison, the authors assessed the breadth and depth of vocabulary. Depth of vocabulary was determined by displaying four semantically related pictures to the test item, and the individual was to select the correct choice. As expected, the SLI and TD group performed similarly on the breadth and depth items, whereas the individuals

with DS performed less well on the breadth and extensively lower on the depth items. The authors concluded that individuals with DS display a significant deficit in semantic knowledge.

In two separate investigations by the same authors with the same subject population [11,16], receptive vocabulary was evaluated in a group of individuals with DS, TD, and a group with intellectual disabilities (ID). Both studies used the PPVT-4 [1] and the Leiter International Performance Test-Revised [12]. In the earlier study, Phillips et al. [11] used the PPVT GSV scores as contrasts. There was no overall effect of the Group for the PPVT-4 over the Leiter-R performance scores. in the latter study [16], only PPVT raw scores were used. The results indicated that the groups with ID and TD scored significantly higher than did the group with DS.

McDuffie et al. [6] concluded that the PPVT is a "fair test of comprehension vocabulary size but not of conceptual difficulty" in individuals with Down syndrome. Interestingly, all of the studies reviewed either used Age Equivalent scores or Standard Scores for comparison. These measures are not adequate for comparison between younger and older individuals as well as individuals with specific disabilities, like Down syndrome [1].

According to Dunn and Dunn [1], The PPVT-4 contains growth-scale-value (GSV) scores for measuring a person's raw score for people of that age. It is not a normative score because it is not a comparison with a norm group. It is a Rasch linear transformation of raw scores to a growth score for statistical comparisons [17,18]. A raw score varies greatly by age level and, therefore, is not a useful measure of comparison. A GSV, in contrast, allows for a comparison of a 3-year-old child with a much older individual like an adult. It is an equal interval scale that permits the scores to be added, subtracted, and averaged.

The GSV can be used to demonstrate growth change in an individual across time. In contrast, a standard score generally remains at the same level because ones vocabulary increases as the person ages. If the standard score declines, which frequently occurs in individuals with Down syndrome, it implies that the rate of vocabulary has not increased at an average rate. It also appears as though the individual's vocabulary has decreased from previous testing. The GSV score controls for this discrepancy. Whereas the individual's standard score may stay the same, the GSV score will increase.

The GSV scores can also be determined between two tests such as the PPVT-III and the PPVT-4 [1]. Therefore, ones vocabulary can be compared across time between an earlier and current test. It can also be used to make comparison between groups of different ages. Standard scores, percentiles, and age equivalent scores are less useful.

An example using the GSV scale is demonstrated in a female subject with Down syndrome, named SG. At age 17 years 11 months, SG was administered the PPVT-III and again at age 20 years 5 months she received the PPVT-4. Since the two instruments yield different standard scores, it is difficult to demonstrate any vocabulary changes over her three year span. However, using GSV scores make this possible. That is, her PPVT-III raw score of 80 can be converted to a GSV score of 136 while her PPVT-4 score of 112 converts to a GSV score of 150. The difference between the two GSV scores of 14 points is significantly different and demonstrates a vocabulary growth over a three year age span.

For this reason, the raw scores, obtained from the PPVT-III and the PPVT-4, were converted to GSV scores in the present study for group comparisons. In addition, the use of Oral and Written Language Scales Comprehension (OWLS-Comprehension) was administered as a comparative measure of language comprehension.

Research Questions

1. Is there a difference in GSV scores between younger, adolescent, and adults with Down syndrome? Given the receptive vocabulary strengths in individuals with DS, we predicted that the GSV scores will not differ.
2. Do the GSV scores among younger, adolescent, and adults with Down syndrome predict language comprehension? Given the previous research on receptive vocabulary and language comprehension, we predicted that older individuals will perform better than younger individuals.

Method

Participants

We compared the PPVT-III or PPVT-4 GSV scores across three groups of individuals with Down syndrome (**Table 1**). The participants were assigned to three age groups for comparison:

Table 1 Characteristics of participants with Down syndrome (DS) across three age periods.

Variables	Age group 1 (n=29)	Age group 2 (n=22)	Age group 3 (n=34)	Total (N=85)
Mean chronological age	8;9	16; 4	29; 6	
Age ranges	5; 1 – 12; 11	13; 1-19; 11	20; 0-56; 8	
Gender: Males/Females	9/20	7/15	14/20	(n=30/55)
PPVT-III mean raw score (Std deviation)	61.0 (34.53)	92.33 (44.96)	61.09 (23.04)	(n=23)
PPVT-4 mean raw score (Std deviation)	60.09 (27.12)	103.73 (31.76)	86.43 (38.21)	(n=61)
GSV mean scale score (Std deviation)	112.86 (23.11)	143.91 (24.23)	127.47 (25.46)	(n=85)
OWLS: mean raw score (Std deviation)	22.47 (12.81)	36.17 (22.52)	35.34 (22.72)	(n=66)

a younger age group, an adolescent age group, and an adult age group. Age-group 1 consisted of 29 individuals with DS from 5;1 years to 12;11 years (mean age = 8;9 years, with 9 boys and 20 girls; Age-group 2 consisted of 22 adolescent individuals with DS ranging in age from 13;1 to 19;;11 years (mean age = 16;4 with 7 boys and 15 girls); and Age-group 3 consisted of 33 adults with DS ranging in age from 20;0 to 56;8 years (mean = 29;6 with 14 males and 20 females)

All of the participants were seen at GiGi's Playhouse Raleigh, NC. At GiGi's Playhouse, all ages are served, from pre-natal to adults. GiGi's Playhouse provides research-based curriculum that works towards advancing literacy, math skills, gross and fine motor skills, improving low muscle tone, building self-esteem, preparing for the workforce, GiGi's foster acceptance, awareness and networking resources for parents, siblings and the community. Part of the program is to provide speech, language, and literacy evaluations to all interested families. All programs are FREE of charge.

Testing

In a one-hour protocol, we administered a vocabulary comprehension test (either the PPVT-III or PPVT-4), an articulation test [19], a sight word reading vocabulary [20], and the language comprehension test (Oral and Written Language Scales, Listening Comprehension Scale) [2]. For this study, only the PPVT and the OWLS were considered. The GSV scale score for the PPVT was analyzed and the raw scores for the OWLS were included.

All testing was done by a team of 2 Communication Disorders graduate students under the supervision of the author. All examiners were trained on the protocol and testing skills needed to administer the instruments to individuals with DS. The test administration occurred over a period of two years and was administered by a total of 34 different graduate students. The scoring accuracy was always checked by the current author.

Results

All analyses were completed using the SPSS-21 program for windows [21]. Our initial assessment was to compare performances by Gender on mean GSV scale scores. An independent t-test was calculated and found to be nonsignificant (f=.442, p = .508). This confirms that GSV scale scores were similar for both the male and female subjects. Therefore, the two groups were combined for all other contrasts.

To test for the first research question, i.e., determining whether GSV scores would differ between age groups, a univariate analysis of variance across GSV scores by the three age-groups revealed a significant difference (F=10.187, p=.000, Eta2=.199). Post hoc Tukey-B contrast indicated that the adolescent group had higher GSV scores than did either the younger age-group or the adults. In contrast, the younger age group did not differ from the adult group. Thus, our prediction of a difference in GSV scores was found to be true, but only for the adolescent group of individuals with DS.

To test for the second research question, i.e., determining whether the GSV scores predict language comprehension, a multiple regression comparing the GSV scores for the three age-groups to the OWLS raw scores was determined. The results revealed a nonsignificant difference (F=2.754, p=.071, Eta2=.190). Thus, our prediction that the GSV scores would differ by age with the OWLS raw score was not found to be true.

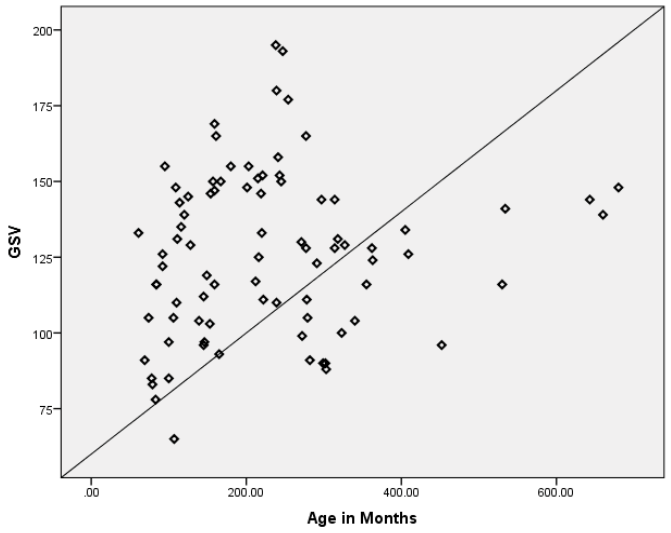

Figure 1 Scatterplots for GSV scores across ages for total group of individuals with Down syndrome.

We did a further analysis correlating (Pearson Correlation 2-tailed) the GSV scores with the OWLS raw scores. The finding indicated a moderate but significant correlation (r=.548, p=0001). This suggests that the two measures of comprehension (i.e., vocabulary comprehension and language comprehension) were "tapping" into similar behavior traits, in this case comprehension.

A final analysis consisted of a regression on GSV scores across the total group of individuals with Down syndrome. The GSV scores have been plotted in **Figure 1**. Age in months was found to be positive but a nonsignificant predictor of GSV scores (r=.155, F=2.016, df=1, 83, p=.159). The general regression equation was GSV=119+.03 age in months. Confidence intervals around the expected GSV score were 26.8.

Using the above equation, it is possible to determine whether an individual's GSV score falls within the range of vocabulary expected for that age group. For instance, using SG's (i.e., female with Down syndrome) GSV score of 150 at age 20 years of age (or 240 months), her expected GSV would be: 119+.03 x 240 or 119+7 or 126; with a confidence interval of approximately 27. This indicates a range of 99 to 153 for expected vocabulary. Since SG had a GSV score of 150, her vocabulary growth score falls within the expected range for her age.

Discussion

The goals of this study were to clarify the value of the PPVT [1,9] comprehension GSV scores across three different age groups of individuals with DS (i.e., younger students, adolescents, and adults). In addition, attempts were made to determine whether the GSV scores differ in language comprehension as measured by the OWLS: Listening Comprehension Scale [2].

The results did indicate a difference in GSV scores by the adolescent group over the younger age group and the adults. This supports the findings of Facon, Facon-Bollingier & Gruber [7] and Miolo, Chapman, & Sindberg [8] in that vocabulary appears to increase in adolescent individuals with DS. Why the adults in the current study did not also increase their vocabulary skills is speculative, but most likely related to the fact that these older individuals did not have the opportunity of early preschool education and literacy skills that the adolescent group in the current study had. The younger group, similarly, did not have the extended educational opportunity provided to the adolescent group. Therefore, it is not surprising that the adolescents had higher GSV scores than did the other groups.

Nevertheless, this investigation is the first to report findings that show the use of the GSV score for contrasts between the three age groups. Using the standard score or the age equivalent score available on the PPVT would have been problematic and impossible because these scores are affected by age. That is, an individual with DS may have a standard score of 80 at 5-years-of age but only a standard score of 65 at 7-years-of age because his/her ability to increase vocabulary does not increase at the same rate as the typical population. The GSV, however, allows a measure of comparisons across different age levels. Consequently, in the current study, the younger age group could be compared to the adult group and found to have no significantly different GSV scores.

The use of the GSV scores by chronological age, as was demonstrated in the female subject SG, indicates another advantage for determining whether the individual's receptive vocabulary lies within average range. Until now, the comparison of individual vocabulary skills has been limited to the general population. Using the current data, it is now possible to compare an individual with DS with his/her peers.

The finding that the GSV scores, across groups, did not differ when compared to the OWLS Listening Comprehension Scale does not support the work of Chapman [4]. In her study, she compared PPVT-3 age-equivalent scores and the Test of Auditory Comprehension (TACL) [10] and found the performance on the PPVT was significantly greater than performance on the TACL. Perhaps the difference between the current findings and those of Chapman lie with her using age equivalent scores whereas we used GSV scores. It is our assumption that valid measures across groups are more accurate when using GSV scores.

A final comparison, in the current study, demonstrated a relationship between the PPVT GSV scores and the raw scores found on the OWLS Listening Comprehension Scale. This suggests that both measures are assessing similar behaviors. These findings support the notion that the PPVT GSV is a fair test for measuring receptive language skills.

Conclusion and Limitations

The individuals with DS were evaluated because the parents or caretakers enrolled them for the evaluations at GiGi's Playhouse. Thus, this was a selective population and not the general population of individuals with DS. That is to say, it is possible that many other individuals did not take the opportunity to receive the evaluations because of ethnic, religious, or language barriers. Consequently, this makes generalization of our findings problematic and the findings should be considered with caution.

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