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Verbal Fluency Difficulties in Dyslexia and Developmental Language Disorder (DLD). Poor Representations or Slower Retrieval Processes?

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Abstract

Dyslexia and Developmental Language Disorder (hereafter DDLD) are two neurodevelopmental disorders which affect, respectively, the typical development of literacy and oral language skills. The current study investigated whether semantic fluency difficulties in dyslexia and DLD are better explained by impoverished semantic structure, or by slower retrieval processes of items from the lexicon while the semantic structure is intact. The semantic fluency task requires the production of as many words as possible which belong to certain categories, such as "animals". This is a task used to investigate lexical organization by analyzing clustering behavior (e.g., "pets"). Another type of fluency task is the phonological fluency task requiring the production of as many words as possible beginning with certain letters. This is a task used to investigate the quality of phonological representations by analyzing clustering behavior (e.g., *fl*ag-*fl*ower). Phonological representations refer to the abstracted way that speech sounds of a particular language are represented in the brain, and the current study investigated the locus of the phonological deficit. That is, whether phonological fluency difficulties in dyslexia and DLD are better explained by degraded phonological representations, or by deficient explicit access to phonological representations while implicit access to them is intact.

Keywords: Dyslexia; Developmental language disorder; Design fluency, Greek; Phonological fluency; Semantic fluency

Abbreviations

DDLD : Dyslexia and/or Developmental Language Disorder

DLD : Developmental Language Disorder

PCA : Principal Component Analysis

Introduction

The predictions of the current study could be summarized as follows. The Poor Lexical-Semantic Structure Model predicts that the DDLD group will produce a significantly smaller cluster size than the TD group [1]. In contrast, the Slow-Retrieval Model predicts that the two groups will not differ on cluster size [2]. Both models predict fewer items and fewer clusters in the DDLD group relative to the TD group [3]. The Degraded Phonological Representations Hypothesis predicts that the DDLD group will produce a significantly smaller cluster size than the TD group [4]. In contrast, the Deficient Phonological Access Hypothesis predicts that the two groups will not differ on cluster size [5]. Both hypotheses predict the production of fewer items in the DDLD group relative to the TD group.

Materials and Methods

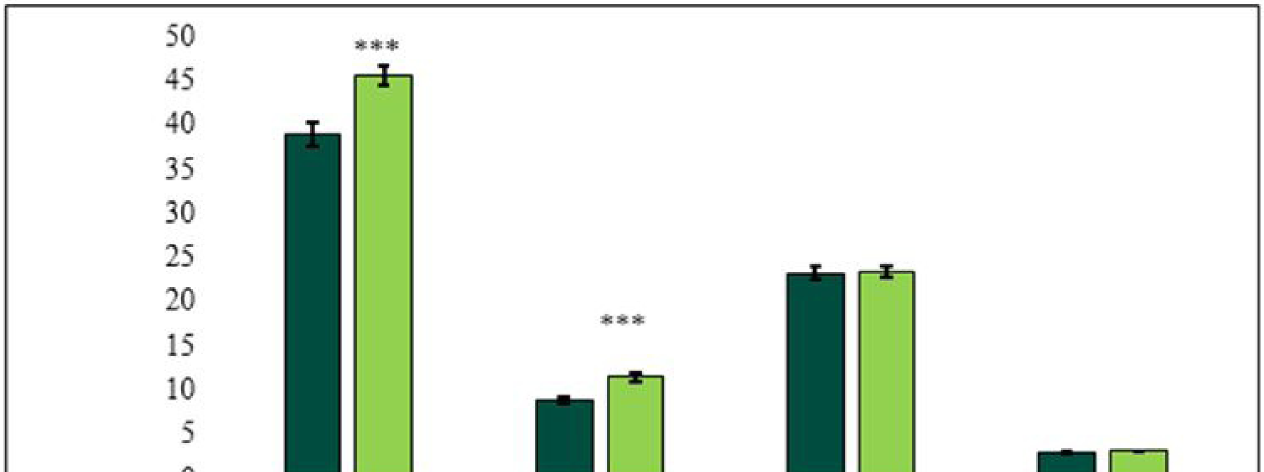
Participants were 66 Greek-speaking children with dyslexia and/or DLD, hereafter DDLD, and 83 TD children, all monolingual Greek speakers. The DDLD group had a mean age (*SD*, range) of 9.51 (1.46, 7;4-12;2) years and the TD group had a mean age of 8.37 (1.77, 6;3-12;4) years. The DDLD group was significantly older than the TD group, $t(147)=-4.30$, $p < 0.001$. On the Greek standardization of the nonverbal IQ task of the Raven's Colored Progressive Matrices (CPM) [6,7], the mean standard score of the DDLD group was 96.74 (*SD*=15.12) and of the TD group was 104.75 (12.94). The TD group significantly outperformed the DDLD group, $t(147)=3.48$, $p=0.001$, as has been found in [8] previous studies of children with literacy and language disorders. Nonverbal IQ was not statistically controlled in the analyses, however, following some researchers argued that using IQ scores as a covariate is misguided and unjustified in cognitive studies with children with neurodevelopmental disorders [9].

Two types of fluency tasks were used. Semantic fluency used the categories "animals", "foods", and "objects from around the house". Children were instructed to produce as many different words belonging to the target category as possible, allowing 60 sec for each category. No examples were given, but "countries" was used as a practice category. The number of correct responses retrieved for the three semantic categories was combined to create a composite semantic fluency score. Phonological fluency used the letters "chi", "sigma", and "alpha" of the Greek alphabet. Children were instructed to produce as many different words belonging to the target category as possible, allowing 60 sec for each category. No examples were given, but the letter "tau" was used as a practice category. The number of correct responses retrieved for the three phonological categories was combined to create a composite phonological fluency score. Nonverbal fluency used a design fluency task. The Neuropsychological Assessment [10] design fluency subtask contains two booklets of 35 five-dot designs each. Four designs were given as practice trials. Children were given 60 sec for each page to create as many different designs as fast as they can by connecting two or more dots in each square. The task measures visuospatial cognitive fluency and performance on the task is expressed as the number of unique designs in both booklets (maximum=70).

Participants also completed a range of tasks assessing language (verbal comprehension, syntax comprehension, sentence repetition, and receptive vocabulary tasks), literacy (reading accuracy, reading fluency, and spelling tasks), and phonological (phoneme deletion, non word repetition, and rapid automatic naming tasks) skills. Analyses used tested for significant group differences in the number of correct items produced in verbal fluency categories, and the number of clusters, switches, and cluster size (i.e., the number of items within a cluster). Analyses also tested the contribution of language, literacy, and phonological skills on semantic and phonological fluency performance. Last but not least, it was researched how specific is the verbal fluency deficit in children with DDLD, and whether it extends to a nonverbal task (design fluency).

Results

Children with DDLD produced fewer items in semantic and phonological fluency tasks than TD children, but a similar semantic and phonological cluster size was found in the two groups as Figures 1 and 2 present.



	No. of correct items	No. of clusters	No. of switches	Cluster size
DDLD group	38.86	8.73	23.08	2.80
TD group	45.40	11.32	23.28	2.95

DDLD group TD group

Figure 1: Raw scores (bars represent *SD*s) of the number of correct responses, the number of clusters, the number of switches, and average cluster size in semantic fluency categories in the DDLD and TD groups; *Notes:* $^{***}p < 0.001$; statistical significance is based on regression analyses.

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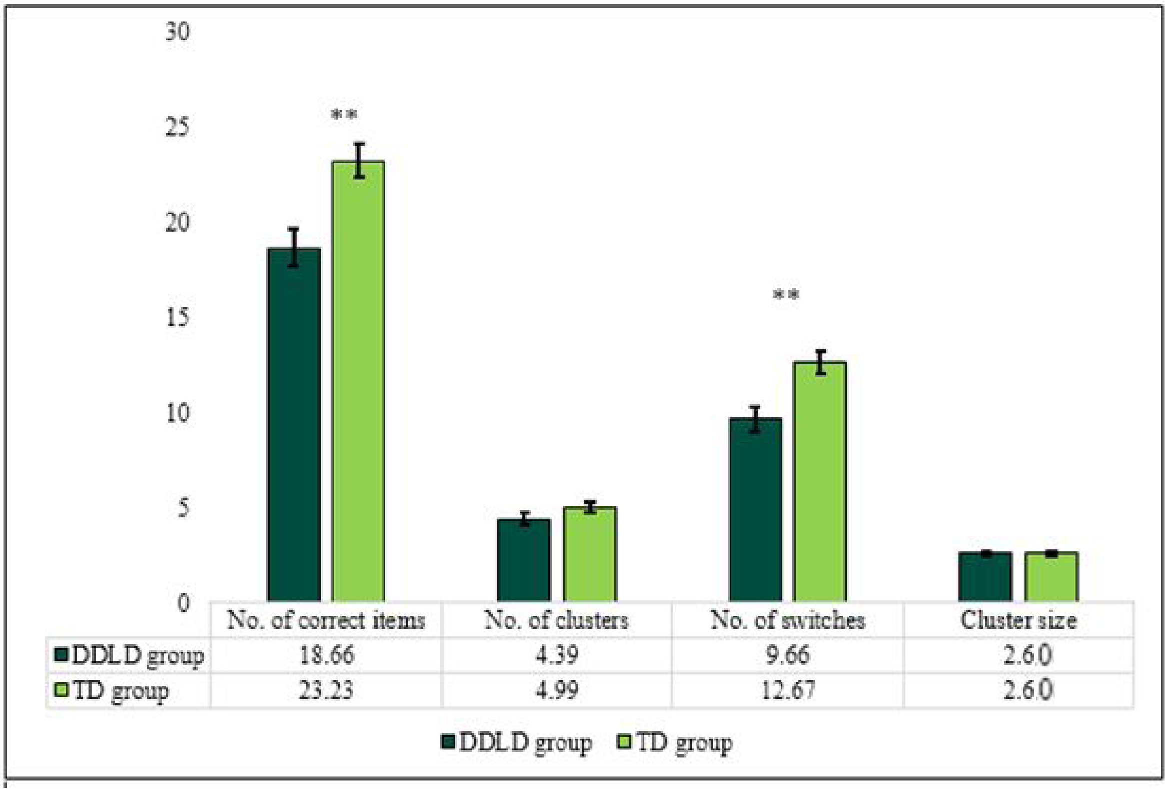

Figure 2: Raw scores (bars represent *SD*s) of the number of correct responses, the number of clusters the number of, switches and average cluster size in phonological fluency categories in the DDLD and TD groups; *Notes:*$^{**}p < 0.01$; statistical significance is based on regression analyses.

Further, 9.4 and 15.6%, respectively, of the variance in semantic and phonological fluency performance was predicted by language, literacy, and phonological skills referred to as component 1 in the analyses. First, a principal component analysis (PCA) was carried out. Next, a linear regression analysis was carried out in the overall sample with semantic fluency performance as the dependent variable, and age and component 1 as the predictors. Age was entered in the first block, and component 1 in the second block. This model was significant, $F(2,143)=39.090$, $p < 0.001$, accounting for 35.3% of the variance in semantic fluency performance. Age and component 1 were significant predictors; age: *Beta*=0.509, $t=7.095$, $p < 0.001$; component 1: *Beta*=0.378, $t=4.571$, $p<0.001$. Component 1 accounted for 9.4% of the variance in semantic fluency performance. The results demonstrate that children's language, literacy, and phonological skills significantly predict semantic fluency performance after controlling for age. Regarding phonological fluency performance, a linear regression analysis was carried out in the overall sample with phonological fluency performance as the dependent variable, and age and component 1 as the predictors. Age was entered in the first block, and component 1 in the second block. Both age and component 1 were significant predictors; age: *Beta*=0.447, $t=6.003$, $p < 0.001$; component 1: *Beta*=0.470, $t=5.882$, $p < 0.001$, and the model was significant, $F(2, 143)=39.524$, $p < 0.001$, accounting for 35.6% of the variance in phonological fluency performance. Component 1 accounted for 15.6% of the variance in phonological fluency performance. The results demonstrate that children's language, literacy, and phonological skills significantly predict phonological fluency performance after controlling for age.

Regarding design fluency performance, the regression model was significant for the number of correct designs, $F(3, 145)=31.529$, $p < 0.001$, accounting for 39.5% of the variance. Group was a non significant predictor of the number of correct designs. Thus, design fluency cannot differentiate well between children with and without DDLD.

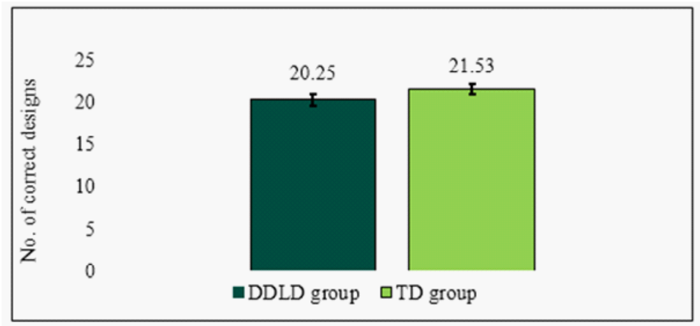

Figure 3: Raw scores (bars represent *SD*s) of the number of correct designs in the DDLD and TD groups.

Furthermore, children with DDLD showed poorer semantic and phonological fluency performance relative to their TD peers even after design fluency performance was controlled, demonstrating the specificity of their verbal fluency deficit. Specifically, in the overall sample, a partial (controlling for age) correlation revealed that the number of correct responses produced in semantic fluency tasks was weakly correlated with the number of correct designs generated in the design fluency task, $r(146)=0.188$, $p=0.022$. Therefore, in order to assess the specificity of the semantic fluency deficit in children with DDLD, an analysis of covariance (ANCOVA) was carried out, with the number of correct responses in semantic fluency tasks as a dependent variable, group as a fixed factor, and age in months and the number of correct designs generated in the design fluency task as covariate variables. ANCOVA revealed that there were group differences for the mean number of correct responses produced in semantic fluency tasks, $F(1, 145)=11.520$, $p=0.001$, $\eta p^2=0.074$. Likewise, in the overall sample, a partial (controlling for age) correlation revealed that the number of correct responses produced in phonological fluency tasks was weakly correlated with the number of correct designs generated in the design fluency task, $r(146)=0.268$, $p=0.001$. In order to assess the specificity of the phonological fluency deficit in children with DDLD, an ANCOVA was carried out, with the number of correct responses in phonological fluency tasks as a dependent variable, group as a fixed factor, and age in months and the number of correct designs generated in the design fluency task as covariate variables. ANCOVA revealed that there were group differences for the mean number of correct responses produced in phonological fluency tasks, $F(1, 145)=9.687$, $p=0.002$, $\eta p^2=0.063$. Together the results demonstrate that after the effects of age and design fluency performance were controlled, children with DDLD still show lexical retrieval difficulties in semantic and phonological fluency tasks, arguing for the specificity of the verbal fluency deficit in children with DDLD. Thus, verbal fluency difficulties and not general speed processing difficulties which might have resulted in lower semantic and phonological fluency performance account for DDLD children's lower verbal fluency performance.

Discussion

Slower retrieval processes originating from deficient access to intact semantic and phonological representations, and also inferior language, literacy, and phonological skills explain poorer verbal fluency performance in children with dyslexia and/or DLD [3,11]. Even though the underlying causes of slow lexical retrieval still need further investigation, insight into the models and hypotheses accounting for poorer verbal fluency performance may inform theory and theory can inform treatment and training of children with dyslexia and DLD in clinical and educational settings. As a first step towards this direction, intervention studies designed to improve children's retrieval processes are needed to investigate any potential gains on productivity in semantic and phonological fluency tasks.

It was predicted that in accordance with the two lexical-semantic models and the two phonological hypotheses, the DDLD group will not differ on design fluency performance from the TD group. It was hypothesized that if there is a slower processing speed in children with DDLD accounting for lower semantic and phonological fluency performance, lower design fluency performance would be also found in the DDLD group; however, if only verbal processing difficulties were to underlie poorer semantic and phonological fluency performance in children with DDLD, the two groups would show similar design fluency performance. The findings support the two lexical-semantic models and the two phonological hypotheses considered in that children with DDLD did not differ from TD children on the number of correct designs generated in the design fluency task, implying that children with DDLD perform age-appropriately. The specificity of the verbal fluency deficit is supported by evidence showing that after the effects of age and design fluency performance were controlled, children with DDLD still showed lexical retrieval difficulties in semantic and phonological fluency tasks.

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References

1. Messer D and Dockrell JE (2006) Children's naming and word-finding difficulties: descriptions and explanations. Journal of Speech, Language, and Hearing Research 49: 309-324.

2. Lenio S, Lissemore FM, Sajatovic M, Smyth KA, Tatsuoka C, et al. (2016) Detrending changes the temporal dynamics of a semantic fluency task. Frontiers in Aging Neuroscience 8: 1-9.

3. Mengisidou M, Marshall CR, Stavrakaki S (2020) Semantic fluency difficulties in developmental dyslexia and developmental language disorder (DLD): Poor semantic structure of the lexicon or slower retrieval processes? International Journal of Language and Communication Disorders 55: 200-215.

4. Goswami, U (2000) Phonological representations, reading development and dyslexia: Towards a cross-linguistic theoretical framework. Dyslexia 6: 133-151.

5. Ramus F and Szenkovits G (2008) What phonological deficit?. Quarterly Journal of Experimental Psychology 61: 129-141.

6. Sideridis G, Antoniou F, Mouzaki A, Simos P (2015) Raven's Educational CPM/CVS. Athens: Motivo.

7. Raven JC (2008) Raven's Coloured Progressive Matrices and Vocab. ulary Scales. Pearson: UK.

8. Ramus F, Marshall, CR, Rosen S, van der Lely HKJ (2013) Phonologi. cal deficits in specific language impairment and developmental dyslexia: Towards a multidimensional model. Brain 136: 630-645.

9. Dennis M, Francis, DJ, Cirino PT, Schachar R, Barnes MA et al. (2009) Why IQ is not a covariate in cognitive studies of neurodevelopmental disorders. Journal of the International Neuropsychological Society 15: 331-343.

10. Korkman M, Kirk U, Kemp S (1998) NEPSY: A Developmental Neu. ropsychological Assessment. San Antonio, TX: Psychological Corporation.

11. Mengisidou M and Marshall CR (2019) Deficient explicit access to. phonological representations explains phonological fluency difficulties in Greek children with dyslexia and/or developmental language disorder. Front Psychol 10: 1-16.