Função motora fina de escolares com dislexia, distúrbio e dificuldades de aprendizagem****

Fine motor function of school-aged children with dyslexia, learning disability and learning difficulties

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****Trabalho Realizado no Centro de Estudos da Educação e Saúde (CEES) da FFC - Unesp - Marília.

Artigo Original de Pesquisa

Artigo Submetido a Avaliação por Pares

Conflito de Interesse: não

Recebido em 21.01.2010.
Revisado em 13.05.2010; 12.08.2010; 24.08.2010.
Aceito para Publicação em 01.09.2010.

Abstract
Background: fine motor function of school-aged children with dyslexia, learning disabilities and learning difficulties. Aim: this study aimed to characterize the fine motor, sensory and perceptive function of school-aged children with dyslexia, learning disabilities and learning difficulties and to correlate these results with the analysis of the children's handwriting. Method: participants were 80 2nd to 4th graders, ranging in age from 7 to 12 years, of both genders, divided as follows: GI: composed of 20 students with dyslexia, GII: composed of 20 students with learning disabilities, GIII: composed of 20 students with learning difficulties and GIV: composed of 20 good readers. All of the children were submitted to an assessment of the fine motor, sensorial and perceptive functions using the Dysgraphia Scale. Results: the results indicated that most groups presented a poor performance in tests of FMF7 (fingers opposition), S8 (graphestesia) and P1 (body imitation). GI and GII were the groups that presented the worst performance in most of the tests when compared to GIII and GIV. Regarding handwriting, it was observed that all of the children in GII are dysgraphics. Conclusion: the presence of motor, sensorial and perceptive alterations is a characteristic of children with learning disabilities and dyslexia. However this characteristic may or may not be found in children with learning difficulties, therefore motor, sensorial and perceptive alterations are responsible for the dysgraphic behavior observed in the children with learning disabilities of the present study.
Key Words: Dyslexia; Learning Disorders; Motor Skills.

Resumo
Tema: função motora fina em escolares com dislexia, distúrbio e dificuldades de aprendizagem. Objetivo: este estudo teve por objetivo caracterizar o desempenho da função motora fina, sensorial e perceptiva em escolares com dislexia, distúrbio e dificuldades de aprendizagem e correlacionar estes achados à escrita destes escolares. Método: participaram deste estudo 80 escolares da 2ª à 4ª série do ensino fundamental, na faixa etária de 7 a 12 anos de idade, de ambos os gêneros, distribuídos em: GI: formado por 20 escolares com dislexia, GII: formado por 20 escolares com distúrbio de aprendizagem, GIII: formado por 20 escolares com dificuldades de aprendizagem e GIV: formado por 20 escolares sem dificuldades de aprendizagem. Os escolares foram submetidos à avaliação da função motora fina, sensorial e perceptiva e análise da escrita por meio da escala de disgrafia. Resultados: os resultados evidenciaram que a maioria dos grupos apresentou desempenho inferior nas provas de FMF7 (oposição de dedos), S8 (grafoestesia) e P1 (imitar posturas). Os GI e GII foram os grupos que apresentaram desempenho inferior na maioria das provas em relação aos GIII e GIV. Quanto à grafia, observou-se que no GII todos os escolares são disgráficos. Conclusão: a presença de alterações motora fina, sensorial e perceptiva é característica de escolares com distúrbio de aprendizagem e dislexia, entretanto esta característica pode ou não ser encontrada nos escolares com dificuldades de aprendizagem, sendo, portanto, esta alteração responsável pelo comportamento disgráfico dos escolares com transtornos de aprendizagem deste estudo.
Palavras-Chave: Dislexia; Transtornos da Aprendizagem; Destreza Motora.

Referenciar este material como:
Capellini AS, Coppede AC, Valle TR. Fine motor function of school-aged children with dyslexia, learning disability and learning difficulties (original title: Função motora fina de escolares com dislexia, distúrbio e dificuldades de aprendizagem). Pró-Fono Revista de Atualização Científica. 2010 jul-set;22(3):201-8.

Introduction

The literature indicates that at least 50% of students with learning problems have a developmental disorder of motor coordination. This relationship between changes in motor coordination and learning disabilities can be a sign of increased vulnerability of neural work that is responsible for sensory-motor integration of information 1-3.

Due to the fact that dyslexia and learning disabilities are related to the change in academic performance, most studies are focused mainly on the description of linguistic and cognitive behaviors related to reading and writing. However, studies indicate the presence of changes in motor ability in these populations 4,5. Studies have shown that people with dyslexia and learning disabilities present difficulties in bimanual coordination, manual dexterity and fine motor skills, explaining the occurrence of dysgraphia in this population 4, 6-8.

Based on the above, this study aimed to characterize the fine, sensory and perceptive function performance in students with dyslexia, learning disabilities and learning difficulties and to correlate this performance with the analysis of these students' handwriting.

Method

This study was approved by the Committee of Ethics in Research from the Faculty of Sciences - FFC / UNESP - Marília, under protocol number 3405/2006.

A total of 80 students from both genders, aged 7 years and 1 month to 11 years and 11 months old, from 2nd to 4th grades of public schools, divided into four groups:

Group I (GI): composed by 20 students with interdisciplinary diagnosis of dyslexia, average age of 10.5 years old, 12 males and 8 females, 30% on 2nd grade, 35% on 3rd grade and 35% on 4th grade of elementary school.

Group II (GII): composed by 20 students with interdisciplinary diagnosis of learning disabilities, average age of 9.9 years old, 10 males and 10 females, 35% on 2nd grade, 35% on 3rd grade and 30% on the 4th grade of elementary school.

The diagnosis of GI and GII was conducted by an interdisciplinary team of the Center of Studies on Education and Health - CEES / UNESP - Marília and Child Neurology Ambulatory - Learning of the Clinical Hospital of the Faculty of Medicine, UNESP-Botucatu, including clinical speech language, neurological, educational, neuropsychological and neuroimaging assessments.

Group III (GIII): composed by 20 students with learning difficulties from a local public school in Marília-SP, average age of 10.5 years old, 12 males and 8 females, 30% on 2nd grade, 35% on 3rd grade and 35% on 4th grade of elementary school.

Group IV (GIV): composed by 20 students without learning difficulties from a local public school in Marília-SP, average age of 10.5 years old, 12 males and 8 females, 35% on 2nd grade, 30% on 3rd grade and 35% on 4th grade of elementary school.

The students in GIII and GIV were selected by teachers based on grade point average of at least two consecutive periods, and high-performing students are the ones who presented a satisfactory performance in Portuguese language tests, and students with learning difficulties, those whose performance was unsatisfactory in this evaluation.

For this study, the students were subjected to:

1. Fine Motor Function Assessment.

This evaluation9 is divided into three parts, in which each is composed of specific tests:

Part 1 - Fine Motor Function: composed of seven tests, which are to: grip, put coins in the safe, nail tacks into the cork, pour a glass of water into another, screw, put beads on a string and finger opposition:
Part 2 - Sensory Motor Function: composed of nine tests, which are: a sense of position of the upper and lower extremities, discrimination of touch with a brush, feeling of pain, temperature sensation, sharp differentiation of the hand, Stereognosis, graphestesia, two-point discrimination and extinction of body parts.
Part 3 - Perceptual Motor Function: comprised of five tests, and imitation of postures, buttoning 5 buttons, tying the ribbon, contouring around the figure and cutting a circle.

Data collection with the children was performed individually in a single session 40-50 minutes each. Data analysis was performed using scores on a scale of 0-3, where: 0 = no function (when not performing the test required), 1 = Low (performs the test with great difficulty), 2 = Fair (held test with difficulty) 3 = Normal (performs the test properly.) The points of all the tests were divided by the total number of tests, which can demonstrate the following result: Grave Dysfunction: 0.0 - 0.9; Moderate Dysfunction: 1.0 - 1.9; Mild Dysfunction: 2.0 - 2.8; No Dysfunction: 2.9 to 3.0.

2. Handwriting Analysis.

Students were asked to write a dictation. The handwriting analysis was performed by applying the Dysgraphia Scale10. This scale consists of 10 assessment items to identify the presence of floating lines, ascending/descending lines; irregular space between words, letters retouched; curvatures of the arches of the angles M, N, U, V; junction points; collisions and adhesions, jerky movements, irregular sizes and bad shapes.

The scoring criteria used to analyze the performance of students in the writing of this study was proposed by Lorenzini10, i.e., the overall score should range from zero to seventeen points and every student with a score of less than eight points and a half (50% of the total grade) is considered dysgraphic.

The results of this study were statistically analyzed by SPSS (Statistical Package for Social Sciences), version 13.0.

Results

Table 1 shows the intragroup comparison of the performance of students on tests of fine motor, sensory and perceptual motor function. With the application of the Friedman test, there was a statistically significant difference when comparing the performance between the tests, showing that students in GI had lower performance in tests FMF7, FMS8 and FMP1, respectively, fingers opposition, graphestesia and imitation of posture while students from GII had a poorer performance on tests of FMF5, FMF7, FMS8, FMS9, FMP1, FMP4 respectively screwing, finger opposition, graphestesia, two-point discrimination, imitation of posture and contouring figure.

The students from GIII had a poorer performance in tests of FMF3, FMF5, FMF7, FMS8, FMP1 and FMP5, respectively, nailing tacks into the cork, screwing, finger opposition, graphestesia, imitation of posture and cutting a circle, while the students from GIV had lower performances on tests of FMF5, FMF7 and FMF8, respectively, screwing, and finger opposition, graphestesia.

Regarding the classification of fine, sensory and perceptual motor function, it is considered that GI presented 20% of students with moderate dysfunction, 50% with mild dysfunction and 30% without dysfunction, while GII had 95% of students with mild and 5% without dysfunction. The GIII had 90% of students with mild dysfunction and 10% without dysfunction and GIV showed 55% of students with mild dysfunction and 45% without dysfunction.

In Table 2 the frequency of each group of students who presented clinical symptoms of dysgraphia is shown. With the application of Kruskal-Wallis test, there was a statistically significant difference indicating that GI and GII had a great number of students, respectively 17 (85%) from GI and 20 (100%) from GII, with dysgraphia

The analysis of table 3 was performed using the Spearman correlation, in order to ascertain the degree of relationship between the framework of dysgraphia and the evidence of fine, sensory, perceptual motor function and cooperation in groups in this study. With this analysis, it was found that there was a significant correlation between the evidence of FMF3, FMP1, and FMP3, respectively, to nail stacks in the cork, to imitate postures and to contour a figure in GIV.

Legenda: FMF1: preensão, FMF2: colocar moedas no cofre, FMF3: pregar tachinhas na cortiça, FMF4: derramar água de um copo para outro, FMF5: parafusar, FMF6: colocar contas num fio, FMF7: oposição de dedos, FMS1: senso de posição das extremidades superiores e inferiores, FMS2: discriminação de tato com pincel, FMF3: sensação de dor, FMF4: sensação de temperatura, FMS5: diferenciação de pontiagudo da mão, FMS6: estereognosia, FMS7: grafoestesia, FMS8: discriminação de dois pontos, FMS9: extinção das partes do corpo, FMP1: imitação de posturas, FMP2: abotoar cinco botões, FMP3: dar laço na fita, FMP4: contornar figura, FMP5: recortar um círculo.

TABLE 1. Distribution of the median and p-value related to the performance of students in GI, GII, GIII and GIV in tests of fine, sensory and perceptual motor function.

Variable	GI		GII		GIII		GIV	
	Median	P value	Median	P value	Median	P value	Median	P value
FMF1	3,00	0,234	3,00	0,317	3,00	0,157	3,00	1,000
FMF2	3,00	0,262	3,00	0,157	3,00	1,000	3,00	1,000
FMF3	3,00	0,317	3,00	0,102	2,00	0,000*	3,00	1,000
FMF4	3,00	0,121	3,00	0,096	3,00	1,000	3,00	1,000
FMF5	2,00	0,083	2,50	0,000*	2,00	0,002*	2,00	0,001*
FMF6	3,00	0,236	3,00	0,414	3,00	1,000	3,00	0,317
FMF7	2,00	0,004*	2,00	0,009*	2,00	0,001*	2,00	0,001*
S1	3,00	0,158	3,00	0,180	3,00	1,000	3,00	1,000
S2	3,00	0,516	3,00	0,739	3,00	1,000	3,00	1,000
S3	3,00	0,550	3,00	0,739	3,00	0,059	3,00	1,000
S4	3,00	0,157	3,00	0,180	3,00	0,157	3,00	0,063
S5	3,00	0,322	3,00	0,739	3,00	0,317	3,00	1,000
S6	3,00	0,157	3,00	0,739	3,00	1,000	3,00	0,317
S7	2,00	0,518	1,00	0,073	2,00	0,157	2,00	1,000
S8	3,00	0,011*	2,50	0,000*	3,00	0,000*	3,00	0,000*
S9	3,00	0,134	3,00	0,000*	3,00	0,257	3,00	1,000
P1	3,00	0,001*	2,00	0,021*	2,00	0,001*	3,00	1,000
P2	3,00	0,414	3,00	1,000	3,00	0,157	3,00	1,000
P3	3,00	0,111	3,00	0,589	3,00	0,180	3,00	1,000
P4	3,00	0,058	2,50	0,035*	3,00	0,157	3,00	0,317
P5	3,00	0,763	3,00	1,000	2,50	0,002*	3,00	1,000
COOPERATION	3,00	0,002*	3,00	0,001*	3,00	0,001*	3,00	0,001*

Caption: FMF1: gripping, FMF2: putting coins in the safe, FMF3: nailing stacks in cork, FMF4: pouring water from one cup to another, FMF5: screwing, FMF6: putting beads on a string, FMF7: opposition of fingers, SMF1: position sense the upper and lower extremities, SMF2: discrimination of touch with the brush, SMF3: feeling pain, SMF4: temperature sensation, SMF5: sharp differentiation of the hand, SMF6: Stereognosis, SMF7: graphestesia, SMF8: discrimination of two points, SMF9: extinction of body parts, PMF1: imitation of postures, PMPF: buttoning 5 buttons, PMF3: tying the ribbon, PMF4: contouring figure, PMF5: cutting a circle.

TABLE 2. **Frequency distribution of dysgraphia in students of GI, GII, GIII and GIV.**

GROUP	DYSGRAPHIA		Total
	WITH	WITHOUT	
I	17	3	20
	85%	15%	100%
II	20	0	20
	100%	0%	100%
III	9	11	20
	45%	55%	100%
IV	3	17	20
	15%	85%	100%
Total	49	31	80
	61,25%	38,75%	100%

$p < 0,001$*

TABLE 3. Relationship between the variables of fine, sensory and perceptual motor function, cooperation and dysgraphia in GI, GII, GIII and GIV.

Variable	Statistics	DYSGRAPHIA			
		I	II	III	IV
FMF1	Correlation coefficient	0,096	—	—	—
	P value	0,686	—	—	—
	N	20	20	20	20
FMF2	Correlation coefficient	-0,196	—	0,034	—
	P value	0,409	—	0,888	—
	N	20	20	20	20
FMF3	Correlation coefficient	-0,140	—	0,154	0,464
	P value	0,556	—	0,518	0,039*
	N	20	20	20	20
FMF4	Correlation coefficient	0,209	—	—	—
	P value	0,376	—	—	—
	N	20	20	20	20
FMF5	Correlation coefficient	0,275	—	0,366	0,343
	P value	0,241	—	0,113	0,139
	N	20	20	20	20
FMF6	Correlation coefficient	0,176	—	0,179	0,140
	P value	0,458	—	0,450	0,556
	N	20	20	20	20
FMF7	Correlation coefficient	-0,103	—	-0,010	0,329
	P value	0,665	—	0,967	0,157
	N	20	20	20	20
S1	Correlation coefficient	0,332	—	—	—
	P value	0,153	—	—	—
	N	20	20	20	20
S2	Correlation coefficient	0,240	—	0,406	—
	P value	0,308	—	0,076	—
	N	20	20	20	20
S3	Correlation coefficient	0,240	—	—	—
	P value	0,309	—	—	—
	N	20	20	20	20
S4	Correlation coefficient	0,140	—	—	—
	P value	0,556	—	—	—
	N	20	20	20	20
S5	Correlation coefficient	0,240	—	-0,163	-0,096
	P value	0,308	—	0,494	0,686
	N	20	20	20	20
S6	Correlation coefficient	0,096	—	0,034	—
	P value	0,686	—	0,888	—
	N	20	20	20	20
S7	Correlation coefficient	0,067	—	0,368	0,308
	P value	0,781	—	0,111	0,186
	N	20	20	20	20

S8	Correlation coefficient	0,240	—	-0,310	—
	P value	0,309	—	0,183	—
	N	20	20	20	20
S9	Correlation coefficient	0,301	—	-0,208	—
	P value	0,197	—	0,380	—
	N	20	20	20	20
P1	Correlation coefficient	0,282	—	0,116	0,464
	P value	0,229	—	0,626	0,039*
	N	20	20	20	20
P2	Correlation coefficient	0,273	—	0,254	—
	P value	0,245	—	0,281	—
	N	20	20	20	20
P3	Correlation coefficient	0,243	—	-0,301	0,487
	P value	0,303	—	0,197	0,029*
	N	20	20	20	20
P4	Correlation coefficient	0,330	—	-0,010	0,031
	P value	0,155	—	0,966	0,898
	N	20	20	20	20
P5	Correlation coefficient	0,275	—	-0,101	0,081
	P value	0,241	—	0,673	0,735
	N	20	20	20	20
COOPERAÇÃO	Correlation coefficient	0,240	—	0,034	—
	P value	0,308	—	0,888	—
	N	20	20	20	20

Caption: FMF1: gripping, FMF2: putting coins in the safe, FMF3: nailing stacks in cork, FMF4: pouring water from one cup to another, FMF5: screwing, FMF6: putting beads on a string, FMF7: opposition of fingers, SMF1: position sense the upper and lower extremities, SMF2: discrimination of touch with the brush, SMF3: feeling pain, SMF4: temperature sensation, SMF5: sharp differentiation of the hand, SMF6: Stereognosis, SMF7: graphestesia, SMF8: discrimination of two points, SMF9: extinction of body parts, PMF1: imitation of postures, PMPF: buttoning 5 buttons, PMF3: tying the ribbon, PMF4: contouring figure, PMF5: cutting a circle.

Discussion

Regarding the fine motor function, we observed that the evidence of FMF5, and FMF7 respectively differentiation of objects and fingers opposition, showed that the students from all groups had poorer performance, as compared with other tests of fine motor function, they were statistically different in most comparisons. As for sensory motor function, we observed that all groups showed lower performance in FMS8, graphestesia, whereas in perceptual motor function, it was found that all groups showed lower performance in FMP1, imitation of posture 11-15.

The study indicates that the change in fine motor function may be present in students with and without learning difficulties, learning disabilities and dyslexia, although GI and GII had a lower percentage of students without the dysfunction. Amongst the groups in this study, we demonstrated that 85% of GI and GII presented 100% of dysgraphia, showing that the fine motor, sensory and perceptive alterations are directly responsible for the changes in the handwriting of these students, which was not identified in GIII and GIV.

The evidence corroborates international studies 4,6,14,16-18, which reported that dysgraphia is present in the population of students with learning disabilities due to change in the fine motor function.

As for the relationship between fine, sensory, perceptual motor function and handwriting, it was observed that the correlation occurred between the students in GIV and the FMF3 FMP1, and FMP3 tasks, respectively nailing tacks in cork, imitating postures and tying ribbons, indicating that the lower the frequency of dysgraphia, the better the performance on fine motor function and global motor function, This can be explained by the fact that students in academic development phase requiring fine and global motor experiences to carry out activities such as dressing, eating, riding a bike and writing 7, 19-21.

Conclusion

The results of this study showed that:

. the change in motor function may be present in both students with and without learning difficulties, learning disabilities and dyslexia, but the students from GI and GII had a higher percentage of subjects with moderate dysfunction and mild dysfunction.
- in relation to handwriting, GI and GII presented higher frequency of children with dysgraphia, showing that the fine, sensory and perceptual motor function alteration present are directly responsible for dysgraphia within these groups.
- there was a correlation between lack of dysgraphia and the evidence of fine, sensory, perceptual motor function in GIV, showing that students without learning difficulties do not have dysgraphia for developing fine and global motor experiences.

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