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Language Disabilities in Three Twin Pairs and Their Relatives

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Abstract. Three pairs of monozygotic twins were ascertained during a general survey of language disabilities conducted among schoolchildren of Porto Alegre, Brazil. Two of them were concordant for dysgraphia, dysorthographia, dyslexia, and speech defects, while the other was concordant for dysorthographia and dyslexia, but discordant for dysgraphia. Two of the mothers and two sibs also presented language problems, but of a type that was not completely similar to those of the twins. Concomitant neurological and psychological studies, as well as the family histories, helped to understand the similarities and dissimilarities observed.

Key words: **Language disabilities, Neuropsychological evaluations, Dysgraphia, Dysorthographia, Dyslexia, Speech defects**

INTRODUCTION

Twin studies concerning language disabilities are not numerous, and they have been generally concerned with dyslexia [7,16,19] or speech defects [5,8,11,12] only; moreover, they did not include the investigation of the twins' relatives. Therefore, when we ascertained three pairs of twins during a general survey on language disabilities conducted among schoolchildren of Porto Alegre, Brazil, we decided to study their parents and sibs, and to report the results in detail. These data are presented herein.

SUBJECTS AND METHODS

The survey was performed in 1,598 schoolchildren from five primary public schools, chosen at random from those attended by children of average socioeconomic level. The screening procedure used was a spelling test, and four of the six twins were ascertained in this way.

The zygosity diagnosis was made using the ABO, MNSs, Rh (five sera), Duffy, Kell and P blood groups; haptoglobin, transferrin, ceruloplasmin and albumin serum protein types; and the following erythrocyte enzyme systems: phosphoglucomutase (loci 1 and 2), glucose-6-phosphate dehydrogenase, phosphogluconate dehydrogenase, adenylate kinase and adenosine deaminase. The methods used were described or referenced in [15]. The highest probability of dizygosity in the three pairs, all of them concordant for all these genetic markers, was calculated as 2%, following procedures given in [13]. The three pairs, therefore were classified as monozygotic.

For the diagnosis of the language disabilities, specific pedagogical tests were elaborated, with different versions for children and adults [3]. For the first, the application of the writing tests involved three sessions of 50 min each, while the reading and comprehension, as well as speech and articulation tests, were conducted in two other 50 min sessions. The adults were studied in sessions of 120 min duration.

The neurological studies included temporal and spatial organization tests [2,4,17], lateral dominance measures [6] and Lefèvre's neurological development profile [10,14], applied in 60 min sessions. Psychological evaluations involved the WISC as well as Bender (Koppitz-Santucci) tests, adapted for use in Brazil [1,9,18], conducted in four 60 min sessions. Finally, information about the twins' pre-peri-and postnatal development, as well as that of their sibs, about the presence of language and/or learning disabilities in their families, and about their socioeconomic levels, were obtained from their mothers, in interviews that lasted about one hour.

RESULTS AND DISCUSSION

All the three pairs of twins have parents of high socioeconomic level; the parents of the c pair (Figure) are now divorced, and the twins are being raised by their mother. Their conditions at birth have been described as good, cII-1 having a birthweight of 2,490g and his brother of 2,420g. The same is not true for the other two pairs, who were born prematurely and in bad health conditions. Their birthweights were as follows: aII-1 and aII-2: 1,200 g; bII-2 and bII-3: 1,850g. Twins aII-1 and aII-2 showed retardation in their language development. Both started to speak the first words at age two only, and to make sentences half-a-year later. No other cases of persons with language difficulties were reported in the three families, besides those indicated in the Figure.

Table 1 presents the results of neuropsychological evaluations made in the three pairs and two sibs of the probands. The spatial evaluation in the neurological evolutional examination, as well as the trunk-limbs coordination assessment in Lefèvre's tests, could not be made in aII-2 because he had poliomyelitis at the age of one year and two months, having as a sequela one leg shorter than the other. Twins aII-1 and aII-2 were not evaluated psychologically because at the time the tests were being performed they had moved without leaving their new address.

Of all subjects tested (the three pairs + two sibs) only aII-2 and aII-3 had problems with the neurological evolutional examination. Discordance concerning laterality occurred in twins bII-2 and bII-3 only, one being classified as total right and the other as not established. As for the neurological development profile, discordance was now observed in twins cII-1 and cII-2. No such discordances were found in the psychological tests, both members of one of the pairs being classified as low average in the WISC and Bender evaluations, while in the other classifications were average for the WISC and low average for the Bender determinations.

The data on language are presented in Table 2 and in the Figure. Concordance was now striking between the twins in relation both to types and number of errors, considering writing, reading and speech tests (exceptions are the number of orthographic errors

Table 1 - Neuropsychological Evaluations of three Pairs of Monozygotic Twins and their Sibs

Evaluation	Position in the pedigrees and age (yr)							
	aII-1 9	aII-2 9	aII-3 8	bII-2 9	bII-3 9	bII-1 11	cII-1 9	cII-2 9
Neurological								
Neurological evolutional examination:								
Temporal and spatial organization								
Knowledge	A	I	I	A	A	A	A	A
Gesture imitation	I	I	I	A	A	A	I	A
Spatial evaluation	A	NT	I	A	I	A	A	A
Rhythm	A	A	A	A	A	A	A	I
Temporal and spatial structuring	A	I	A	A	A	A	A	A
Laterality								
Hand	r	M	r	R	R	R	L	r
Eye	R	l	R	R	r	R	L	r
Foot	R	L	R	R	R	R	M	R
Lateral dominance	NE	NE	NE	R	NE	R	NE	NE
Lefèvre's tests								
Static balance	A	I	BA	BA	BA	BA	A	A
Dynamic balance	I	I	A	A	A	A	A	A
Appendicular coordination	I	I	I	A	BA	A	A	BA
Trunk-limbs coordination	A	NT	A	I	I	A	A	A
Motor persistence	BA	I	BA	A	A	A	A	A
Neurological development profile	I	I	I	I	I	BA	A	BA
Psychological								
WISC								
Verbal IQ	NT	NT	NT	LA	B	AV	B	AV
Performance IQ	NT	NT	NT	LA	LA	AV	HA	AV
Global IQ	NT	NT	NT	LA	LA	AV	AV	AV
Bender								
Gestaltic visual and motor function (Koppitz)	NT	NT	NT	LA	LA	LA	LA	LA
Graphic and motor level (Santucci)	NT	NT	NT	LA	LA	LA	LA	LA

KEY TO ABBREVIATIONS. Neurological evolutional examination: A, Adequate; I, Inadequate. Laterality: L, Total left; l, Preponderantly left; M, mixed; NE, Not established; R, Total Right; r, Preponderantly right. Lefèvre's tests: A, Adequate; BA, Barely adequate; I, Inadequate. WISC and Bender: AV, Average; B, Borderline; HA, High Average; LA, Low average. For all tests: NT, Not tested.

Table 2 - Evaluations Concerning Language Defects in Three Pairs of Monozygotic Twins, Their Parents and Sibs

Characteristics	Position in the pedigrees												
	aII-1	aII-2	aII-3	aI-1	aI-2	bII-2	bII-3	bII-1	bI-1	bI-2	cII-1	cII-2	cI-2
Age (yr)	9	9	8	35	29	9	9	11	38	37	9	9	27
Degree of schooling	2 nd: grade	1 st grade	2 nd grade	Univ.	Prim. Incompl.	2 nd grade	2 nd grade	5 th grade	Prim.	Prim.	3 rd grade	3 rd grade	Univ.
Writing													
Graphic errors													
Types	M, P	M, P	P	P	M, P	M, P	M, P	–	–	P	P	P	–
Numbers	6	5	6	1	1	8	7	0	0	1	7	3	0
Agreement with proband	–	3	3	1	1	–	7	–	–	1	–	3	–
Orthographic errors													
Types	A,V,U,	A,V,U,	A,V,U,	V	A, V	A, V	A, V	A, V	V	A, V	A,V,U	A, V	A
Number	170	35	117	12	88	121	107	96	30	16	228	43	6
Agreement with proband	–	28	78	11	59	–	51	45	12	13	–	43	4
Reading													
Reading errors													
Types	C,I,S,T	C,I,T	C,I,T	–	C,I	C,I,S,T	C,I,S,T,	C,I,T	–	C,I,T	C,I,T	C,I,T	–
Number	30	9	15	0	19	15	15	9	0	4	10	8	0
Agreement with proband	–	9	8	–	9	–	12	8	–	2	–	7	–
Speech													
Speech errors													
Number of types	7	7	7	0	0	7	7	2	0	5	0	0	0
Agreement with proband	–	7	7	–	–	–	7	2	–	5	–	–	–
General language errors													
Number of types	9	7	8	2	5	6	6	7	2	4	7	5	2
Agreement with proband	–	7	8	2	5	–	6	6	2	4	–	4	2
Language defects													
Dysgraphia	+	+	+	—	—	+	+	—	—	—	+	—	—
Dysorthographia	+	+	+	—	+	+	+	+	—	+	+	+	—
Dyslexia	+	+	+	—	+	+	+	+	—	+	+	+	—
Speech disability	+	+	+	—	—	+	+	—	—	+	—	—	—

KEY TO ABBREVIATIONS. A, Auditive; C, Comprehensive; I, Interpretative; M, Motor; P, Perceptual; S, Spatial; T, Temporal; U, Unclassified; V, Visual; +, Present; –, Absent.

in twins aII-1 and aII-2, and cII-1 and cII-2, and one discrepancy for types of reading errors in aII-1 and aII-2.) Considering all tests together, the diagnoses are presented at the bottom of Table 2 and of the Figure. Pairs of families a and b present all four main disabilities (dysgraphia, dysorthographia, dyslexia and speech defects) in a concordant way; while those of family c are concordant for dysorthographia and dyslexia, but discordant for dysgraphia. It should be stressed that all twins have always studied in separate classrooms. As for the twins' relatives, in pedigrees a and b the two mothers, one sister and one brother also showed language disabilities, although in three of the four cases they differed somewhat from those of the twins.

It could be thought that the discordance concerning dysgraphia in twins cII-1 and cII-2 would be related to differences in hemispheric specialization. But the dysgraphic twin presented a more defined hand and eye lateralisation and showed a higher performance IQ than his cotwin; it is however true that he performed poorly than the latter in the gesture imitation test of the neurological evolutional examination.

The results presented here agree in a general way with previous findings concerning dyslexia and speech defects. In relation to the former disability, only 5 of 74 pairs of monozygotic twins (7%) were reported as discordant [7,16,19]; while for speech development, word articulation and stuttering, this value would be about 10% in nearly 200 monozygotic pairs [5,8,11,12]. Much higher frequencies were found among dizygotic pairs. The influence of genetic factors in the etiology of language disabilities is now clearly established, although details of the gene-environmental interaction in the different categories of such defects are far from being elucidated.

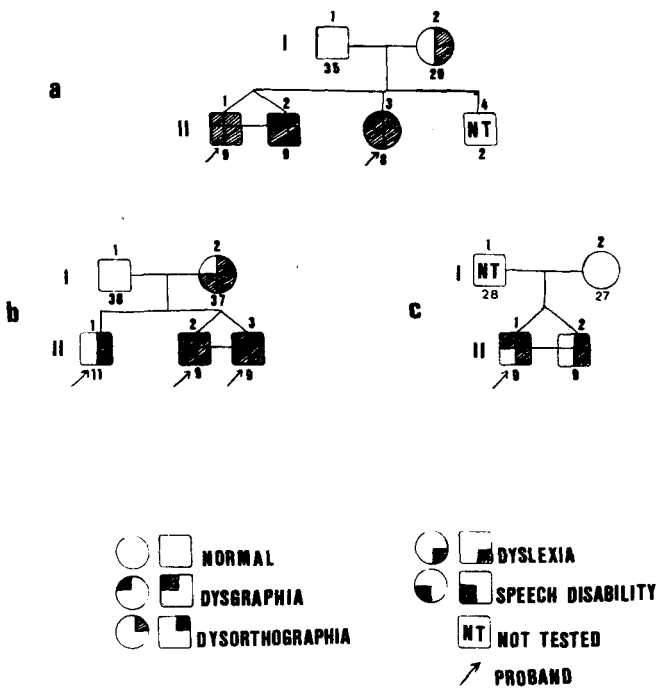

Figure. Language disabilities observed in three pairs of twins and their close relatives.

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REFERENCES

1. Bender L (1974): Test Guestáltico Visomotor: Usos y Aplicaciones Clínicas (BG), 6th Ed. Buenos Aires: Paidós.
2. Borel-Maisonny S (1960): Language Oral et Ecrit. Neuchâtel: Delachaux & Niestlé.
3. Borges-Osório MRL (1985): Fatores Genéticos e do Ambiente nos Distúrbios de Linguagem. Ph.D. Thesis, Curso de Pós-graduação em Genética, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.
4. Galifret-Granjon N (1960): Une batterie de dominance latérale. In Zazzo R (ed): Manuel pour l'Examen Psychologique de l'Enfant. Delachaux & Niestlé, p. 18-36.
5. Godai U, Tatarelli R, Bonanni G (1976): Stuttering and tics in twins. Acta Genet Med Gemellol 25:369-375.
6. Harris AJ (1958): Harris Tests of Lateral Dominance, 3rd Ed. New York: Psychological Corporation.
7. Herschel M (1978): Dyslexia revisited; a review. Hum Genet 40:115-134.
8. Howie PM (1981): Intrapair similarity in frequency of disfluency in monozygotic twin pairs containing stutterers. Behav Genet 11:227-238.
9. Koppitz EM (1980): El Test Guestáltico Visomotor para Niños, 8th Ed. Buenos Aires: Guadalupe.
10. Lefèvre AB (1972): Exame Neurológico Evolutivo do Pré-Escolar Normal. São Paulo: Sarvier.
11. Lenneberg EH (1967): Language in light of evolution and genetics. In Lenneberg EH (ed): Biological Foundations of Language. New York: John Wiley & Sons, p. 227-270.
12. Matheny AP Jr, Bruggemann CE (1973): Children's speech hereditary components and sex differences. Folia Phoniat 25: 442-449.
13. Maynard-Smith S, Penrose LS, Smith CAB (1961): Mathematical Tables for Research Workers in Human Genetics. Boston: Little, Brown & Co.
14. Rotta NT (1975): Avaliação Neurológica Evolutiva, Eletrencefalográfica e Psicológica em Crianças com Rendimento Escolar Deficiente.. Privat Docent Thesis, Fundação Faculdade Católica de Medicina, Porto Alegre, Brazil.
15. Salzano FM, Callegari-Jacques SM, Franco MHLP, Hutz MH, Weimer TA, Silva RS, Da Rocha FJ (1980): The Caingang revisited: Blood genetics and anthropometry. Am J Phys Anthropol 53: 513-524.
16. Schulman J, Leviton A (1978): Reading disabilities: an epidemiologic approach. In Myklebust HR (ed): Progress in Learning Disabilities. New York: Grune & Stratton, p. 65-96.
17. Vayer P (1982): A Criança diante do Mundo na Idade da Aprendizagem Escolar. Porto Alegre: Artes Médicas, p. 242-244.
18. Wechsler D (1964): Escala de Inteligência Wechsler para Crianças, WISC, Manual. Rio de Janeiro: Cepa.
19. Zerbin-Rüdin E (1967): Kongenitale Wortblindheit oder spezifische Dyslexie (congenital word-blindness). Bull Orton Soc 17:47-54.

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