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LATERALITY OF CHILDREN WITH LEARNING DISABILITY

J. BUDAY and I. KAPOSI

Bárczi Gusztáv Training College Teachersa of Handicapped, Department of Pathophysiology, H-1071, Budapest, Bethlen tér 2, Hungary
Institute of Isotopes, H-1071, Budapest, Bethlen tér 2, Hungary

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Abstract

There is an empirical connection between the left-handed or not consistent hand dominance and a learning disability (FROSTIG, 1983). The left- or not consistent dominance may cause uncertain space orientation (NAGAE, 1985; LAENG and PETERS, 1995; BISIACH, 1996), and may therefore exert an undirected influence on learning. This study forms part of a larger project, sponsored by the SOROS Foundation, No. 065/0191.

Key words: laterality, learning disability.

Introduction

Laterality, i.e. the side dominance in the human race, is a long-known and well-studied human feature. Most people are right-handed and also prefer the right leg and eye. The association of handedness and lateral dominance concerning the language was first described by BROCA in 1865. The right side is under the control of the left hemisphere, but the handedness is influenced by the hemisphere dominance.

The connection between handedness and speech was also recognised by Broca (1865). The first observation of the association between lateral dominance and dyslexia was reported by ORTON (1937). The motor speech center in the frontal lobe (Br. 45) and also the sensorial center of the speech (WERNICKE's area, Br 41) are in the left hemisphere of the brain in right-handers and some left-handers. This old observation was supported by MRI findings (MOUNDAS et al., 1995). The asymmetry of the cortex was also revealed in the cerebellum by MRI (SYNDER et al., 1996).

According to another early observation, a number of stutterers and also their relatives are left-handers (SZONDI, 1937). Children with dyslexia or the partial lack of some other ability are often left-handers (BRUNSWICK and RIPPON, 1994; HISCOCK and KISBOURNE, 1995; RICCIO and HYND, 1996). There is an empirical connection between laterality and speech disorders or the late development of speech. There is also a connection between laterality and anxiety (DEJONG et al., 1995; NAVETEUR and

HONORÉ, 1995), and between laterality and the predisposition to psychosis (RICHARDSON, 1994). Left- and mixed-handedness are significantly frequent among autistic children (STATZ, 1985) and mentally retarded children (BATHEJA and MCMANUS,1986).

The different intelligence structures of left- and right-handers have been described. ÁRGYÁN and JAKAB (1956) did not find a significant difference in the intelligence age, although the left-handers' performance intelligence was higher. In contrast MASCIE-TAYLOR (1980) found a higher verbal IQ among left-handers. The performance IQ was greater among right- and mixed-handers. If left-handedness is hereditary, the cognitive functions are better than if there are no other left-handers in the family (VAN STRIEN and BOUMS, 1995).

Despite these studies on the laterality of children and also the abundant experience reported on the lack of special ability among left- or mixed-handers, only a few systematic investigations have been made on the laterality of children with a learning disability.

Subjects and method

This study forms part of a larger project. The project concerns visual acuity, including colour vision, hearing performance and laterality among children with a partial ability lack, such as learning disabilities or dyslexia, who are educated in a special school.

The total number of examined children was 347: 214 boys and 133 girls, aged from 6 to 15 years.

There are numerous different methods for the determination of handedness. The most frequent are based on questionnaires, which are sometimes difficult to use for children. The most detailed method for examination of the laterality of the hand, foot and eye was published by HARRIS (1974). This was modified by VAYER (1974) and later by CAPELLINI and HAUSER (1991). The modified method has been used in our work for two reasons: the intelligence level of the children involved in the study is such that they do not understand some of the original points in the test, and some of them cannot yet write.

In this method, the handedness is examined from 10 different aspects. We speak about strong right- or left-handers if the child performs more than 8 tasks with the given hand. For moderate right- or left-handers, the given hand is used 8 or 7 times. The mixed-handed children perform 6 or 5 tasks with the given hand.

Tests of preference involving the leg and also the eye contain 3 tasks. Right- or left-footed and right- or left-eyed children perform at least 2 tasks in the test with the given leg and eye.

Results

Most studies of laterality deal with handedness. The variations of handedness among adults may result from influences of genetic and cultural factors (LALAND et al., 1995), though inherited factors seem more important (AKINORI and MASAOMI, 1985). The environmental influences include the intrauterine period (SCHLEIRS and VINGERHOCK, 1995) and possibly birth problems, though later observations did not confirm this. The age of a child is not connected with handedness, but before school age the distribution of laterality is "natural". Subsequently the training in the school prefers

the right hand, and therefore the distribution changes (KOVAC, 1995). Handedness is also important in the development of children's drawing (GLENN et al ., 1995).

In our subjects, there was no significant difference between the boys and the girls, and no connection was found between handedness and the age of the child. About three-quarters of the pupils are right-handers (Table 1). The number of left-handers is greater among the boys in our material. The proportion of strong right- and left-handers (i.e. the consistent handers) are also greater among the boys than the girls.

This finding conforms to the GESCHWIND-BEHAN-GALABURDA model (GESCHWIND and BEHAN, 1982; GESCHWIND and GALABURDA, 1985a, b, c). In the early period of ontogenesis of the boys, the number of corpus callosum fibers is low because of the high testosterone level. Therefore, consistent laterality is frequent among boys. There is no similar influence in girls, so incomplete handedness is almost twice as frequent among them as among boys (the gray rows in Table 1). There are some opposite observations: a post mortem examination revealed that the callosal surface was 11% greater among left- and mixed-handers (WITELSON, 1985).

Table 1. Handedness.

Sexes	Strong left-handers		Moderate left-handers		Mixed-handers		Moderate right-handers		Srong right-handers		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Boys	16	7.5	8	3.7	8	3.7	17	7.9	165	77.2	214	100.0
Girls	7	5.3	8	6.0	8	6.0	9	6.8	101	75.9	133	100.0
Total	23	6.6	16	4.6	16	4.6	26	7.5	266	76.7	347	100.0

The preference of the leg has not been widely reported in the literature. There is no significant difference between right- and left-handed children as concerns the preferred leg. The proportion of right-legged children increases with age up to 11 years (GENTRY and GABBARD, 1995). Adults more often prefer the right leg because of environmental influences, e. g. car driving prefers the right leg (GABBARD and HART ,1996).

Table 2. Preference of the leg.

Sexes	Left		Right		Total	
	n	%	n	%	n	%
Boys	35	16.4	179	83.6	214	100.0
Girls	22	16.5	111	83.5	133	100.0
Sum	57	16.4	290	83.6	347	100.0

Similar proportions were observed as concerns the preferred legs among boys and girls (Table 2). More than four-fifths of the children prefer the right leg. No connection was found between the age and the preferred leg, perhaps because the method used is not sensitive enough.

A strong connection has been described between the preferred eye and the dominance of the motor functions (PREVIC, 1994) and also the motor memory (ENRIGHT, 1995). In our material, the preference of the left eye is more frequent than that of the hand or the leg. Two-fifths of the pupils preferred the left eye (Table 3).

Table 3. Preference of the eye.

Sexes	Left		Right		Total	
	n	%	n	%	n	%
Boys	85	39.7	129	61.3	214	100.0
Girls	56	42.1	77	57.9	133	100.0
Total	141	40.5	203	58.5	347	100.0

As regards the combinations of preferred hand, leg and eye, there is a general tendency for a consistent dominance when the preferred hand, leg and eye are on the same side, but any other patterns are also possible. Almost all right-handed persons preferred their right leg, and half of the left-handers are also right-legged. There is no significant difference in the preferred eye between the right- and left-handers (GABBARD and HURT, 1995). It was not confirmed that crossed dominance of the hand, leg and eye is connected with low intelligence (SULBACHER et al., 1994).

A consistent dominance was found in about half of our pupils (Table 4). The next most frequent combination is the opposite side (the gray in Table 4): when the preferred hand and the preferred eye are not on the same side. This situation is more frequent among the girls than the boys: 43.6% and 38.8%, respectively.

Table 4. Combination of the preferences of hand, leg and eye.

Combinations			Boys		Girls	
Hand	Leg	Eye	n	%	n	%
Right	Right	Right	106	49.6	61	45.7
Left	Left	Left	8	3.7	3	2.3
Right	Right	Left	62	29.0	41	30.8
Left	Left	Right	5	2.3	3	2.3
Right	Left	Left	10	4.7	7	5.3
Left	Right	Right	6	2.8	5	3.8
Right	Left	Right	12	5.6	9	6.8
Left	Right	Left	5	2.3	4	3.0
Total			214	100.0	133	100.0

Table 5. Correlations.

	Hand	Leg	Eye	
Hand	1.000	0.563	0.140	
Leg	0.557	1.000	0.191	Girls
Eye	0.163	0.132	1.000	
Boys				

A significantly high correlation was found between the boys' preferred hand and leg, and hand and eye (left matrix in Table 5), but there was no correlation between the leg and eye. There was a high correlation only between the hand and the eye of the girls (right matrix in Table 5), but no correlation between the hand and the eye, or the leg and the eye. Among the boys, therefore the preferences of the leg and the eye are independent from each other, but both depend on the preference of the hand. Among the girls, the preference of the hand depends on the leg, but both are independent of the preference of the eye.

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