PREDICTION OF LEARNING DIFFICULTIES WITH THE TEST OF COMPLEX IMITATION OF MOVEMENT

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Developmental Coordination Disorder (DCD) is one of all of the heterogeneous range of developmental disorders affecting the initiation, organization and performance of actions. It is often being overlooked in school practice and in everyday work with children. Therefore, the aim of this article is to draw attention to this problem and prove how children with DCD can be easily recognized by teachers of different subjects. Especially PE teachers are those who can recognize pupils with learning difficulties, in informal tasks, and later on organize appropriate intervention. A quicker prognosis can lead to faster intervention resulting in the progress of children with DCD in their movement abilities. This research has shown that on the basis of twenty tasks of the Bergès-Lézine's test of the complex imitation of movement/gestures, we can predict which children have some learning difficulties and which do not. Particularly we wish to emphasize three tasks (12, 17 and 20) where children had to cross the vertical midline of their bodies. These three tasks involve bilateral coordination. Children with DCD signs face problems in spatial orientation and in complex imitation of movement/gestures. On the basis of great differences, found in tasks where pupils had to cross the vertical midline of their bodies and rotate their palms, children can be classified into two groups (with and without motor and learning difficulties).

Keywords: DCD, learning difficulties, manual constructional dyspraxia.

INTRODUCTION

Movement is very important during a child's development. It shapes their bodies' scheme, their sense of time and space, their planning ability and adaptability. It is based on self esteem, acquirement of self confidence and personal motor skills, as well as progressive knowledge in motor learning and knowledge of cooperation, mutual and self respect and consideration of diversity. Sometimes a child's motor development is not in proportion with his/her general development. This can be recognized by parents and/or by teachers, especially those of physical education, or by other school experts. These children can have Developmental Coordination Disorder (DCD), also known as Developmental Dyspraxia (Kirby, 2005). It can be recognized in children who experience movement difficulties and who are without any known medical condition or identifiable neurological disease (American Psychiatric Association, 2000). The specific manifestations of the disorder are varied and pervasive including both gross and fine motor skills (Visser, 2003). These problems make a child's day to day activities (such as dressing/undressing, tying shoe laces, doing up a button and writing), as well as sports activities (such as skipping and ball dribbling), extremely difficult. Therefore, in comparison with older children, the lack of different movement abilities can be observed. In a way these characteristics may be recognized as motor immaturity. Often the problems described are associated with yet other difficulties (such as dropping objects, frequent falls, fine motor skills problems, sensor integration, visual perception, reading and writing difficulties). Gross motor skills problems occur in an overflow of energy spent for the practice of even such a basic skill as standing upright (Williams, Fisher, & Tritscher, 1983). In addition to that, problems occur in jumping, roller-skating, accurate throwing of different objects; and especially in the simultaneous coordination of hands with different or identical motor patterns. Even more problems appear with the timing of movement/gestures. Children experience lack of balance, rhythm and spatial orientation, as well as fear of heights and climbing. The realization of the complex movement/gesture is not problematic, however the problem is in its planning.

It has been estimated that between 5% and 9% of all school aged children meet the diagnostic criteria for DCD (Henderson & Hall, 1982; Sugden & Wright, 1998). It was also found that more boys than girls have DCD. These children often have difficulties with reading, writing and mathematical reasoning. Primary school teachers explain school failure with a lack of learning and effort, also with shallowness of character, etc. During PE classes, different problems can occur. Some of them were presented in the introduction (body scheme problems, lack of balance and coordination, difficulties with time and spatial orientation, problems with timing, and so on). All these skills influence a child's ability to master reading, writing and mathematical reasoning. They are also an important factor which determines school success. Therefore, PE and other teachers can be the first ones who recognize different learning difficulties and other problems at school. Previous researchers (Henderson & Hall, 1982; Sugden & Wright, 1998) did not answer the following question: Can manual practise tests help to predict learning difficulties?

In some cases there are no major problems with the simple movements/gestures observed. Difficulties in reading and writing, in complex motor tasks or in difficult motor coordination are observed much later during the school period. Deconinck et al. (2006) divided the underlying causes of the motor impairment into two main lines. The first line focuses on the sensory information process prior to and during the motor response, while the second focuses on the motor component itself. Visuospatial processing (Wilson & McKenzie, 1998) and kinesthetic perception (Smyth & Mason, 1997) as well as cross modal perception were found to contribute to motor coordination impairment in children with DCD. Children with DCD are by definition delayed in the results of norm referenced motor tests (BOTMP – Bruininks, 1987; Movement ABC – Henderson & Sugden, 1992). It is to be mentioned that these tests measure the outcome of the movement rather than how the movement was performed. Motor problems are usually associated with lack of satisfaction in movement. It is not surprising, therefore, that children with DCD tend to participate less in social activities than do other children (Chen & Cohn, 2003), especially when the task is of a motor practical nature. Here the environment plays an important role.

The first persons who can recognize a child with DCD at his/her school are teachers and in particular, teachers of PE class. They can observe a child in his/her complex motion involving difficult coordination as well as time and space oriented tasks. A dance/rhythmic gymnastics/aerobics teacher can observe a child's sense for rhythm and a music teacher can observe his/her coordination when playing different instruments. Teachers can encourage children to participate in various sports activities. However, unlike other conditions such as muscular dystrophy or cerebral paralysis, DCD is often not recognized by parents or primary school teachers as a condition requiring intervention or special assessment. Children with DCD are often observed to be clumsy, unmotivated and lazy. Their problems are often assumed to be the result of other conditions such as ADD or a learning disability. Cairney, Hay, Faught, Corna and Flouris (2006) named children with DCD as "hidden cohorts" and at risk of social exclusion. By experience the condition of DCD is often overlooked in the school field and it could be very efficient and useful to screen pupils during their PE lessons in the first or second class of elementary school.

The purpose of this research was to present a relatively simple way for predicting DCD in the children observed. These asks, based on the Bergès-Lézine's test of the complex imitation of movement, can be used by primary school teachers (as well as PE teachers) in order to recognize pupils with learning difficulties. Based on simple imitation, the tasks can help to expose the ones with specific problems, such as dyslexia, dyscalculia, dysortographia etc. as well as those without. A quicker prognosis can lead to faster intervention and progress in the development of children with DCD.

The aim of this research was also to find prediction variables. The following hypothesis was exposed: Based on some variables of the complex movement/gestures imitation of the Bergès-Lézine's test (1972) it is possible to predict the classification of children into two groups: those with learning difficulties and those without.

METHOD

SUBJECTS

Children from the first triad of the Slovenian primary school in Italy participated in this research. In total, 46 children were tested (52.2% boys and 47.8% girls). Their average was 9 years (SD = 1.572). Children with intellectual disabilities were excluded from the research.

The control group presented 35 children (48.57% boys and 52.94% girls) aged 9.6 years on the average (SD = 1.46). No coordination problems nor learning difficulties were observed beforehand in this group. The experimental group presented 11 children (72.73% boys and 27.27% girls) aged 8.1 years on the average (SD = 1.49). These children were chosen by their teachers who observed and reported coordination problems and learning difficulties. The two groups present independent variables in our research.

PROCEDURES

The second part of the Bergès-Lézine's test (1972 in Išpanović-Radojković, 1986) was used. The 20 different tasks are suitable for children aged 6 to 10 years of age. These 20 tasks examine:

a) recognition of fingers, maturity of fine motor skills (tasks number 1, 2, 3, 4, 5, 6, 7, 9),

b) coordination of directions in space, control of particular body parts, and the ability to asymmetrically use their hands (tasks number 5, 8, 10, 12, 14, 17, 19, 20),
c) recognition of the fingers as a base of a global model where cognitive presentation is needed (tasks number 11, 13, 15, 16, 18).

Each child's execution was numerically evaluated with a zero (failed) or 1 point (passed). Thus 20 dependent variables were exposed (berg1–berg 20). Children were assessed during PE classes.

METHODS OF DATA ANALYSIS

Descriptive statistics, the K–S normal distribution test and regression analysis with step wise methods were used. Data were processed with the statistical programmed package SPSS for Windows (release 13.0).

RESULTS

Cronbach's Alpha coefficient shows a relatively reliable internal consistency of the test (0.756). The regression analysis (step wise method) was used. Of complex hand gesture imitation possibilities, 20 variables were included. Three variables entered the discriminant analysis: bergb 12, bergb 17 and bergb 20 (Sig. 0.000) (TABLE 1). The value of R and R^2 increases from the first to the third model whereas standard error decreases. All three tasks represent hand coordination where crossing the vertical midline of the body is involved. They examine coordination of directions in space, control of particular body parts/limbs, and the ability to asymmetrically use their hands.

In addition, TABLE 1 shows that 46.3% of variance is explained by prediction variables. This means that almost 50% of the explained variance is conditioned by practical variables. The unexplained part of the variance can be attributed to the following factors: verbal memory, phonological awareness, attentional disorders, dysortographia, etc.

TABLE 1
Summary of regression analysis

Model	R	R square	Adjusted R square	Std. error of the estimate
1	.550	.302	.286	.364
2	.670	.449	.423	.328
3	.706	.499	.463	.316

TABLE 2
Differences between experimental and control group

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	1.210	1	1.210	7.440	.009
	Residual	7.159	44	.163		
	Total	8.370	45			
2	Regression	1.858	2	.929	6.135	.005
	Residual	6.512	43	.151		
	Total	8.370	45			
3	Regression	4.173	3	1.391	13.923	.000
	Residual	4.196	42	.100		
	Total	8.370	45			

TABLE 3
Prediction of classification into experimental or control group

Model		Unstandardized coefficients		Standardized coefficients		
		B	Std. error	Beta	t	Sig.
1	**Constant**	1.782	.054		33.035	.000
	bergb 12	.395	.091	.550	4.363	.000
2	**Constant**	1.791	.049		36.883	.000
	bergb 12	.315	.085	.437	3.709	.001
	berbg 17	.272	.080	.399	3.385	.002
3	**Constant**	1.799	.047		38.254	.000
	bergb 12	.276	.084	**.383**	3.281	.002
	berbg 17	.287	.078	**.422**	3.688	.001
	bergb 20	.183	.089	**.229**	2.041	.048

The third model (TABLE 2) at sig. = 0.000 shows that the dependent variable classifies pupils into two groups; the F value increases from model 1 to model 3 up to the value of 13.923. ANOVA shows that there are significant differences between the groups.

The equation constant + 0.383 bergb 12 + 0.422 bergb 17 + 0.229 bergb 20 (TABLE 3) predicts classification into the experimental or control group. Tasks 12 and 17 (sig. < 0.005) show the highest statistical significance, whereas task 20 has the lowest statistical significance (sig. < 0.05).

DISCUSSION AND CONCLUSIONS

For sufficient and quality prediction three variables used in the regression analysis (step wise method) of the second part of the Bergès-Lézine's test, are important: bergb 12, bergb 17 and bergb 20 (Fig. 1). All of the three variables represent tasks where hands needed to be crossed; in tasks 12 and 17 intertwining of fingers was demanded, while in task 20, palm rotation was needed. All of the three tasks represent a complex structure where crossing the vertical midline of the body is involved. The above tasks are in connection with bilateral coordination (i.e. coordinated activities of the left and right side of the brain).

Good coordination of the two body sides is an important foundation for writing with pencils and cutting with scissors. Children learn to coordinate their body sides when they play with toys (for example threading beads, assembling Lego cubes, skipping rope and playing rhythmic games over a rope) or riding a bicycle as suggested in Chen and Cohn (2003).

The ability to coordinate the right and left side of the body and to cross the midline of the body is an indication that both sides of the brain are working well together and sharing information efficiently. Coordination of the two body sides is an important foundation for the development of many gross and fine motor skills. It is essential for the development of cerebral specialization for the skilled use of a dominant hand. A child with poor coordination of the two body sides may adjust his/her body to avoid crossing the midline. He/she may not be able to coordinate one hand's movement while the other is acting as an assistant to ease the effort. A child may switch hands when performing a fine motor task because he/she is experiencing frustration. Namely, in this case, skilful use of both hands is simultaneously needed.

Based upon the results of the complex imitation of the movement/gestures of the Bergès-Lézine's test, the classification of pupils with and without DCD is possible. We can adopt the following hypothesis: the variables of the imitation of the movement/gestures of the Bergès-Lézine's test are good prediction variables for classification into groups.

The results of this research have practical value. The biggest problem was observed in pupils' mental involvement and consequently in their motor performance. Therefore, pupils faced problems with their body scheme and coordination, as well as in spatial perception. As a result of these problems, learning difficulties can occur. With the systematic testing of pupils with the Bergès-Lézine's test, problems in visual perception and in cognitive reasoning can be detected.

Children with DCD signs face problems in spatial orientation and in the complex imitation of movements/gestures. On the basis of differences found in tasks where pupils had to cross the vertical midline of the body and rotate their palms, children can be distributed into two groups (with and without motor and learning difficulties). School teachers, especially PE teachers, are those who can predict learning difficulties in pupils, in informal tasks, and later on organize appropriate physical activities.

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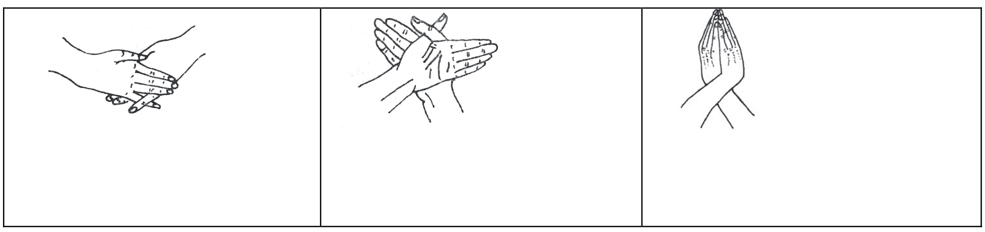
Fig. 1
Tasks 12, 17 and 20 of Bergès-Lézine's test (1972 in Išpanović-Radojković, 1986, 147–148)



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PREDIKCE PORUCH UČENÍ POMOCÍ TESTU KOMPLEXNÍ IMITACE POHYBU

(Souhrn anglického textu)

Vývojová porucha motorické koordinace (DCD) je součástí heterogenní skupiny vývojových poruch a postihuje iniciaci, organizaci a provádění činností. Ve školské praxi i v každodenním životě s dětmi je často přehlížena. Proto si tento článek klade za cíl upozornit na tento problém a ukázat, jak mohou vyučující v různých předmětech děti s DCD snadno rozpoznat. Žáky s poruchami učení mohou rozpoznat zejména vyučující tělesné výchovy při neformálních úkolech a tito mohou později iniciovat příslušnou intervenci. Rychlá prognóza může vést k rychlejší intervenci, což vede ke zlepšení pohybových dovedností u dětí s DCD. Tento výzkum prokázal, že na základě dvaceti úkolů testu Bergès-Lézine pro komplexní imitaci pohybu/gest můžeme určit, které z dětí mají určité poruchy učení a které ne. Chceme zejména vyzdvihnout tři úkoly (12, 17 a 20), při kterých děti musejí protnout vertikální osu svých těl. Tyto tři úkoly zahrnují oboustrannou koordinaci. Děti s příznaky DCD mají problémy s prostorovou orientací a komplexní imitací pohybu/gest. Na základě velkých rozdílů, nalezených při úkolech, kdy žáci musí protnout vertikální osu svých těl a otáčet dlaně, lze děti rozdělit do dvou skupin (s motorickými poruchami a poruchami učení a bez nich).

Klíčová slova: DCD, poruchy učení, instrumentální dyspraxie.

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