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The Motor-Proficiency-Test (MOT 4–6) as a Useful Tool for Diagnosing the Psychomotor Development of Polish Four-year-old Children

Abstract

Developmental disharmony is usually defined as adverse deviation from the normal development, regardless of reasons that cause it (Lagae, 2008). According to the APA, the problem concerns about 5–10% of school-age children (APA, 2000).

The symptoms of developmental disharmony are heterogeneous and their manifestation is determined by the age of the child. The sphere of motor development plays a dominant role in the presentation of these disorders in the case of small children. So researchers suggest a psychomotor diagnosis as the most desirable diagnosis in the case of developmental disharmony of a small child. One of the tools allowing for such a diagnosis is German test MOT 4–6.

The purpose of this article was to describe the validation procedure of the Polish version of the psychomotor MOT 4–6 by R. Zimmer and M. Volkammer for four-year-old children. This age group, due to the lack of objective tools, is very rarely included in diagnostic procedures.

Results: The validation of the Polish version of the MOT 4–6 for four-year-old children indicates this tool as accurate and reliable in diagnosing delays in the psychomotor development of small children. The Polish adaptation of the test will help to fill the existing gap in Polish diagnostic tools for four-year-olds.

Keywords: *development, disharmony, children*

Introduction

In recent years we have been observing changes in education at primary level in Poland. Obligatory pre-school education for all five-year-old children and school education for six-year-old children has been introduced, which means lowering the threshold of school education by one year. This reform coincided in time with the implementation of the idea of inclusive education. We may expect that not only younger children, but also children with special educational needs, which have not yet been identified, will appear in kindergartens and schools. In particular, they may be children with developmental disharmony.

Developmental disharmony is usually defined as adverse deviation from the normal development, regardless of reasons that cause it (Lagae, 2008). According to the APA, the problem concerns about 5–10% of school-age children (APA, 2000).

The picture of disorders in the functioning of a child with developmental disharmony is determined by many factors. It can be caused by organic damage to the structure of the central nervous system (CNS) or by functional disorders of the functioning of the CNS without damage of the structure. In most cases, the area of CNS injury is difficult to locate or entirely impossible. Only the use of specialized measurement and diagnostic methods (positron camera, EEG) may increase the probability of identifying the damaged area of the brain (Kułakowska 2003).

Due to the fact that disorders may be of different character and severity, their symptoms are heterogeneous. As a result, development is not harmonious, which means that a child develops normally in many areas, but does not work properly in others (Yu et al., 2009, Toussaint-Thorin et al., 2013). Most researchers believe that developmental disharmony manifested in one of the areas can be caused by disorders in another sphere or that later it can lead to improper development. As a result, a great diversity of developmental disharmony symptoms can be observed. To a large extent, the manifestation of the described disorder is determined by the age of the child. Many researchers believe that although developmental disharmony may be manifested in every sphere of the child's functioning, the sphere of motor development plays a dominant role in the presentation of these disorders in the case of small children (Kiphard, 1997, McMurray et al., 2009, Thanktong et al., 2013). According to Zimmer, unusual, strange motor behaviors usually occur in children with the described disorders in the first instance. Problems with motor planning, visual-motor coordination, too high or low muscle tone, problems with movement mapping, gravitational insecurity and disorder in the orientation of the body schema are the first symptoms of developmental disharmony. These

symptoms permeate the overall functioning of the child in all areas, giving a characteristic clinical picture of a child with “hidden disability” (Jongmans et al., 2003, Yu et al., 2009, Ramus et al., 2009).

Developmental disharmony usually cannot be fully diagnosed until the child is 7–10 years old (Kutscher & Wolff, 2006, Davis, 2000), because at that time difficulties in thinking and learning process are the most visible. Various studies, however, show that already at preschool age some of the symptoms of this disorder, particularly visible in the motor functioning of the child, can be observed. Therefore, it is reasonable to diagnose the child’s motor development already at preschool age in order to detect any abnormalities (Blythe, 2004, Krombholz, 2005, Kirby 2010, Cools et al., 2010, Vaivre-Douret et al., 2011, Overvelde & Hulstijn, 2012, Wilson et al.).

Researchers suggest psychomotor diagnosis as the most desirable diagnosis in the case of the developmental disharmony of a small child. The psychomotor diagnosis is general examination of the child, which is certainly not sufficient to establish specific disorders, but it may contribute to early detection of symptoms (Kiphard, 2005, Zimmer, 2007). Among Polish diagnostics tools that detect development abnormalities there is a lack of tools for a small child psychomotor level diagnosis. Especially a group of 4-year-old children is not included in psychomotor diagnosis, although, according to psychomotor theories, children at this age may be already diagnosed. In the article this group of children (aged 4) will form the examined group. The MOT 4–6 test usefulness in small children diagnosis will be defined through making use of this group diagnosis.

Purpose of the study

The aim of the article is to present the research on the Polish MOT 4–6 validation for children aged 4. In order to confirm the equivalency of both tests, the tool was translated from German into Polish. Also, the validity and reliability of the Polish MOT 4–6 version for 4-year-old children are defined.

Methods

Working on the validation of the MOT 4–6 was initiated by language adaptation. It was carried out in accordance with the guidelines on the validation procedure of tests (Beaton et al., 2000).

The procedure was described by the authors at six stages. First five related to the translation of the analyzed tools from the German language, the original language of the tool, into Polish. The final step of the cultural adaptation was analysis of the psychometric parameters of the tool. The discriminative power of test tasks and facility coefficient of test trials, validity and reliability of the translated tool were evaluated.

The translation process of the MOT 4–6 into Polish proceeded strictly according to the scheme described by Benton (Beaton, Bombardier, Guillemin, & Feraz 2000). Analysis of the psychometric test parameters was carried out according to selected procedures (Brzezinski, 2000; Guilford, 1964).

The reliability of the Polish version of the MOT 4–6 was determined by examination of repetition. The interval between the first and the second examination was 14 days. The correlation coefficient of both measurements' scores and the Cronbach alpha internal consistency coefficient were calculated.

In the study, the objectivity of the Polish version of the MOT 4–6 was also analyzed. The correlation coefficient between the scores of the studied children, conducted simultaneously by five independent researchers, was the measure of objectivity. Objectivity was checked using Student's T test for dependent samples.

In order to evaluate the validation of the analyzed tool, the study result dependence on sex and age was assessed with the use of the Mann–Whitney *U* test. One-way ANOVA was used to compare the results of the children with dysfunctional psychomotor development from the control group and the children with regular development.

At the next stage of the research, we had to establish the test standards for the analyzed tool. In order to standardize the test scores, average values obtained by the children in the examination and standard deviation were calculated. On the basis of these data we could calculate how far each raw score obtained by using the MOT 4–6 deviated from the average value of the total score in each age group.

Tools – MOT 4–6

The MOT Test 4–6 by R. Zimmer and M. Volkammer is one of the psychomotor tests used to diagnose the level of the psychomotor functioning of preschool children. Coefficients of psychometric tools have been highly evaluated (Validity= 0.78, reliability at 0.85) in several studies (Kambas & et al., 2012, Cools et al., 2010, Otter 2008). The proportion of the number of tasks in relation to the time of their performance was also evaluated favorably. Duration of the examination was

defined by the authors for 20–25 minutes so, according to Cools, the test can be considered as an economic diagnostic tool.

The MOT 4–6 comprises 18 motor tasks that allow examiners to have the multi-faceted analysis of the psychomotor development of a small child. Tasks to the test are chosen in such a way as to allow for the assessment of both fine motor (13 tasks) and gross motor (5 tasks) functioning. The test tasks are simple, everyday motor activities, such as jumping, running, balancing and throwing. This is a favorable factor motivating children in the studied age group to action. Additionally, during the performance of the tasks, the child is observed also with respect to his/her orientation in the body schema, motor planning ability, spatial orientation (determining up, down, right, left, etc.), his/her reaction to more difficult and easier tasks, to success or failure (Zimmer 1987, Cools et al., 2010; Otter, 2008; Zimmer & Volkammer, 1987).

The test should be regarded as a screening tool, which allows for discovering that the level of the psychomotor development of a child is not proper. This diagnosis, however, does not give information which specific disorders underlie difficulties.

Participants

450 children from Lower Silesia nursery schools participated in the research. There were 221 boys and 231 girls. All the children were 4 years old (the age mean = 4.46). Because of the result analysis specificity of the children, the group was divided into two age categories: younger children ($n=211$), who were 4–4.5 years old at the time of the study (the age mean = 4.15), and older children ($n=241$), who were 4.6–4.11 years old (the age mean = 4.72) (Table 1).

Table 1. Children's age classification with the division of psychomotor development level

	1 st age group				2 nd age group					
	Boys		Girls		Boys		Girls		Total	
	Num- ber	Age (SD)	Num- ber	Age (SD)	Num- ber	Age (SD)	Num- ber	Age (SD)	Num- ber	Age (SD)
Mo- torically impaired	3	50 (1.00)	1	50 (0.00)	4	55 (1.41)	0	0.0	8	52.5 (2.87)
At risk	14	50.14 (1.4)	13	50.46 (1.12)	11	56.09 (1.70)	3	56.66 (3.05)	41	52.31 (3.21)

	1 st age group				2 nd age group					
	Boys		Girls		Boys		Girls		Total	
	Num- ber	Age (SD)	Num- ber	Age (SD)	Num- ber	Age (SD)	Num- ber	Age (SD)	Num- ber	Age (SD)
Normal	66	50.51 (1.85)	74	50.21 (1.68)	59	56.33 (2.05)	70	56.55 (2.05)	269	53.28 (3.59)
Good	16	50.06 (1.73)	20	49.55 (1.7)	36	57.02 (2.00)	37	56.91 (2.15)	109	54.59 (3.91)
Very good	2	48.00 (0.0)	2	48.05 (0.7)	10	58.02 (1.81)	11	57.54 (2.29)	25	56.32 (4.05)

Before the research began, it had been decided that 15 randomly selected children would be examined from each kindergarten. Institutions for testing were specified on the basis of statistical sampling using a stratified sampling technique with proportional allocation and variable: delegation. We used statistical data provided by the Lower Silesian Governor's Office - Board of Education.

Results

The translation of the original MOT 4–6 into Polish

After obtaining the permission of the authors of the original German version, two independent translators, for whom the Polish language is the mother tongue, made the translation. One of the translators was competent in the issues of the research, the other was a so-called naive interpreter, for whom the thematic area of Psychomotor skills was completely unknown. Two versions of the translation, T1 and T2, were compared with each other in terms of wording and terminology. As a result, one common version of the translation, T12, was established. This version of the MOT 4–6 was translated back into the source language. The translated version of the test MOT 4–6 from Polish into German, BT12, was again compared with the original version of the MOT 4–6. The comparison revealed no significant differences or errors between the versions.

Subsequently, a committee of experts, composed of psychomotor therapists, educators, and physical education teachers, was created. They collectively discussed the substantive correctness of the wording and terms used in the MOT 4–6 again translated into Polish. As a result of the work of the committee, the final version of the Polish translation of the MOT 4–6 was established. This version was used in the validation procedure.

Assessment of the discrimination power of the MOT 4–6 tasks and facility coefficient of test trials

The value of the facility coefficients of the MOT 4–6 tasks is satisfactory. At the level of solvability of tasks at 1 point, the test was rated as easy. 48 % of the tasks were assessed as moderately difficult, and 39% as easy. In the case of the value of coefficients facility of the tasks with solvability to 2 point the situation is different. 48% of the tasks were considered as difficult and 15% as moderately difficult.

The discrimination power of test tasks was another parameter, which was subject to statistical analysis. In order to determine this parameter, the value of two factors: the point biserial correlation coefficient (r_{pb}) and the indicator of discriminating power D_t were calculated. The assumption was that obtaining 1 point indicates its correct solution. The point biserial correlation coefficient (r_{pb}), calculated for the MOT 4–6, was $r_{pb}=0.35$ and the discriminatory power of the test was $D_t=0.38$

Reliability

The reliability of the Polish version of the MOT 4–6 was determined by examination of repetition. The interval between the first and the second studies was 14 days. The population of the studied children was $n = 35$. The value of the correlation coefficient of both measurements results was $r = 0.99$ with $p < 0.001$. The value of Cronbach's alpha coefficient of internal consistency was 0.77 and it was not changing significantly when the subsequent tasks were being eliminated (Table 2).

Table 2. Values interpretation of task difficulty level indicators

Range of p indicator value	Task difficulty assessment	Task for 1 point			Task for 2 points		
		No. of a task	Total number of tasks	Percentage	No. of a task	Total number of tasks	Percentage
0.00–0.19	Very difficult	0	0	0	9, 5	2	15%
0.20–0.49	Difficult	9, 12, 13	3	23%	3, 6, 7, 10, 12, 13	6	48%
0.5–0.69	Moderately difficult	5, 6, 7, 8, 10, 14	6	48%	8, 14	2	15%
0.70–0.89	Easy	3, 15, 17, 18	5	39%	15, 17, 18	3	23%
0.90–1.00	Very easy	0	0	0	0	0	0

Validity

Conducting one-way ANOVA revealed that the test results are significantly dependent on the age of the examined children $F(1.450)=6.05$, $p<0.001$. The older the children, the higher the results obtained. The mean result of the examined population was 17.14 (SD 5.56), within the group of boys it was 17.01 (SD 5.77), in the case of the girls it equaled 17.27 (SD 5.36). Additionally, it was found that the differences in the results of the younger group vary significantly statistically from the results obtained by the older children, with $p<0.001$ (Table 3).

Table 3. Item–total correlation coefficients

Item	Item means (SD)	(SD)	Corrected item- total correlation	Alpha, if item is deleted
3: Placing dots on a sheet	0.99	0.70	0.34	0.71
5: Sideward jump	0.74	0.59	0.45	0.70
6: Catching a stick	0.76	0.64	0.47	0.70
7: Carrying balls from box to box	0.88	0.67	0.42	0.70
8: Reverse balance	1.04	0.77	0.26	0.71
9: Throwing at a target	0.38	0.57	0.33	0.71
10: Collecting matches	0.76	0.77	0.30	0.71
12: Jumping in a hoop on 1 foot, standing on 1 leg	0.64	0.77	0.46	0.69
13: Catching a tennis ball	0.63	0.74	0.42	0.70
14: Jumping Jacks	0.98	0.75	0.48	0.69
15: Jumping over a line	1.19	0.77	0.53	0.69
17: Standing up and holding a ball on the head	1.50	0.64	0.33	0.70
18: Jump and turn in a hoop	1.10	0.84	0.55	0.68

The post-hoc analyses (with the LSD test) indicated also statistically significant differences in the children's results in particular categories of evaluating the psychomotor development level, with $p<0.000$.

On the other hand, no relationship between the results and the sex of the examined children was found $F(1.450)=7.28$ $p<0.104$.

Objectivity

Analysis of the objectivity of the Polish version of the MOT 4–6 showed that the test meets this psychometric feature of the tests. The calculated value of the dependent samples t-test at the significance level of 0.05 showed no difference between the results obtained by five researchers.

Normalization

Raw scores were recalculated into the T score. To interpret the results, a 5-point Likert scale was applied, in which the two highest classes describe accelerated development while the two lowest inform about retardation or disharmonious development of an examined child indicating the need for a more sophisticated diagnosis. The borders of the particular categories were determined in compliance with the arithmetic mean value and the standard deviation of the derived results. The particular class counts indicate normal distribution (Table 4, Table 5). While conducting analysis of the differences between the means of the two age groups, legitimacy was also given to age categories division: $F(1.450)=5.574, p<.000$.

Table 4. Category structure of results assessment in the modified MOT 4–6 examination – the younger group. Set of figures

Results assessment category	Raw values ranges of particular classes	Number	Percentage
Very good	18	22	6
Good	14	18	36
Normal	6	14	126
Below normal	2	6	38
Dysfunctional	0	2	5

Table 5. Category structure of results assessment in the modified MOT 4–6 examination – the older group. Set of figures

Results assessment category	Raw values ranges of particular classes		Number	Percentage
Very good	20	24	6	2
Good	16	20	40	16
Normal	8	16	158	66
Below normal	4	8	30	12
Dysfunctional	0	4	7	3

Discussion

The validation of the Polish version of the MOT 4–6 for four-year-old children indicates this tool as reliable in diagnosing delays in the psychomotor development of small children. The reliability of the test was rated highly. In the studies, the correlation coefficient was $r = 0.99$, Cronbach's alpha coefficient was 0.77. These values of both coefficients allow for evaluation of the analyzed test as a reliable and internally consistent instrument.

The value of the facility test tasks is also satisfactory. Analysis of this parameter showed that the tasks are difficult or moderately difficult, which positively affects the diagnostic power of the analyzed tool. Testing theories show that such distribution of the facility coefficient of the task determines its high diagnostic strength (Magnusson 1981, Otter 2008)

Tasks evaluating coordination, measuring, e.g., balance or visual-motor coordination, proved to be the most difficult. Precisely these problems were mentioned by researchers as the most visible symptoms of developmental disharmony (McMurray et al., 2009, Cools et al., 2010, Roth et al., 2010).

Validity of the Polish MOT 4–6 version was investigated in the control group, which consisted of children with psychomotor disorders. The analyses indicate validity of the verified tool as the results of the control group confirmed dysfunctions in psychomotor development and were significantly lower than the results obtained by the examined group.

The conducted studies also revealed that age is a significant determinant of the child's result in the examination. Similar outcomes were obtained by A. Kambas (Kambas et al., 2012). On the other hand, the children's sex did not differentiate test results, which is in accordance with the results of the similar studies (Prado et al., 2009; Kambas et al., 2012)

Interpretation of the results indicates that the raw values obtained by the examined children are higher than the results obtained in the study carried out in the 1980s by R. Zimmer and M. Volkamer. The Polish children obtained on average two points more than the children from the German population. The higher scores may indicate increased opportunities and the faster psychomotor development of children currently, compared with those examined by R. Zimmer & M. Volkamer 30 years ago. Such observations allow for identifying certain trends in the psychomotor development of a small child - the secular trend (Malinowski 2004, Roth et al., 2009, Bös, 2003). The described studies also reflect regularity indicating that the decrease in motor skills among contemporary population does not include preschool children when compared to their peers in previous years. Similar results

were obtained also by others, who at the same time suggested the possibility of currently even accelerated development of small children (Bös, 2003, Rethost, 2003).

Conclusions

As a result of research, a Polish cultural adaptation of the psychomotor test MOT 4–6 has been created. The test is the only tool in Poland, which allows for screening assessment of the level of psychomotor development of four-year-old children. The screening nature of this tool and the possibility of using it by kindergarten teachers to implement the program of early intervention and equalizing educational opportunities are important advantages of the created adaptation.

A need for conducting research on the group of five- and six-year-old children in order to create a complete cultural adaptation of the MOT 4–6 is another conclusion of the presented research.

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