

Possibility of 4-years-old children psychomotor development diagnosis with the shortened MOT 4-6. Analysis of psychomotor parameters of shortened MOT 4-6

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Abstract:

Purpose: in this article a modification of the MOT 4-6 will be presented in order to make this test a screening tool. **Material:** The proper study was conducted in stages. The first one is the evaluation of discriminative power and a difficulty level coefficient of particular tasks, further stages include the evaluation of reliability and validity, also normalization and standardization of the analyzed test. **Results:** The received results validate the reasonableness of eliminating 5 tasks. All of them are characterized by the lowest discriminative power out of all test samples. The values of psychometric coefficients of the newly created tool allow for evaluating it as reliable ($r = .99$), internally consistent (Cronbach's alpha 0.77) and valid ($r = 0.93$). **Conclusions:** The analyzed MOT 4-6 modification is a valuable screening test, application of which may be helpful on assessing of possible abnormalities in child's psychomotor development.

Keywords:

psychomotor, diagnosis, test, validity, reliability

Новак Агата. Можливості діагностики психомоторного розвитку чотирирічних дітей скороченим тестом MOT 4-6. Аналіз показників психомоторного укороченого тесту MOT 4-6. Мета: у статті представлена модифікація тесту MOT 4-6 з метою надання йому характеру інструменту для обстеження. **Дослідження** проводилося в кілька етапів. **Матеріал:** на першому етапі була оцінена дискримінаційна потужність і коефіцієнт легкості приватних завдань. Подальші етапи включають в себе оцінку надійності та достовірності, також нормалізації та стандартизації аналізованого тесту. **Результати:** отримані результати підтверджують обґрунтованість усунення 5 завдань. Всі вони характеризуються низькою дискримінаційною потужністю з числа всіх тестових проб. Значення психометричних коефіцієнтів новоствореного інструменту дозволяють оцінити його як надійний ($r = 0,99$), внутрішньо несуперечливої (Cronbach's alpha 0.77) і валідний ($r = 0,93$). **Висновки:** Проаналізована модифікація тесту TO 4-6 підтвердила його цінність, застосування якого може бути корисним при оцінці можливих порушень психомоторного розвитку дитини.

Новак Агата. Возможности диагностики психомоторного развития четырехлетних детей сокращенным тестом MOT 4-6. Анализ показателей психомоторного укороченного теста MOT 4-6. Цель: в статье представлена модификация теста MOT 4-6 с целью придания ему характера инструмента для обследования. Исследование проводилось в несколько этапов. **Материал:** на первом этапе была оценена дискриминационная мощность и коэффициент легкости частных заданий. Дальнейшие этапы включают в себя оценку надежности и достоверности, также нормализации и стандартизации анализируемого теста. **Результаты:** полученные результаты подтверждают обоснованность устранения 5 заданий. Все они характеризуются низкой дискриминационной мощностью из числа всех тестовых проб. Значения психометрических коэффициентов вновь созданного инструмента позволяют оценить его как надежный ($r = 0,99$), внутренне непротиворечивой (Cronbach's alpha 0.77) и валидный ($r = 0,93$). **Выводы:** Проанализированная модификация теста TO 4-6 подтвердила его ценность, применение которого может быть полезным при оценке возможных нарушений психомоторного развития ребенка.

психомоторний, діагностика, тест, валідність, надійність.

Introduction

The early diagnosis of psychomotor developmental abnormalities of little children is difficult because of the symptoms heterogeneity and it requires a specific research approach (Jongmans et al. 2003,).

The majority of early symptoms of psychomotor dysfunctions correlate with motor disorders, which manifest themselves in everyday functioning (Gilberg, 1989).

Among the most frequent symptoms of motor developmental disorders we can distinguish: coordination disorders, motor planning difficulties, motor clumsiness, incorrect balance (APA, 2000, Viholainen et al. 2002, Jongmans et al. 2003, Prado, et al. 2009, Cools, 2009,).

Taking in consideration such symptoms' specification of the described disorders, their diagnosis should be of a psychomotor character and function as an observation of child's natural behavior in simple, everyday motor functioning.

MOT 4-6 seems to be a very attractive tool of the described set. This device is designed for children of 4-6 yrs. age diagnosis and through the selection of test samples it allows overall assessment of child's development (Kambas, et al. 2012, Beulertz, et al. 2013, Ludwig, et al. 2010). In addition, diagnostic interaction's specificity

permits conducting a detailed observation of cognitive and emotional development of examined child.

A weak aspect of the test is that it has too many items and the fact that each motor skill is evaluated within several samples diversified according to difficulty level. As a consequence, there are tasks in the test having little diagnostic power and results, which do not determine reliably the outcome gained by a child.

In this article an attempt to shorten MOT 4-6 is made as well as application of screening character to it. The easiest tasks shall be excluded from the test; their function is described by the authors as primary motivation of children. Also, the tasks for consecutive diagnose of particular skills shall be eliminated. Such a procedure is intended to form a screening tool out of this test, especially desirable in diagnosing a level of little child's psychomotor development.

In the research chosen parameters of a newly created tool will be evaluated for the youngest age group.

Methods

Tools

MOT 4-6 is a reliable (Cronbach's alpha=.85), valid ($r = .78$) and objective diagnostic tool. The test consists of 18 motor samples which allow assessing of child's functioning in terms of fine and gross motor skills and particular motor abilities (Zimmer, Kambas, 1987). Condition abilities are diagnosed throughout 5 motor tasks

and coordination abilities throughout the remaining 13 samples. The tasks differ among themselves by diagnostic power; the easiest exercises shall be at first place. A precise analysis of coordination abilities entitles to treat this tool as a psychomotor test (Cools 2010, Kambas et al. 2012, Wydra 2008). Examination time with use of this tool is about 20-25 minutes; equipment for this diagnosis is widely accessible (balls, gymnastic sticks, tennis balls, hula hoops) and the examination may be conducted by a regular teacher who works with children on daily basis. The test results determine child's development level which is defined on a 5-point Likert scale.

Procedures

The proper study was conducted in stages. The first phase is the evaluation of discriminative power and a difficulty level coefficient in order to define the easiest tasks which are to be eliminated from the test. The next stage is analyzing the chosen psychomotor parameters of the newly created tool.

Reliability of the modified MOT 4-6 version is determined by the test-retest method. Interval between the first and the second examination lasted 14 days. Correlation coefficient of both studies and internal consistency coefficient (Cronbach's alpha) were calculated. In order to confirm concurrence of both measurements, the analysis of statistical significance concerning the differences between the means of both measurements was also carried out.

Validity of the modified MOT 4-6 is determined by correlation of children's results taken from the analyzed MOT 4-6 modification and the original MOT 4-6 version.

Next phase included setting up of test norms for the analyzed tool. The values of means derived from children's examination and the standard deviation were calculated in order to normalize the results of the study. On the basis of these data calculations were made of what was the deviation of each raw score, obtained by the

modified MOT 4-6 from the mean of points' sum in each age group.

Participants

Children involved in the study formed a group that met requirements of age; every child was over 4 years old. The examination was conducted in nursery schools from Lower Silesia, attended by healthy children, who had never been diagnosed and no developmental disorders had been found previously.

Results

Group of 450 children from Lower Silesia's nursery schools took part in the research. They were 221 boys and 231 girls. All children were 4 years old (mean age = 4.46). Because of the results analysis specificity, manifested by the children, group was divided into two age categories: younger children (n=211) who were 4-4.5 years old as on the time of the study (mean age – 4.15), and older children (n=241) who were 4.6-4.11 years old (mean age – 4.72). (see table 1.)

Justification for eliminating five tasks from the MOT 4-6 discriminative power evaluation of MOT 4-6 tasks and the test samples difficulty level coefficient. Tasks number 2, 11 and 16 are marked with the lowest difficulty level coefficient (task 2: $p=.97$, task 11: $p=.86$, task 16: $p=.91$). In the group of the excluded tasks there is also task number 4, which was evaluated as the task with moderate discriminative power and moderate item difficulty level ($p=0.56$). (See table 2.)

Reliability of modified MOT 4-6

The calculated value of the correlation coefficient of the results from both measurements is high and it equals $r=0.99$ with $p<.001$.

Also, alpha coefficient for the modification equals 0.77 and it did not changed significantly, when the subsequent tasks were being eliminated. (See table 3.)

Validity of modified MOT 4-6

In order to assess validity of modified MOT 4-6

Table 1.

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

	1 st age group				2 nd age group				Total	
	Boys		Girls		Boys		Girls			
	Number	Age (SD)	Number	Age (SD)	Number	Age (SD)	Number	Age (SD)	Number	Age (SD)
Motorically 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)
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)

with the original version, a correlation coefficient r was defined, where $r=.73$ with $p<.000$.

Additionally, the Mann–Whitney U test did not reveal any statistically significant differences between the results of the children examined with the original MOT 4-6 and the modified version of this tool for $p=.000$, and post-hoc analyses (with the LSD test) revealed such differences in the results from the particular categories of the psychomotor development level assessment, with $p<.000$.

Sex and age of the examined participants occurred to

be significant determiners for the child results in shortened MOT 4-6 (sex: $F(1,452)=3.42$, $p<.000$). Mean result of the examined population is 11.64 (SD 4.5); for boys it equals 11.53 (SD 4.64) and for girls it is 11.75 (SD 4.36).

Normalization of modified MOT 4-6

Normalization of the constructed tool was conducted in compliance with the difference of the degree of psychomotor development characterized for two age brackets concerning 4-year-old children. The raw scores that reflected the sum of points scored by children in the

Table 2.

Values interpretation of task difficulty level indicators.

Range of p indicator value	Task difficulty assessment	Tasks for 1 point			Tasks 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

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

study were recalculated into the results presented with the T-score. Five point Likert scale was used to interpret the results. The borders of particular categories were determined in compliance with mean value and standard deviation of the derived results. Particular class counts indicate the normal distribution. While conducting analysis of the differences between the means from two age groups, legitimacy to age categories division was also given: $F(1.452)=5.574, p<.000$.

Discussion

The gained results of the conducted study confirmed validity of the offered changes in the test and, as a consequence, allowed for elaborating screening version of this test

Five tasks were excluded from MOT 4-6. All of the items from this group had difficulty level coefficient spanning from 0.97 to 0.87, which describes tasks as too easy, with little discriminative power and undesired in a screening type of the test. Such a tool must include tasks with moderate and high discriminative power, thus with moderate or low difficulty level coefficient (Brzeziński J., 2007, Lord, 1952).

Eliminating five tasks from the MOT 4-6 yielded a new tool consisting of 13 items. This test underwent a validation procedure in order to define the values of selected psychomotor parameters and the final resolution of the issue concerning the tool usefulness in young children diagnosis.

Firstly, test reliability was determined. The internal

consistency coefficient is high (Cronbach's $\alpha=0.77$), thus the test homogeneity is confirmed. Each task of the newly created test strongly correlated with its result, at level of 0.69 to 0.7, which also affirmed the fact that these tasks were homogenous and they related to the diagnosed aspect. Additionally, the value of this coefficient indicates that each of 13 samples influences significantly on results, obtained by children (Brzeziński, 2007).

Reliability coefficient of the test was high as well. It was assessed by the test-retest method, where $r=0.99$, thus the tool shall be considered as stable over time with children aged 4.

It can be said that such research results confirm usefulness of the newly created tool in 4-year-old children psychomotor diagnosis.

Statistic analyses also revealed that age is a significant determinant for psychomotor development level of the examined people. The results from both age groups differed in terms of statistical significance. Older children gained higher results in comparison with the younger group. Determining narrow age categories (every 5 months) made it possible to evaluate precisely young child development providing for even subtle changes in their skills and psychomotor possibilities. These results are in accordance with the theories indicating high dynamism of young child development and the fact that even the difference of several months is greatly determining the child's level (Krombholtz, 2005, Malina, 2004).

Another significant determinant of the child's results

Table 5.

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	3%
Good	14-18	36	17%
Normal	6-14	126	60%
At risk	2-6	38	18%
Motor impaired	0-2	5	2%

Table 6.

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%
At risk	4-8	30	12%
Motor impaired	0-4	7	3%

that emerged was sex. Girls gain higher results than boys in case of statistical significance. It is a kind of regularity that was also observed by other researchers (Rivard et al., 2012, Tseng et al., 2010).

Therefore, due to such results the modified tool may be assessed as reliable and valid as well. Validity of the newly created tool is high ($r=0.73$) and it allows evaluation of this modification as an optimal test for assessing of psychomotor development of 4-year-old children. The test tasks grade children according to their psychomotor development level as children with the lower or dysfunctional psychomotor development level gained statistically significant lower results in the test when compared to the results of children with normal or accelerated development. Additionally, children who occurred in the modified version to be dysfunctional or developmentally challenged obtained the same outcome in the MOT 4-6 examination.

Weakness of this research is lack of a control group. The difficulty to form such a group emerged because at the age of 4 developmental disorders are hardly ever or even never diagnosed, although it is possible very often which was confirmed in the studies (Blucker et al. 2014, Zwahlen et al., 2006; Glascoe; Foster, Wolraich, 1997).

These difficulties largely limited possibilities to define

final validity of a newly created tool. However, the results of the specialized diagnoses gained by the children with the lowest scores in the modified test confirm the high value of this parameter. In additional diagnoses 5 children took part and the results of 4 of them supported reasonableness for conducting a precise development observation with therapeutic and compensatory compliance.

Conclusions

After a validation scrutiny shortened MOT 4-6 version may be approved as useful in screening diagnosis of 4-year-old children psychomotor development.

Elimination of 5 tasks shortened the time of the study from 25 minutes to 10-15 minutes and also enhanced screening character of shortened MOT 4-6. On the other hand, this elimination did not reduce psychomotor parameters' values of modified MOT 4-6, which are high and comparable to those, obtained via original MOT 4-6. Further research with a control group will allow for deciding definitively about usefulness of the test in a specific psychomotor disorders diagnosis.

Conflict of Interests

The author declares no potential conflicts of interest in respect to the research, authorship, and/or publication of this article.

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