Journal of Human Kinetics volume 11, 2004, 101-112

Motor Aptitudes and Cognitive Processes

by

Halina Gula- Kubiszewska [1], Wojciech Starosciak [1]

Motor aptitudes play an important role in psycho – motor activeness of human being, which means, that aptitudes determine the range of psycho – motor development and the extent of effects of motor learning and intellectual activeness. The quintessence of motor aptitudes is described as the individual characteristic, determining capacity of acquisition new motor skills, i.e. velocity, durability, and accuracy of motor learning. Concept Szopy i Latinka (1995, 1998) there are only two complexes, differentiating one from another depending on the function of the control centers: complex of learning i.e. ***motor aptitudes*** *and control and adaptation complex. Factors, under which motor aptitudes display, are: the level of learner' interest for the movement, perception efficiency, attention concentration, memory, imagination, and the ability for interiorization movements. The aim of our research was to estimate the relations between motor aptitudes with some cognitional process, which are significant for motor learning. Research was done in years 2000 – 2002 among 267 female students of the students of University School of Physical Education in Wroclaw. We observed significant relations between short-time memory, intelligence, spatial imaginary and motor aptitudes. These relations have proportional character, i.e. higher level of cognitional processes – higher level of motor aptitudes. .*

Keywords: *motor aptitudes, cognitional process, short-time memory, intelligence, spatial imaginary*

[1] Ph. D. University School of Physical Education, Wroclaw, ul. Witelona 25

Introduction

Motor aptitudes play an important role in psycho – motor activeness of human being, which means, that aptitudes determine the range of psycho – motor development and the extent of effects of motor learning and intellectual activeness. As the result, aptitudes affect the certain level of adaptation to the environment and they ensure optimal possibilities for human functioning. Psycho - motor features are classified on the level of coordination predispositions (Hirtz 1985, Raczek 1986, Raczek, Mynarski, Ljach 2002) or motor abilities (Blume 1981, Raczek , Mynarski 1992, Szopa, Watroba 1992). In one concept, three different complexes of motor predispositions are assumed: motor control and regulation, motor adaptation and motor learning (**motor aptitudes)**. In another concept (Szopa, Latinek 1995, 1998), there are only two complexes, differentiating one from another depending on the function of the control centers: complex of learning i.e. **motor aptitudes** and control and adaptation complex. This first complex consist on creating and correcting new motor programs and inter-neurological connections, the second one consist on functioning already existing motor programs and efficiency of applying them. The quintessence of motor aptitudes is described as the individual characteristic, determining capacity of acquisition new motor skills, i.e. velocity, durability, and accuracy of motor learning (Przeweda 1973, Baranski 1963, Osinski 1986, Szopa, Watroba 1992, Szopa, Latinek 1995, 1998, Rygula, Zaskórnik 1986, Rygula 1977). Factors, under which motor aptitudes display, are: the level of learner' interest for the movement, perception efficiency, attention concentration, memory, imagination, and the ability for interiorization movements(Eider 1983, Gilewicz 1950, Kasa 1983, Przeweda 1973, Rygula, Zaskórnik 1986). However motor aptitudes are strongly connected with mental development, it is difficult to evaluate the participation of cognitional process in motor aptitudes. Results of some research show that motor aptitudes are associated with higher intellectual development indexes and positive mental features (Janowski 1967, Powolny, Mynarski 1978, Sklad 1975, Strzyzewski, Powolny, Górna 1981, Strzyzewski, Górna, Powolny 1985). Motor aptitudes are characterized also by characterological, emotional and temperamental features (Hornowski 1959, Klonowicz 1984, Meili 1967). The very important characteristic, which is in strong relation with motor activeness, awareness process, memory, thinking and imaginary, is the ability spatial imaginary and orientation. (Blume 1981, Eider 1983, Fitts 1964, Gilewicz 1950, Herzberg 1968, Rygula 1977). These abilities are influential in the learning of nonverbal skills, since they are essential for learning behaviors which require

motor anticipation, going beyond individual' experience and awareness. For the connections between motor abilities and mental efficiency point Janowski' research (1967), Powolny and Mynarski' (1978), Rygula' (1992), Sklad' (1975), Strzyzewski' et al. (1981,1985) for the connections with spatial imaginary point Fitts' (1964), Gilewicz' (1950), Herzberg' (1968), Lange' (1977), Schnabel' (1974), Kasa' (1983) research. Due to the fact, that mentioned above features are the structure of motor aptitudes, we could conclude that aptitudes are determined by mental and the neurological system characteristics.

Strzyzewski' et al. research (1985), as well as Szopa and Watroba', (1992) showed that correlations between intelligence and motor aptitude are rather weak. Further research (Szopa, Latinek 1998) allow its authors to advance a thesis that motor aptitude present separate group of predisposition, relatively weakly connected with the rest of coordination abilities: reaction time, visual – movement coordination, movement time, kinesthetical feeling (proprioception) and balance. Clearly separated elements of motor aptitudes – the velocity and accuracy of learning - are the basis for tests built for their measurements. They consist on learning of new sequences of movements. Authors suggest also resigning from complex tests in favor of analytical way of measurement and conducting research on adult population with developed motor abilities and with similar level of known motor skills.

The aim of our research was to estimate the relations between motor aptitudes with some cognitional process, which are significant for motor learning. Our research was conduct among females, students of University School of Physical Education in Wroclaw. We asked following research questions:

1. What is the level of motor aptitudes in subjects?
2. What is the level of some cognitional abilities in subjects?
3. Are there any relations between motor aptitudes and some cognitional abilities (intelligence processes, short - time memory, the ability for revealing meta – rules and spatial imaginary)? If so, what are they?
4. Are subjects with high level of motor aptitudes different in cognitional abilities from subjects with low level of aptitudes?

Research methods

Research was done in years 2000 – 2002 among 267 female students of the University School of Physical Education in Wroclaw. All subjects volunteered in research and they could resign from further tests on any level of the research and without any consequences.

We verified research questions using observation method:

1. We evaluated the level of motor aptitudes using tests for velocity, accuracy, and durability of motor learning (Szopa, Latinek 1995).
2. We estimated the level of cognitional processes using Vienna Test System – complete computer software supporting psychological diagnose (Katalog 04 2000, Raczek, Mynarski, Ljach 2002):

WMT- test for evaluation nonverbal general intelligence, META- test for evaluation the ability for recognition and using complex systems of rules for processing information, A3DW - test for evaluation the ability of mental presentation (self-imagination) and transformation spatial elements, CORSI- test for visual – spatial fresh memory and visual – spatial learning. Test for direct capacity of memory (UBS) examines short-time memory (fresh memory). Test for blocked capacity of memory supra (SBS) determines potential ability for visual – spatial learning.

Statistical methods: W Shapiro- Wilk', R Spearman', U Mann- Whitney' tests.

To make research conditions equal for all subjects we worked with them individually. One person (the same evaluation criteria) did the motor aptitude test. The results of cognitional potential were calculated automatically by computer. The research was conducted within the project "Cognitional conditions of transfer in motor learning" lead by Halina Gula–Kubiszewska, Ph.D., at the University School of Physical Education in Wroclaw.

Results

We started the analysis with characterizing measures describing variables. We evaluated the cognitional potential with percentage scale of computer tests results. The level of motor aptitude was calculated with UR index:

$$\frac{\text{T1- mean}}{\text{standard deviation}} - \frac{\text{T2- mean}}{\text{standard deviation}} + \frac{\text{T3- mean}}{\text{standard deviation}} = UR$$

We used Shapiro – Wilk W test to check goodness of fit between the distribution of variables and normal distribution (Gaussian). Variables, which characterized the cognitional activity of subjects, eventually did not have normal distribution, what is more, they showed some discontinuity. Due to this kind of configuration of independent variables, we used non-parametrical statistics. We used non-parametrical R Spearman' correlation to establish any relations between variables. This analysis showed, that there are, however weak, relations

between motor aptitudes and short-time memory, intelligence and spatial imaginary. Results in table 2.

Table 1. Descriptive statistics for variables characterizing cognitional potential [N= 267]

Features:	N valid	Mean	Minimum	Maximum	Standard deviation
UBS	267	7, 26	4	9	1,019
SBS	267	3	0	6	1,047
WMT	267	57,54	4	99	28,43
A3DW	267	21,26	12	86	11,95
META	267	21,26	12	86	11,95
Index UR	267	0,45	-6,82	4,93	1,92

UBS- short-time memory, SBS- potential ability for visual – spatial learning, WMT- nonverbal general intelligence, A3DW- spatial imaginary (transformation spatial elements), META- test for evaluation the ability for recognition and using complex systems of rules for processing information, UR- motor aptitude

Table 2. Spearman' correlation of rank order for motor aptitudes with some cognitional abilities.

Features:	N valid	R Spearman	t(N-2)	p level
UBS & UR	267	0,299834	5,116335	0,00000005
WMT & UR	267	0,220459	3,679344	0,000283203
A3DW & UR	267	0,271347	4,589389	0,0000006

Existing relations are not very strong, but their statistical significance is beyond reproach. Motor aptitudes correlated with short-time memory (0,299), intelligence (0,22) and spatial imaginary (0,27).

We specified the level of examined variables in subjects categorizing and making the evaluation scale for them.

Nearly half of the examined females presented high level of motor aptitudes (118 subjects- 44,2%) and almost as huge was group of students with average level of motor aptitudes (94 subjects- 35,2%). There were only 15 subjects with low level of motor aptitudes (5,6%) and 40 subjects with very high level of motor aptitudes (15%). As we expected, subjects – students at the very specific

university (physical education) present high and average level of motor aptitudes.

Considering short-time memory (UBS) we distinguished two groups:

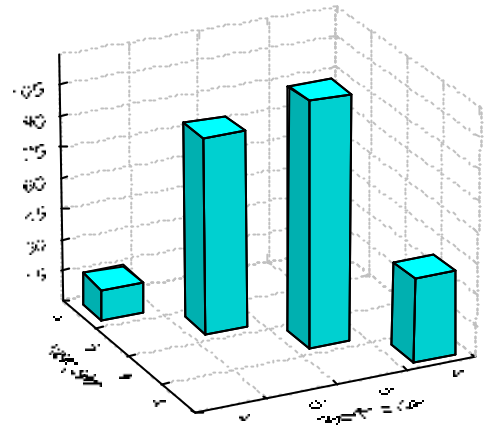

Fig. 1. The evaluation of the level of the motor aptitudes in subjects.
1- low level 2- average level 3- high level 4- very high level

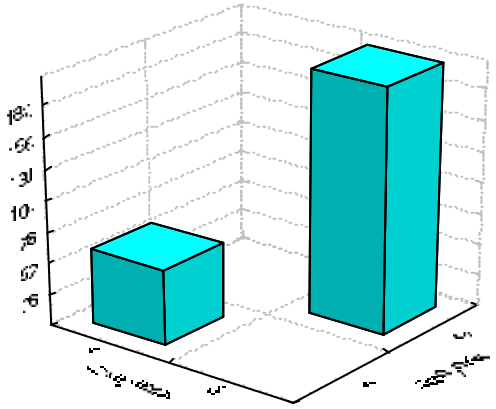

Fig. 2. The evaluation of the level of the short-time memory in subjects.
1-low level 2- high level

Only 23,6% of subjects (63 persons) presented low capacity of visual – spatial subsystem within the confines of short-time memory (fresh memory). 76,4% (204 subjects) of subjects were highly skilled in this ability.

In variables WMT and A3DW we distinguished 4 categories.

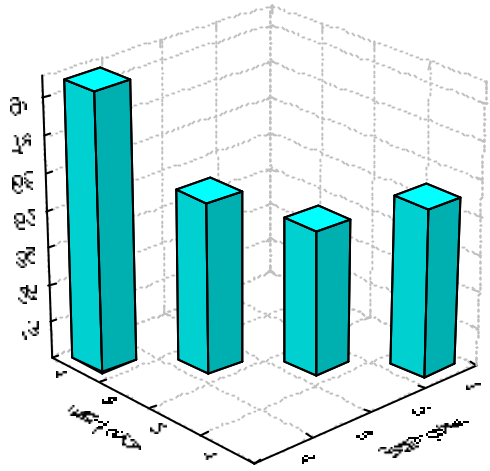

Fig. 3. The level of nonverbal intelligence in subjects.
1- low level 2- average level 3- high level 4- very high level

Among subjects dominated females with very high(36,3%- 97 subjects) and high (22,5%- 60 subjects) level of intelligence. Low level (22,1%- 59 subjects) and average level (19,1%- 51 subjects) is characteristic for about 40% of subjects.

The ability for mental presentation (imagination) and transformation of spatial elements determines spatial imaginary and is one of the intelligence dimension. In this case, the results obtained by subjects were very diversified. More than half of the subjects, i.e. 46,1% (123 persons), presented low level of spatial imaginary. Average (67 subjects) and high level (54 subjects) of spatial imaginary was specific for about 20% of subjects for each level. Very high level of this ability was observed in 8,6% of subjects (23 subjects) (figure 4).

Categorization of independent variables allowed us to compare subjects from extreme intervals of motor aptitudes. For this reason, we used non-parametrical U Mann- Whitney' test.

Tests results showed that there are significant differences in distribution of dependent variable in extreme intervals of variability of characteristics for UBS, WMT, and A3DW. So, we could affirm that persons with better results in cog-

nitional activeness measured with tests used by us, are better also at motor aptitudes.

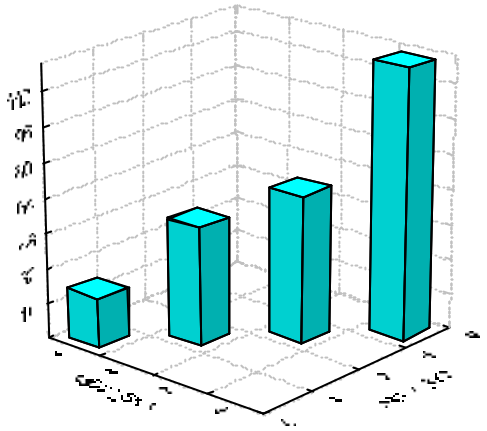

Fig. 4. The level of spatial imaginary in subjects.
1- low level 2- average level 3- high level 4- very high level

Table 3. Correlations between motor aptitudes with some cognitional abilities in groups with high and low level of motor aptitudes.

Independent variable	Dependent variable	Sum of ranks				
		Low level	Very high level[1]	U	Z	P level
UBS	UR	6623,5	29154,5	4607,5	-3,39431	0,001
WMT	UR	3733	8513	1963	-3,28358	0.001
A3DW	UR	8390,5	2340,5	764,5	-3,49164	0,000

Our results should be interpreted with the respect of examined group: very specific group of subjects and in the context of motor aptitudes according to Szopa and Latinek theory (1995). These relations should be verified with research, which would base on the concepts of motor aptitudes as the more general category of human abilities, general conditions for specific motor activities, which are motor abilities. In such a concept, a special role play motor skills

[1] For UBS variable – high level.

(Raczek, Mynarski, Ljach 2000). Coordination abilities (differentiating, orientation, rhythmization, balance, reaction time, motor adapting, and movement integration) are complex of motor learning, motor control, regulation and motor adapting. Measurements of such understood motor aptitudes are strongly connected with the test for movements regulations (horizontal tests), coordination tests in limited time (velocity tests), and motor adapting and switching abilities (complex tests).

Conclusions

1. Among examined subjects dominated group of women with high level of motor aptitudes.
2. In cognitional characteristics, subjects obtained high level of capacity of short-time memory and very high level of nonverbal intelligence. Almost half of the subjects presented low level of spatial imaginary and transformation of spatial elements.
3. We observed significant relations between short-time memory, intelligence, spatial imaginary and motor aptitudes.
4. These relations have proportional character, i.e. higher level of cognitional processes – higher level of motor aptitudes. .

References

Baranski (1963) Charakterystyka zdolnosci motorycznych dzieci osmioletnich na podstawie badan testowych, Rozprawy Naukowe, WSWF, Wroclaw, t.2.

Blume D. (1981) Kennzeichnung Koordinativer Fähigkeiten und Möglichkeiten ihrer Herausbildung im Treiningsprozess, Wiss. Zeitschr. DM: K. Leipzig, nr 3.

Eider J. (1983) Uzdolnienia ruchowe w teorii i praktyce wychowania fizycznego i sportu, WSP, Szczecin.

Fitts F. (1964) Perceptualmotor skill learning [w:] Categories of human learning, red. Melton A., New York, Academic Presse, s.244-265.

Gilewicz Z. (1950) Uzdolnienia ruchowe, sprawnosc ruchowa i sprawnosc fizyczna, Wychowanie Fizyczne nr 10, s.446-452.

Herzberg P. (1968) Zum Problem der motorischen Lernfähigkeit und zu den Möglichkeiten des Diagnostisierens mit motorischen Tests, Theorie und Praxis der Körperkultur, nr 9, s.799-804.

Hirtz P. (1985) Koordinative Fähigkeiten in Schulsport, Volk u. Wissen, Berlin.

Hornowski B. (1959) Analiza psychologiczna testu percepcyjnego „Progressive Matrices" J.C. Ravena, PWN Warszawa.

Janowski D. (1967) Uzdolnienia ruchowe jako kryterium przewidujace postepy w opanowaniu zadan ruchowych, Kultura Fizyczna nr 6, s.259-263.

Kasa J. (1983) Struktura pohybowych schopnosti a zrucnosti, Trener nr 9, s.1-16.

Katalog 04 (2000), Vienna Test System Computer-Aided Psychological Diagnosis (Wiedenski System Testów) Schuhfried, Modling.

Klonowicz T. (1984) Reaktywnosc a funkcjonowanie czlowieka w róznych warunkach stymulacyjnych, Ossolineum, Wroclaw.

Lange H. (1977) Zur Entwicklung der koordinativen Fähigkeiten in den Sportspiel und Komptsportarten, Theorie und Praxis, Leistungssport nr 2, s.112- 123.

Meili R. (1967) Podrecznik diagnostyki psychologicznej, PWN, Warszawa.

Osinski W. (1986) Zagadnienia motorycznosci czlowieka, AWF Poznan.

Pilicz S. (1971) Uzdolnienia ruchowe jako kryterium selekcji sportowej [w:] Wybrane zagadnienia selekcji w sporcie, PKOL, Warszawa.

Powolny L., Mynarski W. (1978) Uzdolnienia ruchowe a sprawnosc umyslowa 10-letnich dzieci wiejskich, Roczniki Naukowe nr 7, s.165-169, WSWF, Katowice.

Przeweda R. (1973) Rozwój somatyczny i motoryczny, WSiP, Warszawa.

Raczek J. (1986) Motorycznosc dzieci i mlodziezy – aspekty teoretyczne i implikacje praktyczne, AWF Katowice.

Raczek J., Mynarski W., Ljach W. (2002) Ksztaltowanie i diagnozowanie koordynacyjnych zdolnosci motorycznych, AWF Katowice.

Rygula I. (1977) Metoda wstepnego doboru mlodziezy do wyczynowego uprawiania skoku w z wyz, Rocznik Naukowy nr 6, AWF Katowice, s.73-117.

Rygula i., Zaskórnik E. (1986) Z badan nad determinantami testu uzdolnien ruchowych, Rocznik Naukowy nr 14, AWF Katowice, s.

Schnabel G. (1974) Koordinative Fähigkeiten in sport- ihre Efrasung und zielgerichte Ausbildung, Theorie und Praxis der Körperkultur nr 7, s.627-632.

Sklad M. (1975) Rozwój fizyczny i motorycznosc blizniat, Materialy i Prace Antropologiczne nr 85, s.3- 102.

Starosta W. (1978) Nowy sposób pomiaru i oceny koordynacji ruchowej, AWF Poznan, Monografia nr 96, s.365- 372.

Szopa J., Watroba J. (1992) Further studies on motoricity structure with a special regard to motor abilities, Antropomotoryka nr 8, s.4- 41.

Szopa J., Latinek K. (1995) Badania nad istota uzdolnien ruchowych i ich lokalizacja w strukturze zdolnosci koordynacyjnych, Wydawnictwo Monograficzne nr 67, Kraków.

Szopa J., Latinek K. (1998) Investigations on the structure of Coordination Abilities (abstract), Antropomotoryka nr 17, s.43- 57.

Strzyzewski S., Powolny L., Górna K.(1981) Dynamika rozwoju podstawowych cech fizycznych i psychomotorycznych oraz inteligencji dzieci z rodzin wiejskich i miejskich w wieku 8- 14 lat, Roczniki Naukowe Instytutu Psychologii UW nr 8.

Strzyzewski S., Górna K., Powolny L., (1985) Uzdolnienia ruchowe dziewczat i chlopców w wieku szkolnym i ich zwiazki z niektórymi cechami rozwoju osobniczego, AWF Katowice.