

Dominant Coordination Motor Abilities in Combat Sports

by
*Jerzy Sadowski*¹

The main objective of this research was to determine the structure of coordination motor abilities (CMA) in different combat sports. The research material included highly qualified athletes, coaches and experts of boxing, kickboxing, taekwondo, wrestling, karate and fencing. The research methods included the analysis of literature, questionnaires and interviews. Experimental data related to the identification of the dominant CMA in athletes of taekwondo and kickboxing was obtained with the use of the Vienna Test System. Other field and laboratory tests were conducted to determine the dominant CMA in male and female representatives of taekwondo and kickboxing.

The results indicate that the structure of CMA of highly qualified male and female athletes of taekwondo and kickboxing are similar. Taekwondo and kickboxing develop a similar coordination profile of athletes, yet the minor differences in the structure of CMA are dictated by sex not the type of sport discipline

Key words: *coordination, motor abilities, combat sports*

¹ - Academy of Physical Education in Biala Podlask, Poland

Introduction

Recently, significant attention has been given to the understanding of the structure of Coordination Motor Abilities (CMA). The main objective of coaches and scientists is to determine the dominant role of particular abilities in different sport disciplines. It seems that CMA are of great significance in combat sports. They play a major role in precision and economy of sport movements under constantly changing conditions (the ability to differentiate movement variables), the precision of evaluating body position changes (time and space orientation), speed and precision of movements to expected and unexpected signals, with the whole body or its parts (speed of reaction), the ability to change from one movement performance to another upon combat situation (motor adjustment), the ability to combine single movements into complex ones (movement combining), the ability to maintain balance during static body positions (static balance) or the ability to regain balance during the fight (dynamic balance) and precise reproduction of perceived rhythm (movement rhythm).

An attempt to determine the dominant CMA in different combat sports has been made by many authors: fencing (Bojczenko, Koganow, Kaszuk 1986, Bojczenko et al 1988, Czajkowaski 1993, 1995, Schich 1979), judo (Wengliarskij 1980, Manotaki 1989, 1990, Schich 1979), freestyle and classic wrestling (Sikkut 1976, 1987, Todorow 1991, Szulika 1990, Kuhn 1985), kickboxing (Kulikow 1997), taekwondo (Gil, Czui Hwan 1991, Bujak 1998, Uljajewa 1998, Lee 1998, Litwiniuk 1998, Sadowski 1998, Vishujakov, Kashkarov 1998).

A review of these papers indicates highly varied opinions and different experimental data related to the significance of particular CMA in combat sports. It seems that Petrow's opinion (1997), who stated that no scientist has yet fully determined the structure of motor abilities that significantly influence performance in particular combat sports.

The main objective of this research was the determination of dominant CMA in different combat sports.

Material and methods

To obtain the answers to the main research questions the following research methods were applied:

- the analysis of literature (tab.5)
- Questionnaires and interviews of highly qualified coaches and other specialists of boxing, kickboxing, taekwondo, wrestling, karate and fencing (n=47)

- Questionnaires and interviews of highly qualified athletes representing taekwondo (n=23) and kickboxing (n=28)
- expertise evaluation of CMA significance in different combat sports (n=7)
- experimental data related to the identification of the dominant CMA in athletes of taekwondo and kickboxing with the use of the Vienna Test System. It allowed to collect data on 45 indices of CMA. The test has been described precisely by (Raczek, Mynarski, Ljach 2002)
- the computer system “Motoryk” which allowed to pinpoint data on 14 indices of CMA (Juras, Waskiewicz 1998)
- laboratory tests which allowed for the description of 17 indices (Sadowski 2000, Waskiewicz 2002)
- field tests created by the author and others which gave 56 indices of CMA (Sadowski 2000)

After the pilot studies and conducted analysis, 47 tests were chosen for the evaluation of CMA in athletes representing different combat sports. The following abilities were evaluated: rhythm – 7 indices, movement differentiation – 9 indices, movement adjustment – 9 indices, body balance – 4 indices, time and space orientation – 8 indices, movement combining – 6 indices, speed of reaction – 4 indices. A precise description of these indices is presented in the work of Sadowski (2000). The research material included female (n=15) and male (n=13) taekwondo athletes, as well as 10 female and 20 male kickboxers, between the age of 18 and 27, all members of the national team. The main objective of the experimental part of this research was the determination of the dominant CMA in taekwondo and kickboxing and the evaluation of directed coordination training on the structure of CMA and the stability of its main factors.

The collected data was analyzed statistically. The factor analysis was used with Hotteling’s main components with Tuckers modification, supplemented with the Varimax rotation proposed by Kaiser (Czyz 1971, Weber 1982). The factor analysis was conducted for all the tested subjects together and separately for male and female representatives of taekwondo and kickboxing. Combining females and males into one group was dictated by the fact that in most CMA indices there were no significant sexual differences.

Results and discussion

The results of factor analysis allowed to exclude dominant CMA in highly qualified female and male athletes representing taekwondo and kickboxing. These results are presented in tables 1-4. Table 5 presents the data obtained from literature review. The opinions of experts related to the significance of

particular CMA in combat sports are presented in table 6, while those of highly qualified athletes of taekwondo and kickboxing in table 7. The results of experimental data confirmed the hypothesis related to the complexity of CMA in the motor fitness of highly qualified athletes participating in martial arts. The conducted statistical analysis allowed to exclude the following dominant abilities in the structure CMA of athletes in different combat sports.

1. motor adjustment
2. movement combining
3. movement differentiation
4. space orientation
5. speed of reaction
6. movement rhythm
7. body balance

It was observed that the structure of CMA in female and male taekwondo representatives was specific (tab. 1 and 2). The dominant abilities in female athletes included: movement differentiation, rhythm, space orientation and speed of reaction. These three factors explained 54.3% of common variance. The structure of dominant CMA was slightly different in male athletes. The most important abilities in case of men were: motor adjustment, speed of reaction, space orientation and movement differentiation (48.8% of common variance).

Table 1

Pre (1) and post (2) experimental structure of coordination motor abilities (CMA) in highly qualified male taekwondo athletes (n=15)

Nr	Factor	% of factor input in general dispersion	
		1	2
1	Motor adjustment	18,5	20,8
2	Speed of reaction and orientation	18,4	15,1
	Movement differentiation	11,9	20,2
3	a) force variables	5,9	10,5
	b) space variables	6,0	9,7
4	Rhythm	7,4	9,1
5	Movement combining	11,2	8,2
6	Balance	5,5	7,9
	Percent of common variance	72,9	81,3

Table 2

Pre (1) and post (2) experimental structure of coordination motor abilities (CMA) in highly qualified female taekwondo athletes (n=13)

Nr	Factor	% of factor input in general dispersion	
		1	2
	Movement differentiation	21,4	26,9
1	a) force variables	8,3	16,6
	b) space variables	13,1	10,3
	Rhythm	20,9	22,1
2	a) rhythm changes	12,3	12,9
	b) rhythm reproduction	8,6	9,2
3	Speed of reaction and orientation	12,0	12,5
4	Movement combining	11,0	9,3
5	Balance	10,3	9,2
6	Motor adjustment	8,4	-
	Percent of common variance	83,7	80,0

Table 3

The structure of coordination motor abilities (CMA) in highly qualified male kickboxers (n=20)

Nr	Factor	% of factor input in general dispersion
1	Motor adjustment	19.8
2	Speed of reaction and orientation	17.1
3	Movement differentiation	20.2
	a) force variables	7.7
	b) space variables	12.5
4	Rhythm	12.2
5	Balance	8.3
6	Movement combining	7.7
	Percent of common variance	85.3

Table 4

The structure of coordination motor abilities (CMA) in highly qualified female kickboxers (n=10)

Nr	Factor	% of factor input in general dispersion
1	Movement differentiation	28.1
	a) force variables	11.2
	b) space variables	16.9
2	Rhythm	19.0
	a) rhythm changes	12.0
	b) rhythm reproduction	7.0
3	Speed of reaction and orientation	19.3
4	Balance	10.6
5	Movement combining	8.5
6	Motor adjustment	3.0
Percent of common variance		88.8

Table 5

Dominant CMA in particular combat sports (Sadowski 2000)

Type of combat sport	Coordinations Motor Abilities (CMA)	Author
Judo	Precise reproduction of basic movement variables	Pidoria (1988)
	Precise reproduction of basic movement variables, rhythm muscle relaxation	Wengliarskyj (1980)
	Movement combining, precise differentiation of movement, force variables, space orientation	Manolaki (1990)
	Fast and precise reacting, differentiation of movement force variables	Martemianow (1990)
	Movement differentiation, space orientation, balance, speed of reaction, movement combining and adjustment.	Schich (1979)
Wrestling (freestyle)	Movement differentiation, speed of reaction, movement adjustment anticipation	Szulika (1993)

(freestyle and classic)	Speed of reaction, rhythm motor adjustment, movement differentiation	Sikkat (1987)
	Motor adjustment, precise reproduction of movement variables, balance, space orientation, speed of reaction	Todorow (1991)
	Space orientation, speed of reaction, movement differentiation	Kühn (1985)
Fencing	Movement combining, differentiation of movement variables during unexpected conditions and limited time	Bojczenko et al. 1986, 1988 Czajkowski (1993)
	Motor adjustment, space orientation, speed of reaction, anticipation, the feeling of distance	Schich (1979)
Kickboxing	Static and dynamic balance, differentiation of movement force variables, speed of reaction, movement combining	Kulikow (1997)
Teakwondo	Differentiation of movement variables, space orientation, speed of reaction, movement combining	Dzunyj (1994)
	Speed of reaction, space orientation, anticipation movement combining, differentiation of force and space movement variables	Lee (1998)
	High movement frequency rhythm speed of reaction, motor adjustment, movement differentiation, space orientation.	Sadowski (2000)

When general and specific coordination exercises were introduced into the annual training cycle of these athletes, certain changes occurred in the structure of CMA. They did not change the basic factors and the general structure of CMA, yet the input of particular factors changed (tab. 1 and 2). The comparison of the structure of CMA in male taekwondo and kickboxing specialists, indicated great similarities when basic factors were considered and their input into the general dispersion (tab. 1 and 3).

Table 6*The significance of particular CMA in different combat sports (data from experts, n=9)*

Coordination abilities	Kickboxing		Teakwon-do		Boxing		Karate		Wrestling		Judo		Fencing	
	S pkt	Rank	S pkt	Rank	S pkt	Rank	S pkt	Rank	S pkt	Rank	S pkt	Rank	S pkt	Rank
Speed of reaction	15,5	1	15	1	13	1	17	1	25	2	25	2	9	2
Motor adjustment	16,5	2	19	2	24	2	20,5	2	14,5	1	16,5	1	26,5	1
Time and space orientation	43	5	49,5	6	46	6	45,5	6	38,5	3	43,5	4	38	3
Movement differentiation	56	7	46,5	5	55	8	48,5	7	40,5	4,5	46	6	41,5	4
Movement combining	30,5	3	33,5	3	40	3,5	40,5	4	43,5	6	44,5	5	42,5	5,5
Dynamic and static combining	35,5	4	37	4	40	3,5	36,5	3	40,5	4,5	26	3	42,5	5,5
Rhythm	37,5	8	66,5	8	52,5	7	64,5	8	37	7	69	8	60	8
Muscle relaxation	48,5	6	51,5	7	44,5	5	41,5	5	50,5	8	47,5	7	47	7

The structure of CMA in case of female athletes representing the same sport discipline was almost identical (tab. 2 and 4). The thesis that taekwondo and kickboxing develop similar coordination profiles may be accepted. It seems that the minor differences in the structure of CMA are related to sex and not the type of sport discipline. Interesting results were obtained by the analysis of literature (tab.5), and the results of experimental data which were directed at the determination of dominant CMA before and after the application of

Table 7

Questionnaire results of highly qualified kickboxers and taekwondo athletes related to dominant coordination motor abilities (CMA) in martial arts.

Coordination motor abilities (CMA)	Kickboxing n=28		Taekwondo n=28	
	Points	Rank	Points	Rank
Speed of reaction	34	1	39,5	1
Movement adjustment	133,5	4	97	4
Space orientation	97,5	2	94,5	3
Movement differentiation	140	5	133	7
Movement combining	102	3	80	2
Balance	170,5	7	115,5	5
Rhythm	147	6	151	8
Vestibular stability	181,5	8	117,5	6

coordination exercises (tab. 1-4). The same comparison was done with the results gathered from the opinions of experts (tab. 6), as well as questionnaires and interviews of combat sport specialists and athletes (tab. 7). In most cases the results were similar, yet in particular ones they differed significantly. The greatest differences occurred in the identification of the structure of CMA in female taekwondo and kickboxing athletes. The following reasons may explain these phenomena: subjective methods of interview, different testing procedures of particular authors, different understanding of the meaning of CMA in combat sports by experts, coaches and athletes. Similarities in obtained results by different authors and through different methods allows for a better understanding of the role CMA play in particular combat sports. The results of the experimental data allow to recommend general and specific coordination exercises directed at the development of all abilities in all combat sports. It seems that the priority of developing particular CMA should be different in male and female athletes representing combat sports. Male athletes should pay more attention to

such abilities as: motor adjustment, speed of reaction, time and space orientation as well as movement differentiation. On the other hand females should concentrate to a higher extent on the development rhythm, time and space orientation and speed of reaction.

Conclusions

1. The area of CMA of highly qualified athletes representing taekwondo and kickboxing includes: motor adjustment, movement combining, movement differentiation, time and space orientation, speed of reaction, rhythm and balance.
2. The structure of CMA in males and females practicing taekwondo is specific. The dominant abilities in the structure of CMA of females include movement differentiation, rhythm, space orientation and speed of reaction while in males these abilities include motor adjustment, speed of reaction, space orientation and movement differentiation.
3. The structure of CMA of highly qualified male and female athletes of taekwondo and kickboxing are similar. Taekwondo and kickboxing develop a similar coordination profile of athletes, yet the minor differences in the structure of CMA are dictated by sex not the type of sport discipline.
4. The results of experimental data as well as results of interviews, questionnaires and experts opinions determining the dominant CMA in combat sports are very similar. It was stated that experimental data, especially in females differed significantly from results obtained through the analysis of interviews, questionnaires, and literature as well as experts and athletes opinions.
5. Reaching more uniform opinions on the role of dominant CMA in combat sports, should be preceded by a better understanding of the significance of particular abilities among specialists of these sport disciplines as well as the improvement of diagnostic methods, both laboratory and field tests.

References

- Bojczenko S.D. i wsp. 1988. Koordynacyjnye sposobnosti – weszczestwennyje korelaty techniczskoj podgotowki fechtowalszczikow. Teorija i praktika fizycznej kultury, 1, 37-39.
- Bojczenko S.D., Koganow W.J., Kaszuk W.G. 1986. Koordynacyjnye sposobnosti i techniczeskaja podgotowlennost fechtowalszczika. Fechtowanie: Jezegodnik. Fizkultura i Sport, Moskwa.
- Bujak Z. 1998. Differences in the level of selected elements of motor coordination among taekwon-do contestants at unsophisticated and masterly level. W: (red. J.

- Sadowski, W. Starosta) Movement coordination in team sport games and martial arts: International Scientific Conference. IWFIS, Biala Podlaska.
- Czajkowski Z. 1993. Od zwinności do zdolności zbornościowych. Sport Wyczynowy, 3/4, 18-33.
- Czajkowski Z. 1995. Nawyki czuciowo-ruchowe w działalności sportowej. Katowice.
- Czyż T. 1971. Zastosowanie metod analizy czynnikowej do badania struktury ekonomicznej regionalnej Polski. Prace Geograficzne. PAN, Wrocław.
- Gil K., Czur Hwan. 1991. Isskustwo taekwondo: Tri stupieni: Pier. s niem. Stupen 1: K golubomu pojasa. Sow. Sport, Moskwa.
- Gil K., Czur Hwan. 1991. Isskustwo taekwondo: Tri stupieni: Pier. s niem. Stupen 2: Ot golubogo pojasa k czernomu. Sow. Sport, Moskwa.
- Gil K., Czur Hwan. 1991. Isskustwo taekwondo: Tri stupieni: Pier. s niem. Stupen 3: Ot wtorogo dana k czetwe rtomu. Sow. Sport, Moskwa.
- Juras G., Waskiewicz Z. 1998: Czasowe, przestrzenne oraz dynamiczne aspekty koordynacyjnych zdolności motorycznych. AWF, Katowice.
- Kuhn J. 1985. Untersuchungen zur technisch – koordinativen Vervollkommnung der Kampfhandlungen junger Ringer. Theorie und Praxis der Körperkultur, 11, 848-854.
- Kulikow A.N. 1997. Kikboksing. Agentstwo FAIR, Moskwa.
- Lee K. 1998. Taekwondo kyorugi. Trening walki sportowej. Warszawa.
- Litwiniuk A. 1998. The level of selected motorial coordination elements among taekwondo contestants at the directed preparation stage. W: (red. J. Sadowski, W. Starosta) Movement coordination in team sport games and martial arts: International Scientific Conference. IWFIS, Biala Podlaska.
- Manolaki W.G. 1989. Eksperimentalnoje obosnowanie informatiwnosti testow dla kontrola za podgotowkoj kwalificirowanych dzjudoistok. Stanowlenie i sowierszenstwowanie techniko-takticzeskogo masterstwa w sportiwnoj barbie. Omsk.
- Manolaki W.G. 1989. Eksperimentalnoje obosnowanie informatiwnosti testow dla kontrola za podgotowkoj kwalificirowanych dzjudoistok. Mediko-pedagogiczeskije aspekty podgotowki junych sportsmenow. Sb.naucz.tr. Smolensk.
- Manolaki W.G. 1990. Pedagogiczeskij kontrol za urownem podgotowlennosti kwalificirowanych dzjudoistok na etape sportiwnogo sowierszenstwowania. Awtoref.diss. ...kand.ped.nauk. Moskwa. – 24 s.
- Pietrow A.M. 1997. Centralnoje programmirowanie mechanizmow realizacji koordynacyjnych sposobnostej sportsmenow i ich pedagogiczeskije obosnowanie. Awtoref. siss. ...dokt.ped.nauk. Moskwa. – 48 s.

- Raczek J., Mynarski W., Ljach W. 2002. Kształtowanie i diagnozowanie koordynacyjnych zdolności motorycznych. Podrecznik dla nauczycieli, trenerów i studentów. AWF, Katowice.
- Sadowski J. 1998. Studies of selected elements of movements coordination in taekwondo athletes. *Roczniki Naukowe*, 5, 37-40. IWFIS, Biała Podlaska.
- Sadowski J. 1998. The level of chosen coordinational abilities in taekwondo athletes. W: (red. J. Sadowski, W. Starosta) *Movement coordination in team sport games and material arts: International Scientific Conference*. IWFIS, Biała Podlaska.
- Sadowski J. 1998. The relation of the level of coordination abilities and technical skills among the elementary taekwon-do players. W: (red. J. Sadowski, W. Starosta) *Movement coordination in team sport games and material arts: International Scientific Conference*. IWFIS, Biała Podlaska.
- Sadowski J. 2000. Teoretiko-metodiczeskije osnovy kontrolia i trenirowki koordynacyjnych sposobnostiej w wostocznych widach jedinoborstw (na primierie kiboksinga i taekwondo). *Awtoref.diss. ...dokt.ped.nauk. Moskwa.* – 46 s.
- Schich M. 1979. Zur Objektivierung der Antizipationsfähigkeit im Fechten. *Theorie und Praxis der Körperkultur*, 2, 118-121.
- Sikkut T.H. 1976. Izuczenie dynamiki psychomotoriki junych борцов. *Materiały VI naucz.-met. Konf. Resp. Pribaltiki i Belirusii po problemam sportiwnoj trenirowki*. Wilnius.
- Sikkut T.H. 1987. Dynamika i wzaimoswiaz dwigatelnych sposobnostej, swojstw wnimania i operatiwnogo myszenia u борцов w processe mnogoletniej trenirowki. *Awtoref.diss. ...kand.ped.nauk. Moskwa.* – 20 s.
- Todorow A.S. 1991. Kontrol koordinaci dwizenij борцов wolnogo stilja. *Dis. ...kand.ped.nauk. GCOLIFK, Moskwa.* – 240 s.
- Uljajewa L. 1998. Struktura sportiwnych sposobnostej w taekwondo. *Czelowiek w mire sporta: nowyje idei, technologii, perspektiwy. Tez.mezd.kongressa. T 2. Moskwa.* – S.398-399.
- Vishnjakov A.V., Kashkarov V.A. 1998. The principle of construction of teaching and training programs of long-term preparation taekwondo sportsmen. W: (red. J. Sadowski, W. Starosta) *Movement coordination in team sport games and material arts: International Scientific Conference*. IWFIS, Biała Podlaska.
- Waskiewicz Z. 2002. Przebieg procesów koordynowania ruchów człowieka pod wpływem anaerobowych wysiłków fizycznych. AWF, Katowice.
- Weber G. 1982. *Grundriss der biologischen Statistik*. VEB Gustav Fischer, Jena.
- Wengliarskij G.B. 1980. Uprawlenie specjalnoj podgotowlennostiu dzjudoistow wysszych razrjadow na pedsorewnowatelnom etape trenirowki: *Awtoref.diss. ...kand.ped.nauk. Moskwa.* – 24 s.