DIFFERENCES IN MENTAL POTENTIAL OF YOUNG FEMALE ATHLETES

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ABSTRACT
Success in a particular sports branch is determined by a large number of factors, abilities and characteristics that are necessary for players to respond to specific requirements and the structure of a different sport. Knowing the hierarchy of anthropological characteristics and abilities dominant for a particular sporting branch, should serve to sports professionals as the starting point in the management of the training process. Each athletic competition at the same time is both physical and technical-tactical, and also mental. The importance of psychic factors has its confirmation in every competition (Lazarević, 2003). Many sports branches require developed visual motor coordination and reaction speed. The aim of this paper is to determine similarities or differences in mental potential with the following abilities: psychomotor speed and movements coordination between young table-tennis, karate and volleyball female players. Multivariate variance analysis (MANOVA) has shown that there are differences in the expression of cognitive abilities among girls involved in various sports in the whole system of observed variables (p = ,00).
Key words: *coordination, reaction speed, psychological efficiency*

INTRODUCTION

The management of training process involves programmed training, and it implies constant objective feedback through regular control, diagnostics and evaluation of the current state in all aspects of the athlete's training. Programmed training is a central and essential part of training technology and the key to successful maximization of dominant abilities in each individual (Fratric, 2006).
Athletic competition at the same time is both physical and technical-tactical, and also mental. The importance of psychic factors has its confirmation in every competition (Lazarević, 2003).
Importance of psychological factors in the successful sports performance of racket sports is unquestionable. Inappropriate muscular contraction and poor mental function greatly reduce the ability of the player to effectively fight against the opponent's tactical changes (I-Ting et al., 2010).
Athletes mental strength is an important factor in the sporting performance, so in fact the upper limit of the performance of a sportsman is determined by the weakest link in the chain of his preparations. In other words, the player loses where he is the weakest (Mikić, 2006).
Many sports branches require developed visual motor coordination. Depending on the structure and requirements of the sports games, the hand-eye coordination (table tennis, volleyball, etc.) will be dominant, or the coordination of the foot-eye (football, martial arts, etc.).
Coordination shows how well athletes adjust the recruitment of motor units by using force when using a props (for example, a tennis racket) or how well the jump moment is assessed and in order to capture the ball. It is important for the realization of movements that depend on the oculomotor system (hand-eye connection). Coordinated movements represent a significant qualitative determinant of a particular sport (Drid, 2012).
Nothing less is relevant and the time it takes from the moment when we notice the stimulus until the moment when we respond to this stimulus. The speed of the reaction depends on the different factors of perception, data processing and response.
One of the more dominant skills that successful table-tennis players need to have is certainly speed. Table tennis is considered to be the fastest game with a racket where the game takes place quickly in a relatively small space.
In the final strokes, the ball reaches a speed of up to 140 km/h. The speed of the hand movement with the racket is 60-70 km/h (Hudetz, 2000). This suggests that besides agility, explosive strength and reaction speed is crucial for this game.
One of the most important speed aspects in karate is individual movement speed, regardless of whether the karatists have defined themselves as kata or kumite. Fast and precise movement by hand or foot is the need of modern karate.
Volleyball as polystructural sports game, it sets requirements to the players that are determined by the official rules and game structure. Players should be "supplied" with explosive power, agility, speed, coordination to perform in the performance of certain technical-tactical knowledge (service, service reception, block, smash etc.).
Cognitive is often equated with mental, intelligent, and perceived. Chronometrics in psychology is the studying approach and it

presents characteristic psychic phenomena, which starts from the assumption that, based on the time of the occurrence of some phenomenon, it can be perceived in the complexity of its structure and decipher the dynamics of mechanism functioning by which they are realized (Drenovac, 2009).
The mental potential and functional characteristics of performing mental activities, according to this approach, are determined by indicators of the effects and functional characteristics of various forms and mechanisms of processing and storing (Vujanović, 2011). Sports efficiency in the processing of stimulus content was determined, among other, by the relation to that content and the situation characteristics of the inflammatory situation itself. Neurophysiological research suggests that in every form of activity besides cognitive is present and emotional component of processing the current content. While cognitive processes manifest rapidly, emotional reactions occur with larger latent periods, or much later (Behter's, 1971, according to: Drenovac, 1994)
The aim of this paper is to determine the similarities or differences in mental potential at psychomotor speed and movements coordination between young top-ranked table-tennis, karate and volleyball female players.

METHOD

The Sample was made of 25 young top athletes, of which 8 were table tennis players, 9 karate and 8 volleyball players, aged 16 to 18 years, from the territory of AP Vojvodina, tested using CRD battery test in the diagnostics cabinet of the Provincial Institute for Sport and sports medicine in Novi Sad.
The CRD series of psychodynamic tests contains 38 standardized tests for diagnosis and monitoring: perceptual abilities, thinking, memory, and various forms of psychomotor reactions. (Drenovac, 1994).
For the research purposes, Test *CRD 4-11*, which contains a signal circuit of four lights, which outline the corners of trapezoid. In the lower corner there are lamps that represent signals for the feet answers. In the tasks one to three lamps go light and should be answered by pressing the answer keys with one or synchronized combination of the extremities. Test measures movement coordination, in other words, the operational thinking in managing the synchronized work of arms and legs.
CRD 4-33 test consists of a signal circuit of one lamp and one answering key. The task of the respondent is to press the answer key as fast as possible when the light signal appears, while pressing the button prior to the occurrence of the signal is registered as an error. The test consists of 35 tasks and measures the speed of a simple psychomotor reaction.
As variables for mental potential assessment, or efficiency of athletes, in this work were used:
Time: the shortest test time (TMIN) that represents the potential mental speed that is closest to the "physical limit" of the functionality of the mechanism by which a mental function is achieved, total resolution test time (UT) that represents the interaction of all factors that make success to test resolution; ie. interaction of speed, stability, accuracy and durability.
Accuracy: total number of errors (UG) which is an indication of the reliability of the neuropsychological functions and operative performance of mental activities, as an indicator of dissociation and concentration.
Ballast: total lost time, i.e. ballast (UB) which is an indicator of mental function stability, i.e. Indicator of irrationally spent time in solving the test.
Central and dispersion parameters of the entire sample are calculated first. Then, we calculated the differences at the level of the whole system of observed variables with multivariate variance analysis (MANOVA), while differences between groups are calculated by univariate variance analysis (ANOVA).

RESULTS AND DISCUSSION

CRD tests are intended for determining (diagnostics and monitoring) the time and accuracy of achieving different mental and psychomotor functions, as well as the dimension of the ability and functional characteristics of the actualization of the individual mental potential. The model by which the concept CRD test battery is based rests on the point of view of the psychic processes being treated from the point of view of information processing. Mental potential and functional characteristics of performing mental activities, according to this approach, are determined by indicators of the effects and functional characteristics of various forms and processing mechanisms and storage (Drenovac, 2009).
For the purposes of this paper, the following indicators of mental potential capacity have been taken into account:
Perception, or noticing the signal appearance, because the perception is the initial phase of each receptive process in which the meaning is not recognized, but only the signal appearance is recorded. In contrast to the orientational reflex, an unintentional reaction due to a strong stimulus, perception is a component of conscious signaling in the cycle of a simple psychomotor reaction. The simplest form of mental activity of observing the expected signal was called A reaction by Doners, and Wundt called it a simple reaction.

Operational thinking is a complex mental activity of structuring elements that are an integral part of the response pattern or run from the permanent memory of the learned response to the current stimulus, as well as formatting of the operational process management and the control of the implementation of such a form of action. (Drenovac, 1994).

The speed of reaction through the variables of total time, minimum time, total number of errors and total ballast to determine the mental potential of athletes is shown in Table 1 which clearly shows the basic descriptive statistics within groups of athletes as well as the entire research sample. Female athletes are aged 16-20.

Table 1. Basic descriptive indicators of mental potential variables (for reaction speed)

VARIABLE/ ATHLETES		N	AS	SD	Min	Max	*SWp*
age	Table tennis	8	18,38	1,77	16	20	,04
	karate	9	18,22	1,92	16	20	,01
	volleyball	8	16,88	,10	16	19	,02
	total	25	17,84	1,70	16	20	
Reaction speed (UT) -sec	Table tennis	8	8,39	1,21	7,24	10,79	,21
	karate	9	8,45	1,51	6,74	11,31	,20
	volleyball	8	10,51	1,91	7,41	12,43	,19
	total	25	9,09	1,80	6,74	12,43	
Reaction speed (TMIN)	Table tennis	8	163,88	19,32	134	185	,20
	karate	9	166,89	16,76	138	194	1,00
	volleyball	8	161,88	7,00	151	172	,90
	total	25	164,32	14,88	134	194	
Reaction speed (UG) -ms	Table tennis	8	,25	,46	0	1	,00
	karate	9	,33	,71	0	2	,00
	volleyball	8	2,88	,64	2	4	,04
	total	25	1,12	1,36	0	4	
Reaction speed (UB)	Table tennis	8	2,86	2,11	1,15	6,97	,03
	karate	9	2,50	1,58	1,29	5,89	,01
	volleyball	8	4,72	1,97	1,38	6,90	,41
	total	25	3,33	2,06	1,15	6,97	

Legend: N- number of subjects, AS-arithmetic mean, SD-standard deviation, MIN-minimum values of measurement results, MAX-maximum values, SWp level of statistical significance Shapiro Wilk coefficient

Coordination through variables of Total time, minimum time, total number of errors and total ballast which determine the mental potential of athletes in the work is shown in Table 2, and clearly shows the basic descriptive statistics within groups of athletes as well as of the entire research sample.

Table 2. Basic descriptive variables indicators of mental potential (for coordination)

VARIABLE/ ATHLETES		N	AS	SD	Min	Max	*SWp*
Coordination (UT) -sec	Table tennis	8	23,53	5,98	16,61	34,80	,48
	karate	9	27,98	5,11	19,85	33,34	,13
	volleyball	8	30,12	5,98	24,80	42,82	,06
	total	25	27,24	6,09	16,61	42,82	
Coordination (TMIN) -ms	Table tennis	8	349,25	54,39	258,00	419,00	,73
	karate	9	407,33	36,45	349,00	449,00	,30
	volleyball	8	412,63	62,84	318,00	484,00	,22
	total	25	390,44	57,39	258,00	484,00	
Coordination (UG)	Table tennis	8	5,88	3,14	2	11	,24
	karate	9	8,11	4,91	2	15	,36
	volleyball	8	8,75	3,77	5	15	,12
	total	25	7,60	4,07	2	15	
Coordination (UB)	Table tennis	8	11,30	4,61	6,89	20,94	,13
	karate	9	13,75	4,80	7,25	21,12	,45
	volleyball	8	15,86	5,41	9,19	25,88	,57
	total	25	13,64	5,09	6,89	25,88	

Legend: N- number of subjects, AS-arithmetic mean, SD-standard deviation, MIN-minimum values of measurement results, MAX-maximum values, SWp level of statistical significance Shapiro Wilk coefficient

The results of the univariate variance analysis (ANOVA) show that there is a statistically significant difference between the observed subunits in the following variables of the reaction speed-total time (p = ,02), reaction speed-number of errors (p = ,00) and the coordination-total time (p =,04). In other dependent variables statistically significant differences were not observed (Table 3).

Table 3. Results of multivariate and univariate variance analysis (MANOVA / ANOVA)

DEPENDENT VARIABLES	N	AS	Lev p	F	p
age	25	17,84	0,04	2,09	,15
Reaction speed (UT)-sec	25	9,09	0,48	4,80	**,02**
Reaction speed (TMIN) -ms	25	164,32	0,10	,23	,80
Reaction speed (UG)	25	1,12	0,75	47,63	**,00**
Reaction speed (UB)	25	3,33	0,54	3,28	,06
Coordination (UT)-sec	25	27,24	0,96	2,81	,08
Coordination (TMIN) -ms	25	390,44	0,14	3,75	**,04**
Coordination (UG)	25	7,60	0,19	1,12	,35
Coordination (UB)	25	13,64	0,77	1,70	,21
λ= .05			**p= .00**		

Legend: N-number of subjects, AS-arithmetic mean, SD-standard deviation, Lev p-level of statistical significance of f-test Leven coefficient; p - statistical significance level for f, λ - Wilks Lambda value indicator

Multivariate variance analysis (MANOVA) has shown that there are differences in the expression of cognitive abilities among girls dealing with various sports in the whole system of observed variables p =,00.

Individually concerning, the univariate variance analysis (ANOVA) has shown that there are statistically significant differences between the athletes' groups ,which is shown in the table.

When the results of the dependent variables are observed separately (Table 4), along the Bonferonio adjusted level, we note that a statistically significant difference confirmed in the reaction speed-total time (p = ,04) between table-tennis and volleyball players for the benefit of table-tennis players (2.12 seconds faster), and karate are faster than volleyball players in 2.06 seconds (p = ,04).

Table 4. Real differences between groups. - Bonferronian groups comparison

Observed variables	I	J	differences AS (I-J)	p
Reaction speed (UT)-sec	1	2	-,06	1,00
		3	**-2,12·**	**,04**
	2	1	,06	1,00
		3	**-2,06·**	**,04**
	3	1	**2,12·**	**,04**
		2	**2,06·**	**,04**
Reaction speed (UG)	1	2	-,08	1,00
		3	**-2,63·**	**,00**
	2	1	,08	1,00
		3	**-2,54·**	**,00**
	3	1	**2,63·**	**,00**
		2	**2,54·**	**,00**

Legend: 1-table-tennis, 2-karate, 3-volleyball

Statistically significant difference was noticed in the variable reaction speed-number of errors (p = ,00) where the average number of errors in volleyballs is greater than table tennis by 2.63 and from Karate by 2.54.

CONCLUSION

One-factor multivariate analysis of variance shows the differences between athletes dealing with table- tennis, karate and volleyball in abilities: speed of reaction and movement coordination. Study results showed that there is a difference in the psychomotor speed between all three groups of athletes, and statistically significant difference was observed in the total time between table tennis players and volleyball players, as well as karate and volleyball players. Variable total time indicates the efficiency in expressing psychomotor speed. Better results of table-tennis and karate compared to volleyball players at psychomotor speed can be a consequence of the specificity of the training and competitive structure of these individual sports. The results of our research can point out the importance of adequate selection for a particular sport, bearing in mind the dominant ability. The total number of errors, which is an indication of the reliability of neuropsychological functions, the dissociation and maintenance of attention focus, is statistically significantly higher in volleyball compared to table-tennis and karate female players (p = ,00). This result can be explained by differences in the implementation of training processes between table tennis and karate as individual sports in which emphasis is placed on these psychotomotor characteristics.

LITERATURE

1. Drenovac, M, (2009). "Kronometrija dinamikementalnog procesiranja". Osijek: Sveučilište Josipa Jurija Stossmayera, Filozofski fakultet.
2. Drenovac, M. 1994). "CRD serije psihodijagnostičkih testova". Zagreb: AKD.
3. Drid, P. (2012). Teorija sportskog treninga.Novi Sad: Fakultet sporta i fizičkog vaspitanja
4. Fratrić, F. (2006). Teorija i metodika sportskog treninga. Novi Sad: Pokrajinski zavod za sport.
5. Hudetz, R. (2000). Stolni tenis 2000. Zagreb: Huno sport.
6. I-Ting C., Che-Wei C., Chiao-Ling H., Ling-Chun C., , and Tsung-Min H. (2010). Investigation of Underlying Psychological Factors in Elite Table Tennis Players. , International Journal of Table Tennis Sciences, No.6(2010), 48-50.
7. Lazarević, Lj. (2003). Psihološka priprema sportista. Beograd: Viša škola za sportske trenere
8. Mikić, B. (1996). Psihologija sporta, Tuzla: Filozofski fakultet Univerziteta u Tuzli.
9. Vujanović, S. i Tišma M. (2011). Povezanost kompetitivne anksioznosti i efikasnosti sportista. Novi Sad: Aktuelno u praksi.
10. Vujanović, S., Kalentić, Ž., Jovančević, V., Sudarov, N., Strajnić, B., Đukić, B., Vujkov, N. (2013). Specific Aspect of Football Goalkeepers Mental Potential in Relation to Other Players in the Team. Tirgu Mures: 1st International Conference ICHMS.

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