HUMAN MOVEMENT
2012, vol. 13 (2), 161–169

SELECTED PSYCHOLOGICAL DETERMINANTS OF SPORTS RESULTS IN SENIOR FENCERS

doi: 10.2478/v10038-012-0018-1

MACIEJ TOMCZAK *, MAŁGORZATA WALCZAK, GRZEGORZ BRĘCZEWSKI
University School of Physical Education, Poznań, Poland

ABSTRACT
Purpose. The aim of the present study was to determine the correlations between the strength of the stimulation process, mobility of nervous processes, achievement motivation and sports results of fencers in the senior age category. **Methods.** The sample was comprised of 38 senior fencers (19 men and 19 women) aged 21–32 years. The strength of the stimulation process and mobility of nervous processes were assessed with the Strelau and Zawadzki PTS inventory. The subjects' achievement motivation was measured with the achievement motivation questionnaire by Widerszal-Bazyl. **Results.** The study revealed that senior fencers (women, in particular) featured higher mean levels of the examined psychological determinants, i.e., strength of the stimulation process, mobility of nervous processes and achievement motivation than the general population in the same age range. Strong and statistically significant correlations were found between all the studied psychological determinants and sports results among the male fencers in the sample. In the group of female fencers none of the correlations were statistically significant. **Conclusions.** The results might provoke reflection on the role of coaches and, consequently, may have implications for the cooperation between coaches and athletes, indicating that the individual psychological differences of fencers should be considered during training. The coach may also decide on the necessity for considering on the reported diversification within the gender or age domain, and the need to consider such psychological properties as temperamental characteristics or the level of achievement motivation.

Key words: psychology, temperamental features, achievement motivation, fencing

Introduction

Psychological research is often an integral component of the multidimensional process of athletic training. The results of psychological studies not only enable the development of theoretical frameworks describing and explaining the structure of a number of psychological factors, but also on the determinants of sports results. They indicate the potential guidelines for future research. Psychological studies are carried out on various populations of athletes, whose variability depends on the type of sport, age category, length of competitive experience and sports level. Therefore the structure of the determinants of sports results is usually different in each study group. This variability is related to a great extent to the factors of general and specific physical fitness and well as to psychical fitness that can determine sporting success in different age groups.

Taking into considering the psychological determinants of sporting success, three basic groups of factors affecting the range of variability in athletes are often enumerated: temperament, motivation and cognition [1, 2]. Their role is crucial as competitors usually display a similar level of physical fitness in senior categories, i.e., in already a selected population.

A factor often associated with a fencers' effective action is undoubtedly his or her psychical resistance, whose counterpart in an individual's temperament is having a strong stimulation process, i.e., the ability of the nervous system to endure long-term or short-term intensive effort or arousal. Individuals with a high level of strength of the stimulation process can act effectively in heavily stimulating conditions, such as stress-inducing conditions, and feature low levels of affective disorders and changes in effectiveness under heavy or long-term stimulation. They also feature lower susceptibility to fatigue, do not need long rest, act efficiently in unplanned situations, experience less emotional tension and emotional dysregulation. Another important temperamental factor determining fencers' effectiveness is the mobility of nervous processes, i.e., the speed and adequacy of responses to quick and unexpected conditions in fencing [3], or in other words, one's adjustment speed to new situations.

Achievement motivation, which is manifested by the willingness to achieve the best possible results, is particularly important in fencing. Achievement motivation is often understood as the tendency to pursue standards of perfection via competition [4]. It is related to actions pursuing ever higher standards without any external rewards. Persons with high achievement

* Corresponding author.

motivation are able to take risks, achieve their goals with ingenious instrumental actions, display a high level of time utilization skills, organize their life according to the standards they pursue and want to demonstrate their own effectiveness in actions [5–7].

The structure of relationships among temperamental and motivational factors is often complex and multidimensional. The aim of the present study was to determine correlations between the strength of the stimulation process, the mobility of nervous processes, achievement motivation and the sports results of fencers in the senior age category. The strength of the stimulation process, the mobility of nervous processes and achievement motivation were considered as the main independent variables, whereas the sports result in fencing was treated as the dependent variable and the subjects' age as the extraneous variable. For the study, the following research hypotheses were formulated:

1. Higher strength of the stimulation process positively affects the sports results of senior fencers.
2. Higher mobility of nervous processes positively affects the sports results of senior fencers.
3. Higher achievement motivation positively affects the sports results of senior fencers.
4. The structure of correlations between the studied psychological determinants and fencers' sports results is different in male and female fencers.

Material and methods

The sample comprised of 38 competitive fencers (19 men and 19 women) aged 21–32 years selected by way of purposive sampling. The fencers represented all three fencing disciplines: sabre (13 individuals: six women and seven men), épée (13 people: seven women and six men) and foil (12 people: six women and six men). Out of the entire research group, 24 people (ca. 63% of the researched group, 12 women and 12 men) were part of the very narrow group of fenders who were Polish national representatives in their fencing disciplines. The study was conducted on those fencers who, having equal chances in the cup rankings (each of the studied fencers had participated in the same number of the Polish Cups and Poland National Championships) were all ranked on the list of the Polish Fencing Federation. Each of the fencers had also participated in at least two international championships. The subjects were selected with regard to their age, gender and sports results in the senior fencing age category. The selection was made with reference to the independent variables (age, gender) to reflect the population of senior fencers in the best way possible.

The strength of the stimulation process and the mobility of nervous processes (as independent variables) were measured with the Pavlovian Temperament Survey (PTS) constructed by Strelau and Zawadzki [3], which contained 57 items in three sets corresponding to the individual properties of the nervous system: strength of the stimulation process, strength of inhibition and mobility of nervous processes. Each property was examined in 19 items and each subject gave his or her answers on a four-point scale. Although the subjects fulfilled the entire inventory, only the items referring to the strength of the stimulation process and the mobility of nervous processes were taken into consideration. Each property was then scored from 19 to 79 points [3].

Fencers' achievement motivation was measured with the 20-item Achievement Motivation Inventory designed by Widerszal-Bazyl [5]. The total score for this property was between 20 and 100 points. Each subject chose one out of three or five answers in each inventory item.

The senior fencers' sports results were taken from the annual ranking lists of the Polish Fencing Association. Each fencer under study was given a number corresponding to his or her place on the ranking list.

The normal data distribution was checked with the Shapiro-Wilk's test; the homogeneity of variance was checked with Leaven's *F*-test. The Student's *t*-test (for one sample) was also used to verify whether the studied properties in the studied group of fencers differed significantly from the general population in the same age brackets (arithmetic means from the normalized inventories – arithmetic means from the general population). The standardized effect (*SE*) was determined by estimating the differences between the mean values of the psychological determinants in the study group and in the general population, expressed in units of population standard deviation. In addition, the values were provided as a standardized sten scale (a "Standard-Ten" point scale).

To compare the studied properties in the male and female fencers the Student's *t*-test for independent groups was applied. The strength and direction of the correlations between the studied determinants and the fencers' sports results was measured with Pearson's coefficient of correlation. In order to explain the variance of the sports results for all independent variables, a model of multiple regression was used [8], where a stepwise forward selection regression method was employed. Additionally, the best subsets of the predictors of the sports results were obtained based on the Mallows' Cp criterion that determines the degree of fitness of a potential model to the data (the lower the Mallows' Cp, the better fit of the model).

Results

First, the subjects' descriptive statistics were provided and then the sample was compared with the general population in the same age range with regard to the studied determinants: strength of the stimulation process, mobility of nervous processes and achieve-

Table 1. Descriptive statistics and comparison of independent variables between senior fencers and general population: strength of stimulation process, mobility of nervous processes and achievement motivation

$N = 38$	Gender	$\bar{x}$	SD	t (χ – GP)	SE	Sten	t (W – M)
SSP	W	55.26	9.70	5.65***	1.49	8	0.88
	M	52.79	7.33	2.97**	0.66	7	
	M + W	54.02	8.57	5.65***	1.06	–	
MNP	W	57.68	8.25	3.07**	0.77	7	0.50
	M	56.37	8.10	2.04	0.48	6	
	M + W	57.03	8.09	3.66***	0.63	–	
AM	W	69.32	6.53	6.22***	1.43	8	1.32
	M	66.16	8.10	3.31**	0.76	7	
	M + W	67.74	7.43	6.41***	1.04	–	

Source: authors' own study

**$p < 0.01$; ***$p < 0.001$

SSP – strength of stimulation process
MNP – mobility of nervous processes
AM – achievement motivation
$\bar{x}$ – arithmetic mean
SD – standard deviation
SE – standardized effect computed using Cohen's formula (sample mean – population mean/population standard deviation)
Sten – results presented on a 1 to 10 Sten scale
t (W – M) – Student's *t*-test value (male and female fencers)
t (χ – GP) – Student's *t*-test value (senior fencers and general population)

Table 2. Matrix of correlations between the variables in the group of female fencers

$N = 19$	SSP	MNP	AM	SR
SSP	1.000	0.836	0.209	**0.334**
	–	$p = 0.000$	$p = 0.389$	$p = 0.162$
MNP	–	1.000	0.029	**0.125**
	–	–	$p = 0.907$	$p = 0.608$
AM	–	–	1.000	**0.324**
	–	–	–	$p = 0.175$
SR	–	–	–	**1.000**

Table 3. Matrix of correlations between the variables in the group of male fencers

$N = 19$	SSP	MNP	AM	SR
SSP	1.000	0.678	0.457	**0.601**
	–	$p = 0.001$	$p = 0.049$	$p = 0.006$
MNP	–	1.000	0.595	**0.581**
	–	–	$p = 0.007$	$p = 0.009$
AM	–	–	1.000	**0.525**
	–	–	–	$p = 0.021$
SR	–	–	.–	**1.000**

The correlations between the psychological variables and the sports results are in bold
SSP – strength of stimulation process
MNP – mobility of nervous processes
AM – achievement motivation
SR – sports result

ment motivation (Tab. 1). Correlations between the variables were presented (Tab. 2, 3) and the multiple regression model was used in reference to the sports results (Tab. 4–8).

Since no significant differences within the scope of the studied variables as well as the correlation structures were observed between the fencing disciplines (sabre, épée and foil), a common analysis was performed for the fencers regardless of the discipline. The participants, however, were analyzed separately in regards to the basic division criterion, gender.

The data from Table 1 show that the senior fencers had a significantly higher mean level of strength of the stimulation process than the general population at the same age. The standardized effect value was also high at (*SE* = 1.06), particularly among the female fencers (*SE* = 1.49; *t* = 5.65; $p \leq 0.001$; a high score: a sten score of 8), although the difference in the male group of fencers was also statistically significant at $p \leq 0.01$ (*t* = 2.97) with *SE* = 0.66 (a score at the beginning of a high score band: a sten of 7).

The female fencers had also a higher level of mobility of nervous processes than the general population (*t* = 3.07; $p \leq 0.01$), with a relatively high standardized effect value of 0.77 (a score at the beginning of a high scores band: a sten of 7). The *t*-test value in the male fencers was statistically non-significant, and the standardized effect for the male fencers was 0.48 (an average score: a sten of 6).

The studied fencers also featured significantly higher achievement motivation than the general population with a high standardized effect (1.04). The standardized effect was particularly high in female fencers (*SE* = 1.43; *t* = 6.22; $p \leq 0.001$; a high score: a sten of 8) and lower but still relatively high in male fencers (*SE* = 0.76; *t* = 3.31; $p \leq 0.01$; a score at the beginning of a high score band: a sten of 7).

The subjects' gender had no significant effect on the studied psychological determinants. None of the obtained *t*-test values was of statistical significance at $p \leq 0.05$.

The distribution of fencers' results was significantly different from that of the general population. Fencers featured significantly higher levels of the examined psychological properties. Also the female fencers constituted a more select group than men in terms of the studied properties – the standardized effects and sten values for each psychological determinants were higher in women. The mobility of nervous processes featured lower standardized effect values than the two other psychological properties. Following these calculations

the relationships between the variables were analyzed (Tab. 2, 3).

The data from Table 2 revealed that no correlation between the psychological determinants and sports results in the group of women was statistically significant at $p \leq 0.05$. In the group of male fencers (Tab. 3), however, the correlations were positive, statistically significant and relatively strong between: the strength of the stimulation process and sports results ($r = 0.60$, $p \leq 0.01$), the mobility of nervous processes and sports results ($r = 0.58$; $p \leq 0.01$), and between achievement motivation and sports results ($r = 0.52$; $p \leq 0.05$). The study revealed a totally different structure of correlations in the male and female fencers.

Next, the stepwise forward selection regression was employed for sports results in the whole group of participants (Tab. 4).

Introduced in the first step, the strength of the stimulation process accounted for ca. 21% of variance in sports results in fencing. Achievement motivation, which was introduced in the second step, increased the explanation of variance by ca. 10%. Adding another predictor in the next step did not increase the R^2 significantly; however, it decreased the adjusted R^2, which points to a fall in the quality of the model. The obtained model with two predictors reached the assumed statistical significance ($F = 7.808$; $p \leq 0.01$) and explained about 27% of variance in sports results (based on the adjusted coefficient). This model with two predictors (standardized coefficients: SSP: $\beta = 0.34$; $p \leq 0.05$ and AM: $\beta = 0.34$; $p \leq 0.05$) had the best goodness of fit as based on the Mallows' Cp criterion in the light of other potential models. For this model the Cp (Cp = 1.03) was the smallest (model no. 1: Tab. 5).

Table 4. A stepwise forward regression model for the dependent variable sports results for the whole studied group

Step	Predictors	Beta (p-value)	St. err. Beta	ΔR^2	R^2	Adj. R^2	F(p-value)
1	SSP	0.456 (0.004)	0.148	0.208	0.208	0.186	9.462 (0.004)
2	**SSP** **AM**	**0.342 (0.028)** **0.337 (0.031)**	**0.149** **0.149**	**0.100**	**0.308**	**0.269**	**7.808 (0.002)**
3	SSP AM G	0.344 (0.030) 0.342 (0.033) –0.026 (0.858)	0.152 0.154 0.146	0.001	0.308	0.248	5.072 (0.005)
4	SSP AM G MNP	0.351 (0.132) 0.343 (0.037) –0.027 (0.859) –0.001 (0.966)	0.227 0.158 0.149 0.227	0.000	0.308	0.225	3.693 (0.014)

The model that best fits the data in the context of other models based on the adjusted R– squared (the model with two predictors) is in bold
SSP – strength of stimulation process, MNP – mobility of nervous processes, AM – achievement motivation, G – gender

Table 5. The selection of the model that best fits the data as based on the Mallows' Cp criterion. The models are arranged in ascending order from 1 to 10, where 1 indicates the best fitting model and 10 indicated the worst fitting model

Model no.	The best subset selection method in regression (standardized regression coefficients for each model)					
	Mallows' Cp	Predictors (amount)	SSP	MNP	AM	G
1	**1.033**	**2**	**0.342**		**0.337**	
2	3.002	3	0.344		0.342	–0.026
3	3.032	3	0.347	–0.007	0.338	
4	3.384	2		0.248	0.367	
5	3.829	1	0.456			
6	3.964	1			0.453	
7	5.000	4	0.351	–0.010	0.343	–0.027
8	5.383	3		0.248	0.368	–0.020
9	5.749	2	0.408	0.063		
10	5.782	2	0.451			0.031

The model that best fits the data in the context of other models based on the Mallows' Cp Criterion (the model with two predictors) is put in bold
SSP – strength of stimulation process, MNP – mobility of nervous processes, AM – achievement motivation, G – gender

Table 6. A stepwise forward regression model for the dependent variable sports results in the female fencers

Step	Predictors	Beta (p-value)	St. err. Beta	ΔR^2	R^2	Adj. R^2	F(p-value)
1	SSP	0.334 (0.162)	0.228	0.111	0.111	0.060	2.139 (0.162)
2	SSP	0.764 (0.081)	0.411	0.080	0.191	0.089	1.887 (0.184)
	AM	–0.513 (0.229)	0.411				
3	SSP	0.638 (0.168)	0.441	0.036	0.227	0.073	1.470 (0.263)
	AM	0.202 (0.414)	0.241				
	MNP	–0.414 (0.352)	0.431				

SSP – strength of stimulation process, MNP – mobility of nervous processes, AM – achievement motivation

Table 7. A stepwise forward regression model for the dependent variable sports results in the male fencers

Step	Predictors	Beta (p-value)	St. err. Beta	ΔR^2	R^2	Adj. R^2	F(p-value)
1	SSP	0.601 (0.006)	0.194	0.361	0.361	0.323	9.606 (0.006)
2	**SSP**	**0.456 (0.045)**	**0.210**	**0.080**	**0.441**	**0.371**	**6.304 (0.009)**
	AM	**0.317 (0.151)**	**0.210**				
3	SSP	0.358 (0.189)	0.260	0.015	0.456	0.348	4.201 (0.024)
	AM	0.248 (0.313)	0.238				
	MNP	0.191 (0.518)	0.288				

The model that best fits the data in the context of other models based on the adjusted R- squared (the model with two predictors) is in bold
SSP – strength of stimulation process, MNP – mobility of nervous processes, AM – achievement motivation

Table 8. The selection of the model that best fits the data as based on the Mallows' Cp criterion. The models are arranged in ascending order from 1 to 7, where 1 indicates the best fitting model and 7 indicated the worst fitting model

Model no.	The best subset selection method in regression (standardized regression coefficients for each model)				
	Mallows' Cp	Predictors (amount)	SSP	MNP	AM
1	**2.439**	**2**	**0.456**		**0.317**
2	2.638	1	0.600		
3	3.091	2	0.382	0.322	
4	3.270	1		0.581	
5	3.893	2		0.416	0.278
6	4.000	3	0.357	0.190	0.248
7	4.978	1			0.525

The model that best fits the data in the context of other models based on the Mallows' Cp Criterion (the model with two predictors) is in bold
SSP– strength of stimulation process, MNP – mobility of nervous processes, AM – achievement motivation

Next, the contribution of the particular predictors to the dependent variable in the group of women was analyzed (Tab. 6).

None of the predictors that were introduced (and, consequently, none of the obtained models in the group of women) reached the assumed statistical significance. Next, the contribution of the predictors was analyzed in the group of men (Tab. 7).

Introduced in the first step, the strength of the stimulation process explained ca. 36% of variance in the fencers' sports results. Achievement motivation, which was introduced in the second step, increased the explanation of variance by ca. 8%. Adding another predictor in the next step did not increase the R^2 significantly; however, it decreased the adjusted R^2, which points to a fall in the quality of the model. The obtained model with two predictors reached the assumed statistical significance (F = 6.304, $p \leq 0.01$) and explained about 37% of variance in sports results (based on the adjusted). This model with two predictors (standardized coefficients: SSP: $\beta = 0.456$; $p \leq 0.05$ and AM: $\beta = 0.317$; $p \leq 0.151$) had the best goodness of fit (as-

sessed as based on the Mallows' Cp criterion) in the context of other potential models (model no. 1: Cp = 2.439) (Tab. 8).

Multiple regression analysis showed that the psychological determinants explained many more variances of sports results in men than in women.

Discussion

The senior fencers under study featured higher mean levels of psychological properties, i.e., strength of the stimulation process, mobility of nervous processes and achievement motivation, than the general population in the same age category. Particularly significant differences between the fencers and the general population were found in the group of female fencers featuring high standardized effect values, e.g., 1.49 (sten of 8) for the strength of the stimulation process and 1.43 (sten of 8) for achievement motivation. This can be an indication of the fencers' selectivity due to the studied determinants and could be also related to the length of fencing training and the competition experience of senior fencers, who in order to comply with the heavy demands of fencing must display a specific profile of psychological properties. The group of senior fencers could have stemmed from some process of natural selection, which eliminated individuals with less suitable psychological properties. The obtained results are partly consistent with the findings from previous psychological studies conducted on competitive athletes. Dissertations on the psychological studies conducted on fencers are sparse, which is one of the reasons why the results from this study found a frame of reference not only in the studies on fencers but also on other competitive athletes. Thus, for instance, Williams et al. [9] obtained somewhat different results and revealed that National Fencing Women's Foil Team showed an average level of anxiety (a strong negative correlate of strength of stimulation process). However, results similar to those obtained in our research were reported by Bandach [10] who conducted studies on National Fencing Men's Team in the age range of 17–36. Bandach's research participants revealed, among other things, a high resistance to risk situations and a larger acceptance towards adapting to one's surroundings (positive, strong correlate of strength of stimulation process and mobility of nervous process). These findings are quite consistent with those obtained by Gracz and Tomczak [11], who conducted their studies on fencers (treating all three fencing disciplines as one) aged 14–32 years (41% of whom were the members of National Fencing Team in their age group). The fencers, inter alia, showed low emotional reactivity (a negative correlate of strength of stimulation process), a quite high level of mobility of nervous processes and slightly above average level of achievement motivation. Again, comparatively similar results were obtained by Tomczak [12] in the studies investigating adolescent fencers who showed low emotional reactivity (a negative strong correlate of strength of stimulation process), relatively high briskness (a positive strong correlate of mobility of nervous processes) and high achievement motivation. In turn, relatively similar results were reported by Bukowska and Zgadzaj [13], who examined a population of football players and chess players. Their studies revealed that the subjects displayed significantly higher levels of strength of the stimulation process than the general population. Moreover, the footballers also featured a higher level of mobility of nervous processes than the general population, whereas the chess players displayed a higher level of inhibition strength. Similar results were obtained in the studies carried out by O'Sullivan et al. [14], where young (student) competitors of team sports (footballers, hockey players, etc.) featured a significantly lower level of neuroticism and anxiety (negative correlates of strength of the stimulation process) when compared with the university population. The findings from these studies, however, are not always so clear-cut. A comprehensive study in Korea compared athletes and non-athletes (mean age 17 and 36, respectively) and demonstrated that athletes and persons leading physically-inactive lifestyles did not differ with respect to novelty seeking (a demand for stimulation), harm avoidance, reward dependence, and persistence. On the other hand, the levels of both trait and state anxiety were found to be lower in the population of non-athletes than athletes [15]. Furthermore, similar results were obtained in the studies carried out by Malinauskas [16], in which rowers and middle-distance runners (both groups were comprised of members and candidates of the Lithuanian national team) featured a relatively high level of neuroticism (a negative correlate of strength of the stimulation process).

The obtained high values of the psychological determinants should come as no surprise. The strength of the stimulation process, identified with the strength of the nervous system, is crucial in sport, both in long-duration training (taking place in highly stimulating situations) and actual fencing combat. On the other hand, the mobility of nervous processes, implying the speed of adjustment to new situations is highly significant in fencing, in which the situation on the strip changes frequently and rapidly. Achievement motivation is important in every task situation, not only in competitive sport [17–20].

The formulated research hypotheses which (1, 2, 3) assumed positive correlations between the psychological variables and sports results in senior fencing were confirmed in the male group. The initial regression analysis employed on the whole studied group of fencers pointed to two significant predictors: the strength of stimulation process (introduced in the first step) accounting for 21% of the variance in the sports results and achievement motivation (introduced in the second step) then increasing the explanation of variance by

ca. 10%. However, a detailed analysis of the relationships within each gender revealed that these factors were of great importance in the group of men, where the noted correlations were relatively strong: $r = 0.60$ ($p \leq 0.01$) for strength of the stimulation process and sports results, $r = 0.58$ ($p \leq 0.01$) for mobility of nervous processes and sports results, and $r = 0.52$ ($p \leq 0.05$) for achievement motivation and sports results. These results were confirmed by the regression model that was employed. These variables accounted for about 37% of the variances of sports results (37% based on the adjusted R^2, 44% based on R^2). Introduced in the first step, the strength of stimulation process was of great importance in this model and explained 36% of the sports results. Less significant, however, for achieving a better fitting model was achievement motivation (introduced in the second step), which increased the explanation of variance by ca. 8%.

These results party overlap with the results obtained by Borysiuk [21, 22], who also showed that the strength of simulation process is a significant predictor of the sports level in senior male fencers (however, in the studies conducted by Borysiuk this predictor turned out to be also significant in the group of senior female fencers). He also showed that the strength of simulation process was significant in the junior female fencers, but not in the junior male fencers and no significant relationships between the mobility of nervous processes and fencers' sports level [21] were observed, which is comparative to the obtained results, since in the light of the regression model, mobility did not turn out to be a significant predictor after the strength of simulation process and achievement motivation had been introduced to the model. However, no direct relationships of emotional reactivity (a negative correlate of strength of stimulation process), briskness and achievement motivation with sports results of adolescent fencers were found in the study conducted by Tomczak [12].

The obtained results were also partly in accord with the results from Rychta's study [23] that examined a group of fencers within the age range of 14–32 years, and revealed a statistically significant average correlation between the mobility of nervous processes and the fencers' sports level. The obtained results confirm the view expressed by Czajkowski [24, 25] as to the importance of the strength of the nervous system and achievement motivation for action effectiveness in fencing, in particular in the senior stage [21]. The results also confirm the great importance of psychological factors in fencing within the context of other important variables from various groups, such as physical, physiological and motor factors, and factors of special fitness, which were pointed out by Roi and Bianchedi [26].

Thus, the fourth hypothesis that assumed that the structure of correlations between the studied psychological determinants and the sports results of senior fencers was different in men and women was in fact confirmed. However, in the group of female fencers the correlations were lower and did not reach the assumed level of statistical significance (0.05). Likewise, the regression model did not obtain the assumed statistical level of significance and showed that the predictors accounted for a small part of variance in sports results. On the whole, when compared with the general population, women turned out to be better selected than men in terms of the studied psychological factors. However, the relationships between these factors and the results in the female group are lower than in the male group. Possible explanations for these results could be the different approaches by men and women towards rivalry and competition in general. Men are usually more disposed towards direct rivalry, fighting and in making comparisons of different determinants than women. This attitude could be explained by the different tasks (in family, at work) and social roles that had been fulfilled by the two genders for thousands of years. In men, these tasks required more intensive rivalry and fighting for material and non-material resources. On the other hand women's tasks involved less direct rivalry and more focus on upbringing children and household duties [27, 28]. Women have also taken an less active part in wars and conflicts, and it needs mentioning that fencing is an exemplification of real combat. It might be then that women engaged in fencing, as a sport involving long-term direct competition and fighting (which shows that this activity suits them well) are better selected than men in terms of certain psychological determinants than men who are more directly competitive by nature. Beside the differences between the senior female fencers and the general population, and the group of male fencers and the general population, no other significant differences in the examined psychological properties were noted between the two genders; whereas men from the general population usually display higher strength of the stimulation process and mobility of nervous processes. Thus it can be stated that female fencers display a "male" temperament in terms of the levels of the studied psychological determinants.

Thus, female senior fencers can be expected to feature weaker correlations with their sports results. In fact, due to the greater selection, they had significantly fewer low and very low results than men, which could have been related to low and very low sports results. In this group, however, having fulfilled a certain required criterion, e.g., a high level of strength of the nervous system, other factors can also determine the level of specific fitness, such as intuition. On the other hand, in the less selected group of male fencers, still featuring low levels of studied determinants, correlation coefficients can be high, as they can be related with low sports results or at least could impede the achievement of high sports results.

Another explanation could be related to the other determinants of sports results, such as motor fitness,

which could play a greater role in male fencers whose combat often depends on the factor of speed. In female fencers there could be some factors that are more individual than statistical, e.g., a high level of intuition can compensate for a lower level of a certain skill. If that is so, then a low variance of motor fitness (low standard deviation) could have been noted in the male group of fencers and the fitness results could have been distributed to the right of the arithmetic mean. However, this group would not have featured strong correlations between motor fitness and sports results, rather other correlations would have been found between other psychological properties and sports results.

Thus after having met a certain criterion of motor fitness in a population where all members feature a similarly high level of this criterion, it ceases to differentiate this population in terms of their effectiveness. More significant here may be other variables, for example, the "psychical fitness" examined in the present study.

Conclusions

1. Senior fencers had higher mean levels of the studied psychological properties, i.e., strength of the stimulation process, mobility of nervous processes and achievement motivation, than the general population in the same age range. It could be an indication of the high selectiveness of fencers in terms of the studied psychological determinants. The female fencers constitute a better selected group than male fencers in all studied psychological determinants of sports results.

2. A relatively strong correlation can be noted between the male senior fencers' strength of the stimulation process, mobility of nervous processes and achievement motivation and their sports results. It can be illustrative of the tendency to achieve higher sports results by men with a higher level of strength of the stimulation process, mobility of nervous processes and achievement motivation than men with lower levels of these properties.

3. No statistically significant correlations were noted between the strength of the stimulation process, mobility of nervous processes, achievement motivation and sports results in the studied senior female fencers.

4. The obtained results from the present study conducted in order to identify the main determinants of sports success in fencing may have far-reaching implications for the interactions between coaches and athletes. Coaching should recognize the individual psychological differences among fencers and should reflect the effects of gender and age diversification on psychological properties such as temperamental characteristics or the level of achievement motivation.

References

1. Keegan R., Spray Ch., Harwood Ch., Lavallee D., The motivational atmosphere in youth sport: coach, parent, and peer influences on motivation in specializing sport participants. *J Appl Sport Psychol*, 2010, 22 (1), 87–105, doi: 10.1080/10413200903421267.
2. Mann D.T., Williams A.M., Ward P., Janelle C.M., Perceptual-cognitive expertise in sport: a meta-analysis. *J Sport Exerc Psychol*, 2007, 29 (4), 457–478.
3. Strelau J., Zawadzki B., PTS – Temperament Questionnaire [in Polish]. PTP, Warszawa 1998.
4. Atkinson J.W., An introduction to motivation. Princeton, Van Nostrand 1964.
5. Widerszal-Bazyl M., Achievement motivation questionnaire [in Polish]. *Przegląd Psychologiczny*, 1978, 2, 355–368.
6. Kipp L., Amorose A.J., Perceived Motivational Climate and Self Determined Motivation in Female High School Athletes. *J Sport Behav*, 2008, 31 (2), 108–129.
7. Hodge K., Allen J.B., Smellie L., Motivation in Masters sport: Achievement and social goals. *Psychol Sport Exerc*, 2008, 9 (2), 157–176, doi: 10.1016/j.psychsport.2007.03.002.
8. Brzeziński J., Methodology of psychological research [in Polish]. PWN, Warszawa 1996.
9. Williams J.M., Hoepner B.J., Moody D.L., Ogilvie B.C., Personality traits of champion level female fencers. *Res Q*, 1970, 41, 446–453.
10. Bandach L., Personality conditions of the combat style in foil fencing [in Polish]. *Sport Wyczynowy*, 1997, 3–4, 33–39.
11. Gracz J., Tomczak M., Selected temperamental properties and achievement motivation of fencers. *Studies in Physical Culture and Tourism*, 2008, 15 (2), 109–118.
12. Tomczak M., Psychosocial conditionings of individual development in sport in adolescence: The case of fencing [in Polish]. *Monografie AWF w Poznaniu*, 2010, 392.
13. Bukowska K., Zgadzaj R., Comparative analysis of the temperament of Hess and football players against a background of the general population. *Hum Mov*, 2007, 8 (2), 89–97.
14. O'Sullivan D., Zuckerman M., Kraft M., Personality characteristics of male and female participants in team sports. *Pers Indiv Differ*, 1998, 25, 119–128.
15. Han D.H., Kim J.H., Lee Y.S., Bae S.Jo., Bae S.Ji., Kim H.J. et al., Influence of temperament and anxiety on athletic performance. *J Sport Sci Med*, 2006, 5, 381–389.
16. Malinauskas R., Peculiarities of emotional states of sportsmen in cyclic sports. *Int J Sport Psychol*, 2003, 34 (4), 289–298.
17. Etnier J.L., Sidman C.L., Hancock L.C., An examination of goal orientation profiles and motivation in adult team sport. *Int J Sport Psychol*, 2004, 35 (3), 173–188.
18. Krawczyński M., Personality anxiety and achievement motivation in football. In: Mikołajczyk M. (ed.), Psychological correlates of physical activity and success in sport [in Polish]. PTNKF, Warszawa 2004, 57–63.
19. LaChausse R.G., Motives of competitive and non-competitive cyclists. *J Sport Behav*, 2006, 29 (4), 304–314.
20. Petherick C.M., Weigand D.A., The relationship of dispositional goal orientations and perceived motivational climates on indices of motivation in male and female swimmers. *Int J Sport Psychol*, 2002, 33 (2), 218–237.
21. Borysiuk Z., Psychomotor and personality determinants of the champion's level in fencing [in Polish]. *Studia i Monografie Politechniki Opolskiej*, 2002, 127.
22. Borysiuk Z., Complex evaluation of fencers predisposition in three stages of sport development. *Biol Sport*, 2006, 23 (1), 41–53.

23. Rychta T., Goal behavior and sportsmen' personality. In: T. Rychta (ed.), Goal behavior and personality in sport [in Polish]. PTNKF, Warszawa 1998, 54–96.
24. Czajkowski Z., Understanding fencing. The unity of theory and practice, SKA SwordPlay Books, Staten Island 2005.
25. Czajkowski Z., The "warrior" and "technician" types of fencers. *Hum Mov*, 2004, 5 (2), 141–147.
26. Roi G.S., Bianchedi D., The science of fencing: Implications for performance and injury prevention. *Sports Med*, 2008, 38 (6), 465–480, doi: 10.2165/00007256-200838060-00003.
27. Best D.L., Williams J.E., Briggs S.R., A further analysis of the affective meanings associated with male and female gender-trait stereotypes. *Gender Roles*, 1980, 6 (5), 735–746, doi: 10.1007/BF00287493.
28. Archer J., Gender differences in social behavior: Are the social role and evolutionary explanations compatible? *Am Psychol*, 1996, 51 (9), 909–917, doi: 10.1037/0003-066X.51.9.909.

Paper received by the Editors: May 31, 2010
Paper accepted for publication: November 23, 2011

Correspondence address
Maciej Tomczak
Zakład Psychologii
Akademia Wychowania Fizycznego
ul. Królowej Jadwigi 27/39
61-871 Poznań, Poland
e-mail: maciejtomczak5@gmail.com