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COMPLEX EVALUATION OF FENCERS PREDISPOSITION IN THREE STAGES OF SPORT DEVELOPMENT

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Abstract. The work presents detailed analysis of somatic, psychomotor, special and psychologic parameters of fencers during initial, directed and master stage of the training. Using specific statistical methods (factor and regressive analyses - Hellwig's model) agents determinig the sport fitness were identified (n=65). Averages of height and body mass as well the slender index according to Roeher were calculated basing on age and registered somatic features. Following tests were performed as considering the special fitness predisposition: fencing endurance, precision of weapon movement, speed and special coordination, motorial adaptation and motions frequency capacity (Zuchory's test). As regards the psychomotor abilities the visual-motion coordination test (cross apparatus) and simple and complex computer speed trials with mistakes recording were done. The whole procedure was enriched with the psychological examination through temperamental features measurement - Strelau Temperament Inventory (STI) and personality dimensions - Eysenck Personality Questionnaire (EPQ). The factors analysis was conducted as considering the specific fencing ability. It allowed the evaluation of the fencing abilities factors internal structure. As the most predictive and statistically significant following variables were found: fencing endurance, movements precision and motorial adaptation. Research confirmed the special preparation importance and the role of psychomotor indices, especially the visual-motion coordination and concentration in tests examining the variety of reactions. Contemporary fencers turned to be athletes with strong nervous system what was proved by the temperament and personality tests. Final conclusions of this research focus on the application thoughts, mostly in a sphere of diagnostics and training methods which would take into account the whole exploratory procedure. Comparative analyses of 3 examined groups showed that during the initial stage of training the physical fitness of fencers plays an important role while during the directed and master phase of practice the technical abilities development and psychomotor parameters grow more important.

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Introduction

The nowadays sport requirements command - not ignoring the studies and partial analysis - more synthetic treatment of research inquires. The integration of various scientific fields factors gives the fully objective view of complicated dependencies assembling the talent and sport level in specific sport branches [13,17,22]. It may be assumed that it is the best way of the identification of elements influencing sport outcomes.

Beside the motorial abilities and energetic predisposition, the psychomotor capacities (different types of speed reaction) and psychological features (temperament and personality dimensions) play the key role in fencing and other similar sports. According to specialists [7,14,21] the most important in the whole training process are:

- the ability of transferring training skills, habits and features to the tournament combat;
- versatility, regarded as the combination of technique, various reactions - coordinative predispositions, motorial aptitudes, tactics as well as psychic features and processes,
- the ability of controlling during the competition mental processes and emotional states, stress resistance, adjustability to different adversaries.

Many authors partook in the complex formulation of the research subject - [4,6] and [3,5]. The latter ones are worth notation for they treat the training process in the systemic way as considering its steering and optimisation. The new approach was possible owing to the biometric regression model usage. This method allows the precise forecast of optimal system of factors determining examined subjects sport level. Moreover, it enabled the reduction of endogen variables to a few, most important ones. As a conclusion the characteristic information mess can be avoided and processes of selection and training control may be rationalised.

The following questions answer was attempted to gain in presented study:

1. Which of examined variables condition in the largest degree the high sport level in fencing?
2. How the features and abilities development at various training stages runs?
3. Can presented tests and trials be useful instrument of fitness state diagnostic in the training practice ?

To obtain the above questions response the main focus at the search of dependencies between chosen indices of psychology, psychomotor abilities, somatic parameters, special fitness factors and sport level was put. The interior structure of fencing fitness components was determined using the factor analysis and treated in following regression analyses as dependent variable.

What is more, there was accepted that the division of sport advancement for 3 classes presents athletes sport stage most efficiently: Olympic, junior and youngsters from the micro-regional list. The additional advantage of such a division became the possibility of comparison of the specific features in sensitive period, their biggest increase exactly in the junior age [11,15].

Materials and Methods

Fencing athletes in number of 65 took part in the study. Their were divided according to the age criterion recommended by the Polish Fencing Union. Following age groups were created:

1. Status 1 - (n=16) athletes classified in FIF (Fencing International Federation) as the Olympic group;
2. Status 2 - (n=23) athletes classified in Polish Fencing Union as junior group
3. Status 2 - (n=36) athletes classified on Śląsk macro region list - macro-region group.

Athletes of 3 different fencing weapons took part in the experiment: sabre, foil and epee. Measurements were taken by the author with cooperation of Polish representation coaches during senior and junior grouping and macro-regional camps in 1999/2000 playing period.

Age and somatic features: Markings of the mean age, body height and mass were done by the Roeher's index calculation according to: body mass [gr]x100/height [cm]^3 formula.

Specialistic tests: special endurance - measurement of time in which athlete goes through the fencing floor on the 16x6m distance forwards and backwards in on-guard position.

a. motions precision and spatial orientation - scored pinning on with the blade's end of falling glove (3 trials, 5 series). The gymnastic bench was put by the wall-bars in standard angle (70 cm from vertical point). The place of pinning on responded the place of hitting in the corpus - it was restricted by tapes at 100 to 170 cm height.

b. speed of motions complex in respect of coordination - test encompassed 3 fencing actions which were timed electronically: first was the corpus thrust, then

on-guard position taking, thrust executed with a beat and corpus lunge or in sabre fencing - cut on the mask, on-guard position - step backwards, feint attack with corpus step lunge, in sabre fencing - with flank cut and back to the on-guard position. The above exercises combination was used during lessons with coach.

c. the ability of motorial adjustment - the test presented obstacle track with fencing armour on. It was placed on 9x9m square and obstacles were placed on each straight segment. The first were 3 athletic hurdles, second was the gymnastics box put lengthwise, third were 2 mattresses and forth was the biggest element of gymnastic box through which subjects had to do interlacement. Examined could not separate with their fencing weapon. Obstacles could be overcome according to individual ideas. The time of circles was measured.

d. ability of performance motions with high frequency - the test was a form of skipping, with clapping under the knee and lasting for 15 s. The number of recorded claps was taken as a result.

Psycho-motorial capacity measurement:

a. visual-motion coordination - cross apparatus test with "forced programme". The sum of 3 time versions was the result: 50, 70,90 imp./60 s.

b. simple reaction time according to Ryguła's [18] computer programme. It consist in the exposing of 30 light impulses in various time sequences. The result present the average time of reaction speed and mistakes registration i.e.: not responded stimuli or premature reactions.

c. the time of reaction with choice [18]. Examined had to react with left or right hand on used light signs (colours) as fast as they were able.

Signals of 2 different colours were composed into the sequence of 40 light stimuli. Athletes ought to restrain their reaction on its view. Computer recorded average speeds of reaction and mistakes number.

Both cases i.e.: simple and with choice reaction the errors registration was taken as the concentration and attention focus index.

Psychological examinations:

a. measurement of individual differences considering temperament using the Strelau's Temperamental Questionnaire modified by Wjatkin [23].

4 factors were determined:

- nervous processes activity
- activation processes strength
- restraining processes strength
- nervous processes balance as the activation and restraining force quotient.

b. measurement of individual differences as regards personality dimensions according to

Personality Inventory of H.J. Eysenck [8].
3 indices were found:
- neuroticism
- extroversion/introversion
- lie

Data statistical analysis methods: Following statistical methods were used:

1. factor analysis for the dependent samples number reduction. Principal component extraction was applied as a factor isolation criterion accepting the eigenvalue not smaller than one. If the factor analysis results showed the existence of important structure the factor indices were calculated (regressive method) and used for further regressive-correlative analysis.
2. correlation and regression calculus was used as for the measurement arrangement. Taking into consideration the proper methodological estimation of biometric regression model [17] the explanatory variables optimal choice algorithm proposed by Hellwig [18] was applied.

All the analysis were performed using the STATISTICA 6.0 statistical kit.

Results

Table 1
Average variable values and standard deflection in examined groups

No	Variable	Olympic Gr. n=16		Junior Gr. n=23		Macro region Gr. n=36	
		Variable	±SD	Variable	±SD	Variable	±SD
1.	Age (years)	23.28	12.45	17.23	4.32	14.52	3.84
2.	Body height (cm)	179.44	5.44	177.84	7.88	170.76	7.18
3.	Body weight (kg)	76.10	5.44	68.28	8.29	57.00	9.58
4.	Roeher's index (points)	1.33*	0.06	1.24*	0.06	1.16*	0.15
5.	Cross apparatus (points)	113.69*	22.55	76.12	30.54	43.76*	21.36
6.	Simple reaction time (s)	0.18	0.02	0.19	0.03	0.21	0.03

7.	Choice reaction time (s)	0.37	0.03	0.36	0.51	0.44	0.05
8.	Simple reaction errors index (points)	0.54	0.90	1.11	1.94	1.69	4.66
9.	Choice reaction errors index (points)	3.79	3.50	4.38	3.91	6.89	4.95
10.	Fencing capacity - test (s)	36.48	1.69	37.63	3.10	44.18	2.75
11.	3 fencing types combination (s)	3.95	0.40	4.20	0.46	6.11	0.48
12.	Pin on gloves (points)	10.12*	1.82	8.09*	3.11	4.62*	1.52
13.	Obstacle track	33.70	2.31	34.80	6.27	41.90	3.82
14.	Zuchory's test (points)	45.89	4.33	42.11	5.90	39.28	5.97
15.	Strelau-stimulation processes strength (points)	45.28	11.63	43.53	10.53	34.16	9.37
16.	Strelau-nervous processes activity (points)	58.96*	8.98	53.45*	9.76	44.60*	9.28
17.	Strelau-nervous processes balance (points)	1.18	0.38	1.16	0.34	0.93	0.25
18.	Strelau-restraint processes force (points)	40.15	8.29	40.20	11.43	38.80	0.51
19.	Eysenck-extroversion/introversion (points)	36.08	3.91	34.70	7.31	27.30	7.19
20.	Eysenck-neuroticism (points)	17.02	8.19	16.01	9.34	24.26	7.70
21.	Eysenck-lie (points)	8.02	3.54	6.90	3.55	7.12	3.06

*indices with the statistically highest variation between groups ($p<0.05$)

Somatic factors analysis: The results analysis shows that fencers are close to footballers and handball players as regards somatic parameters. It is confirmed by the height-weight index (1.33) comparable with data gained for team games representatives [2,12]. It should be noted that presented here (averaged) data do not fully present the phenomenon diversity for in fencing, sabre fencers are higher from epee and foil fencers. Roeher's index above 1.3 informs that nowadays fencers are more athletic type. The logical explanation of this tendency is the contemporary style of fight which is more dynamic (FIF regulations) through the shorter time of encounter. Author's own research [3] confirmed that the fencing became based on mixed and anaerobic energy influencing the somatic profile of athletes.

Fencing fitness internal indices structure:

Table 2
Fencing fitness components analysis

Variable	Value
Fencing capacity	0.851*
Combination of 3 fencing actions	0.659
Pinning on the glove	-0.728*
Obstacles track	0.780*
Zuchory's 15s test	-0.673
Eigenvalue	2.781
% of total variety	0.556

$p<0.05$

Factor analysis of 5 fencing abilities test was conducted (Table 2). One index result applied explains 55.62% of the total variety. The higher was the value of factor load the stronger saturation of respective feature with this factor was. In this case - fencing fitness. Some special remarks should be said about 3 factors with values exceeding 0.700. The fencing capacity is on the top. The result corroborates aptness of made choice. It seems that proposed test presents optimally the specificity of fencing work of legs, its directions changeability, technique and special endurance (average 40 s of intensive work). Second (0.799), as considering statistical significance, was the obstacle track. This trial turned to be an important

diagnostic mean of the motorial adaptation ability in different tasks demanding individual invention.

An important accuracy (-0.728) showed the speed and motions precision test. Many practices enhance the additional ability which this trial display namely, the spatial orientation. It undoubtedly has the predictive qualities an ought to be applied in training process.

The trial of Zuchory, used usually as a mean of fencing adepts selection, was taken into consideration as well. The above test obtained a moderate statistical value (-0.673). The specific test of technique and motion coordination described as the combination of 3 fencing activities presented the average level of special fitness factor loads (0.658). It can be assumed that in this case speed measurements do not render the technical structure correctness as for examined preferred higher speed from precision of performance.

Internal structure of psycho-motorial factors: The simple reaction time analysis showed the statistically significant difference between the Olympic and junior groups and macro-regional one. Taking into consideration average age of Olympic and junior group the lack of significant differentiation among them proves the restricted influence of this factor on the sport level in leading fencing athletes. Similar dependencies were stated in choice reaction tests. The fact that in all groups the choice reaction test displayed over twice longer average time than in the simple reaction trials is worth noticing. The above differences are regarded as many scientists as the ability of making choice or stimuli differentiation [11,20]. The analysis of errors indices in both tests produce some interesting notices namely, the linear dependencies between respective groups. Visual prevalence of Olympic group - high class fencers - states their ability to avoid wrong reactions. This specific predominance is the effect of high predisposition in a field of concentration, its divisibility and focus through needed in trial time. Hence the low factor of errors.

The crucial role among discussed psychosomatic parameters has the visual-motorial coordination measured by cross apparatus. According to specialists [15,16] this ability is an aspect of spatial orientation and may be diagnosed by use of other means e.g.: Piórkowski's apparatus. In this research the above predisposition places itself as the best index of examined athletes sport level (repeated regression analysis shows that - Table 3) the more so as it is also characterised by linear dependency in tested groups arrangement.

Temperament and personality predisposition changeability analysis: The psychological study results indicate that the temperament profile among fencers varies all groups significantly. The biggest strength of activation processes is

characteristic for Olympic group athletes and smaller - for juniors. The macro-regional group is characterised by significantly lower level of nervous processes balance and activity parameters.

As regards personality, the dominant feature is the extroversion enforced in the Olympic group. The low level of neuroticism in two first statuses forces the opinion that this feature is the psychological predictor of success in fencing.

Biometric model as the mean of variables complex analysis regarding fencing ability: The linear regression model was used (Table 3) as for the examination of interaction of explanatory variables and their influence on the sport level in athletes. Biometric model of regression allowed in this work for the endogen variables specification influencing in the most crucial way the fencing abilities in the Olympic, junior and macro-regional group. Basing on the structural parameters of regression equation there can be assumed that the biggest effect on fencers from the Olympic group has the X_{15} variable and next - X_5 and X_9. The combination of 3 variables which were found in regression model is substantially very interesting since each of them reflects the importance of respective factors gathering deciding about outstanding achievements in fencing. The analysis of mentioned above variables vectors regard explained (Y) displayed the following crucial dependencies: X_5 (0.894); X_{15} (0.400); X_9 (0.009). This results confirm the hypothesis saying about the great influence of visual-motional coordination, activation processes strength and low index of errors in choice reaction test on fencing achievements. Three endogen variables took into account in regression equation clarifies 92% of studied phenomenon changeability - determination factor = R^2-(0.918). It proves the extremely high predictability of discussed variables in the field of success in fencing. Similar procedures were applied for other groups (junior and macro-regional). In junior group the optimal combination of explanatory variables created the following indices: time of complex reaction, activation processes strength and visual-motional coordination measured with cross apparatus. In the macro-regional group the statistical analysis isolated only two factors: body height and visual-motional coordination. Conducted comparisons of groups showed that factors with the highest informational load are the psycho-motorial variables (cross apparatus, low index of errors in choice reaction test and speed of choice reaction) and the temperament feature - activation processes strength. The most important for the macro-regional group turned the visual-motional coordination and somatic component - body height.

Table 3
Optimal combination of fencing abilities variables

Group	Regression equation	R^2	Hellwig's index
Olympic	$Y=1.314-0.400x_{15}+0.894x_5+0.099x_9$	0.918	0.875
Junior	$Y=0.506+0.261x_7+0.470x_{15}+0.909x_5$	0.962	0.934
Macro-regional	$Y= 0.113 + 0.895x_5 - 0.204x_2$	0.887	0.873

X_{15} - activation processes strength
X_5 - visual-motional coordination
X_9 - choice reaction errors index
X_2 - body height
X_7 - choice reaction time

Discussion

The 3 examined groups factor analysis shows a clear view of 5 components creating structurally uniform factor - specific fencing fitness. Hence, it can be stated that eventual significant correlations of other determined factors or components and fencing fitness may give an authoritative view of their usability as predictors of sport achievements in fencing. Then, the fencing fitness is treated as dependent variable.

While examining differences regarding athletes status the conclusion arose that the Olympic group slightly differs from juniors with fencing parameters and both these groups exceed the macro-regional one significantly. The interesting index is the one obtained in the pin on the glove test since it statistically differs all groups. It certainly has a diagnostic traits as it goes beyond only one ability test. It may be supposed that it expresses simultaneously the fast reaction capacity, motions precision and visual-motorial coordination.

Following observations occur: 1) So called sensitive period - accelerated development of respective psycho-motorial abilities falls on around 15-17 years old [15]. It may be thought that in age over 17 years old discussed features grow is slight. 2) The natural process of selection during the initial training period eliminated adepts with smaller velocity predisposition. 3) According to some authors [1,10] high class athletes in fencing and similar disciplines are differentiated usually not by simple reaction times but by more complex factors,

mainly from the field of psychical processes (concentration and attention focus, reaction durability, long-lasting and repetitive stimuli endurance). Generally it should be stated after Czajkowski [7] and Hardman [9] that people practising sport have shorter times of reaction than non-athletes. Similarly athletes with long sport experience display better simple reaction times than beginners though as this study showed the differences are insignificant or at the statistical significance border.

Using the known psycho-motorial teaching concepts [19] the statement arises that what differentiates the choice and simple reaction comprise itself in a delitescent period i.e.: during the sensorial-motorial response programming therefore in the central not peripheral phase of the nervous system activity.

The comparison of individualistic and temperamental aspects of examined subjects inclines to creation following general conclusions:

- Olympic group is characterised by crucially higher level of temperament extroversion.
- temperamental and personality features convergence as well as their high level considers also the junior group what indicates that discussed psychological aspects display themselves strongly already in an early age of juniors.
- the total result of temperament and personality tests prompts to formation of a statement that the fencers psychological properties spectrum is quite wide though so called master model is characterised by the large strength of a nervous system and lack of neurotic inclinations. The above inference does not exclude that among world champion medallists can be athletes with other characteristics e.g.: introverts with restraining processes supremacy. Many researchers [4,23] tend to accept the thesis about large introversion and neuroticism of leading fencers. Presented above study and final analysis of repeated regression incline to somewhat different conclusions enhancing simultaneously the prevalence of strong types, extroverts with low neuroticism level.

Analysing the whole research procedure results there can be stated that the highest predictive and diagnostic value at various stages of fencers training present: cross apparatus as visual-motional coordination trial; computer test in option of choice reaction errors index and two specialistic test - pin on the glove as the speed and motion precision trial and fencing capacity test (6x16m in on-guard position). The above tests have the crucial value as the selection means and may be used by trainers to the athletes starting disposition evaluation.

Conclusions

1. Accepted form of regression function and factor analysis of fencing fitness components point at very high dependencies between specified factors and sport level in examined fencers.
2. The optimal combination of regression explanatory variables for Olympic group create the two psycho-motorial indices: X_5 - visual-motional coordination and X_9 - choice reaction errors factor as well as one temperamental feature: activation processes strength - X_{15}.
3. All variable comparative analysis allow the statement that during the sport development, from initial phase till the master class, the largest amount of information give factors connected with psychology: perceptivity, concentration and focus divisibility as well the motions precision. These results show that in the initial part of training the physical fitness, including somatic traits, is crucial. Next, in the directive and special period of training the technique and personal development grow more significant.

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