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REACTIVE STRESS TOLERANCE AND PERSONALITY CHARACTERISTICS OF HUNGARIAN ELITE FENCERS

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ABSTRACT

Decision making is an essential part of athletes' success in open-skill sports, such as fencing. The main aim of this paper was to reveal differences between fencers and non-fencers in terms of reactive stress tolerance, a person's ability to provide quick serial answers to continuously changing stimuli. Secondly, we were also interested to explore if there were specific differences in personality characteristics. The Vienna Test System's Determination Test and the Temperament and Character Inventory were used for the examination of 90 participants, grouped as a function of their fencing level skills: Mastery level, Talented, and Non-fencing. First, analyses revealed significant differences between mastery level fencers and non-fencing participants in terms of reactive stress tolerance, favoring participants in the Mastery level group. Second, in terms of differences in temperament, analyses proved that female athletes were more sensitive and reward-dependent than males; and that there were significant differences in terms of self-control capacity, determination, self-congruence, and lust for revenge between mastery and non-fencing groups. Furthermore, participants' determination and the self-congruence were found to be associated with their reactive stress tolerance. Findings are discussed form an applied perspective.

KEYWORDS: *fencing, reactive stress tolerance, determination, associated ability to react, personality*

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The present study aimed to investigate traits that could contribute to fencers' success. In what aspects does an elite fencer differ from talented fencers and non-fencers? What are the characteristics or abilities that make a champion? We did not venture to provide a detailed answer to this question, but to find out whether a particular ability can partially answer this question. This ability is related to decision making. For the description of the decision process, we preferred the human information processing model, as opposed to the simplified 'Input → Decision Making → Output → Feedback (→ Input)' circle model. The human information processing model is depicted in **Figure 1**, as adapted from Wickens, Hollands, Banbury, and Parasuraman (2016). Accordingly, the input arrives as a stimulus observed by sensory organs, and via perception, these pieces of information are identified, interpreted, hence meaning is attached to them. The next stage of this process is when the interpreted input arrives to the working memory, which is in constant connection with long-term memory, after which the output of these two units and the already interpreted stimuli enter the next stage, response selection, or the decision making phase. The final stage of the process is response execution, which represents the actual execution of the formulated action.

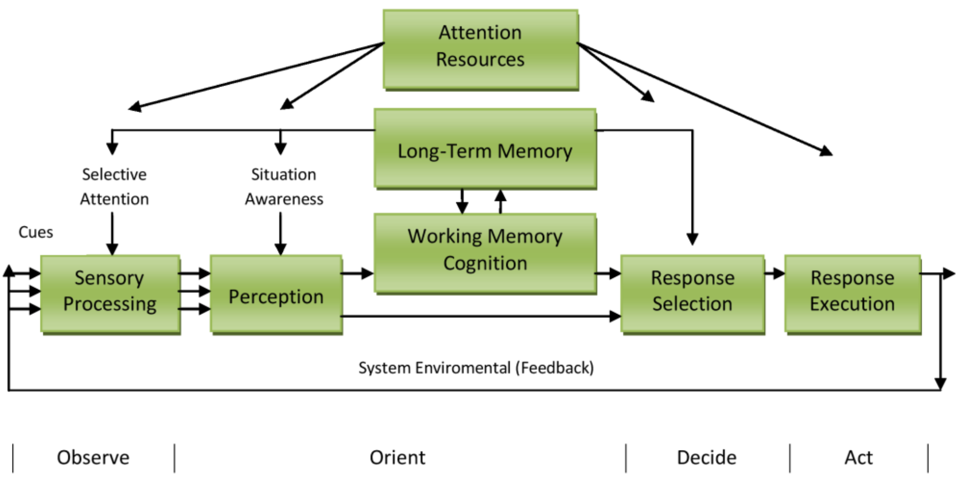

Figure 1. The human information processing model, adapted from Wickens, Hollands, Banbury, & Parasuraman (2016).

During a fencing situation for instance, a new stimulus might emerge from the existing environment, and also from environmental factors arising as a result of the formerly executed action (e.g., opponent thwarts the plan). Understandably, in this type of situations, a competitor's response to stress plays a crucial role. In this study, we will solely focus on competitive stress, defined by Mellalieu, Hanton, and Fletcher (2009) as an "*ongoing transaction between an individual and the environmental demands associated primarily and directly with competitive performance*" (p. 4). Out of the environmental factors/ demands, we emphasize the stress generated by processing the ever changing stimuli varying in their nature (visual, auditory, audio-visual), and its role in the decision making process.

Several studies have been conducted revealing various aspects of sport performance and psychology that can be linked to the stages represented in the information processing model. Some of these focused on the perceptual skills of athletes, their ability to retrieve and recognize meaningful information (Doğan, 2009; Williams, 2000), which can be identified as the perception phase of the model. Others have examined outside-of-sport stressors, organizational stressors, stress and training associations (Hanton, Fletcher, & Coughlan, 2005; Rushall, 1990), or various psychological skills and states of athletes (Cox, Zhan, & YiJun, 1996; Doron & Martinent, 2015) and the differences of functional asymmetry of brain hemispheres (Porozov et al., 2011). There are several comparative research studies regarding fencers' reaction time (response execution stage; Gutierrez-Davila, Rojas, Antonio, & Navarro, 2013; Poliszczuk, Poliszczuk, Dabrowska-Perzyna, & Johne, 2013).

Although decision making at speed (response selection and execution stages) is a vital part of success in fencing, reaction time by itself does not distinguish between fencers. As discussed by Czajkowski, it is not enough to be able to execute a given stroke fast, as during a bout, a fencer must decide "*when and how to apply a given action*" (Czajkowski, 2009a, p. 241), as the "*selection of the right stroke is probably the most basic tactical ability of a fencer*" (Czajkowski, 2009b, p. 371).

Hence, timing is essential in decision making, especially in a combat situation. Nevertheless, oftentimes fencers already know before the actual hit what action they want to execute, they have a plan, yet it frequently happens that they have to postpone the execution as the combat situation has changed, the right moment has passed, or the opponent acts/reacts different than anticipated. This flow or change of events is absolutely natural in fencing, since the fight is happening within the framework of a tactical duel. As Poliszczuk et al. (2013) stated, "*it is the appropriate reaction, not speed, which is crucial. A fencer will not be able to even land a very quick strike, if they fail to recognize their opponent's true intentions*" (p. 27). To defeat their opponent, fencers have a complex task: they have to choose an action from a *set of possible and appropriate solutions* with a speed applicable in the given situation, and to execute it in the appropriate time and from the appropriate distance.

Hence, it can be inferred that not only the presence of a single factor is needed for better performance, but rather a related and coherent system of the previously mentioned factors: stress tolerance, reaction time, and choice of action. During the decision making process, the ability capacitating a person to give serial answers to serial, continuously changing stimuli is known as reactive stress tolerance. A higher number of good answers/actions provided in response to the incoming stimuli indicate a better reactive stress tolerance ability. So far, less attention has been paid to reactive stress tolerance, although several aspects of related skills and abilities have been investigated. Our study aimed to explore this neglected area.

There are also large individual differences in terms of stress tolerance. People's behavior in a stressful situation can vary according to their personality traits, and the type of stress they are exposed to. In this respect, we aimed to find personality factors that enable athletes to have better reactive stress tolerance or increase this ability.

Hence, in the current study, we aimed to investigate reactive stress tolerance and decision making in fencers. Given that fencers are often (daily or sometimes more than once a day in training and competitions) exposed to reactive stress similar to the tests applied, we hypothesized that elite fencers would have a better reactive stress tolerance compared to talented fencers, and that talented fencers would outperform non-fencing participants. Additionally, we explored whether some personality traits were associated with increased reactive stress tolerance.

METHOD

Participants

This study included 90 voluntary participants representing three groups in terms of fencing skills: (1) Mastery, (2) Talented, and (3) Non-fencing. The fencers of the Mastery group were the elite fencers, achieving at least a medal during junior or senior European/World Championships or at the Olympics, hence those who would identify as Elite Referenced Excellence (Bailey et al., 2010) or as "Mastery" and "Elite" level under the Foundation, Talent, Elite, Mastery model (FTEM; Gulbin, Croser, & Morley, 2013). Talented group fencers were competitive training partners of the first group, and some have represented their country, but without international medal success, they would identify as Personal Referenced Excellence or "Talent" level within the FTEM. The Non-fencer group consisted of people who do not have connection with sports, but also of athletes without reference to their branch of sport, thus making our Non-fencing group more reliable.

Of the 90 participants, 46.7% were Non-fencing, 32.2% were identified as Talented and 21.1% was Mastery. At the time of testing the mean age was 27.6 with a standard deviation of 6.1 years, the youngest participant was 18 and the eldest was 40. There were no differences in terms of age between female and male participants (see **Table 2** for descriptive statistics).

Procedure

Testing took place in Hungary between 2012 and 2015. The research was submitted to and accepted by the Institutional Ethics Committee of the University of Physical Education, Hungary. The voluntary participants were informed about the purpose, methods and possible uses of the research, they gave their consent for using the data for scientific purposes. The Schuhfried GmbH Vienna Test System (VTS; Kallweit, 2012) for Psychological Assessment was used for the study, which was favorably reviewed recently by Ong (2015) in relation to sport psychology research highlighting objectivity as its strength.

Materials

Determination Test (DT)

This test measures Reactive Stress Tolerance (RST) and Associated Ability to React (AAR). The DT test is a complex multiple stimulus multiple choice reaction test. During task unfolding, quick, precise and varying responses had to be provided as reactions to continuous, random and changing visual, acoustic and audio visual stimuli. The test taps cognitive abilities that are necessary to differentiate colors and sounds, to memorize the characteristics of stimuli configurations, and select relevant answers according to the given instructions (Kallweit, 2012). Signals were presented at a self-paced speed – the quicker the participant answered, the quicker the next question appeared. Thus, in a timed test (15 minutes, including instructions) more tasks would be attempted by those who reacted quicker.

Temperament and Character Inventory (TCI)

The Temperament and Character Inventory (TCI) is a personality test measuring automatic emotional reactions. The TCI assessment measures various personality traits, based around temperament which is seen as relatively stable throughout one’s lifetime, and around character which is based on self-concept, and is therefore shaped by experiences that can change over time (Cloninger et al., 1993; Cloninger et al., 1994). The test consisted in a 25-minute questionnaire; all questions had to be answered, omitted questions were presented again at the end of the questionnaire. Out of the TCI factors of the assessment, six were selected for examination in relation to fencing level and gender.

RESULTS

Profile analysis of Hungarian fencers

Table 1 shows the profile analysis of Hungarian fencers. In the hierarchical cluster analysis Ward's method was applied with Euclidean squared distance metric, through which 5 profile types were clearly distinguished. Afterwards, we analyzed differences among the profiles. Based on the Kolmogorov-Smirnov test, only reward dependency (Z = 1.36, p = .051) and self-control capacity (Z = 1.15, p = .05) could be considered normally distributed variables. Thus, in these cases we used an analysis of variance (ANOVA), whereas in the case of other factors, Kruskal-Wallis analysis was used. Out of the examined 29 factors, 18 have played a significant role in the segmentation of the profiles at a 95% confidence level. Table 1 reveals that RST, its AAR factor, and curiosity and exaggerated behavior, untidiness, determination, and self-control capacity were more characteristic to the Mastery group as of the other profiles. At the same time, damage avoidance, reward dependency, cooperativity, anticipatory worries and pessimism, and fear of uncertainty were less characteristic factors for this group.

Table 1.
Description of the five profiles of Hungarian Fencers

Item	Mainly Non-fencing	Non-fencing & Mastery	Talented & Non fencing	**Mainly Mastery**	Mainly Talented
Reactive Stress Tolerance (RST)	--	+	+	++	--
Associated Ability to React (AAR)	--	+	+	++	-
Curiosity behavior	--	+	0	++	--
Damage avoidance	++	--	++	--	++
Reward dependency	--	-	++	--	++
Persistence ability	--	+	0	**0**	+
Self-control capacity	--	++	+	++	0
Cooperativity	+	+	+	--	+
Exaggerated behavior	--	0	0	++	--
Untidiness	-	+	0	++	--
Anticipatory worries & pessimism	+	-	0	--	++
Fear of uncertainty	+	--	+	--	++
Attachment	-	0	+	+	-
Determination	--	+	+	++	--
Empathy	-	++	+	--	0
Pity	+	0	+	--	0
Sensitiveness	++	0	+	-	0
Self-congruence	--	0	+	++	++

Note. 0 = sample average; + = just over the average; - = just under the average; ++ = very much over the average; -- = very much under the average

Profiles indicate the combination of factors that are typical of a group of fencers. By profile analysis, we obtained a more subtle distinction of fencers than we would have using a "simple average" analysis. There can be factors, for which not the highest or lowest value is the most appropriate or the most typical on a given level. For example, in the case of 'Mainly Mastery', profile persistence ability is a characteristic to an average extent, while in the 'Talented' group it is more typical than the average. In the 'Talented' group sensitiveness and self-control capacity is typical to an average extent, as opposed to the 'Mastery' group, where it is more typical than the average. However, we considered it essential to conduct further analysis on these variables regarding the original groups as well (Mastery, Talented, Non-fencing).

Fencers' reactive stress tolerance (RST) and associated ability to react (AAR)

For the normality analysis of each variable, the Kolmogorov-Smirnov statistic was used. In order to identify possible differences among the three fencing groups' mean scores, we used the Kruskal-Wallis analysis for non-normally distributed scores. When normality was met, we performed a one-way ANOVA. We applied the Levene's test to check homogeneity. In cases with no homogeneity, we investigated the relationships by the robust Welch probe. In the case of ANOVA for the three groups, the pairwise group differences were demonstrated by the least significant difference post-hoc test, while along with the Welch probe, the Dunnett's T3 post-hoc test was applied.

Table 2 presents both the descriptive statistics and the results regarding RST and AAR scores according to the studied factors (gender, fencing group). Table 2 reveals that the average RST score was 311.5 with a variance coefficient of .11, whereas the average AAR score was 318.9 with a variance coefficient of .12. A proportion of 55.6% of the sample was male and 44.4% was female, which is broadly in line with the ratio of male and female fencers in junior and senior category in Hungary between 2012 and 2015 (Magyar Vívószövetség [Hungarian Fencing Association], 2016).

As shown in **Table 2**, based on the Kolmogorov-Smirnov analyses, we can conclude that the RST and AAR factors were normally distributed, therefore parametric tests like *t*-test and ANOVA were conducted. Levene statistic proved that standard deviations can be treated the same regarding Gender but they are different across the Fencing Level groups. The results showed that Mastery level fencers have significantly lower variance on RST and AAR scores, compared Talented and Non-fencing groups. This indicates that there was a varying set of RST scores, there could be people with higher RST scores within Non-fencing and Talented groups, but the homogeneity of higher scores in the Mastery group is suggestive. Hence, in order to reveal significant differences across the Fencing

Level groups, we employed the robust Welch probe instead of ANOVA, but in the case of Gender the traditional *t*-tests were used.

Table 2.
Descriptive statistics and analysis results for reactive stress tolerance (RST) and associated ability to react (AAR)

Factor	Ratio (%)	Age (years)	Reactive Stress Tolerance	Associated Ability to React
Fencing level*				
Non-fencing	46.7	28.3 (6.0)	303.3 (32.5)	310.1 (34.5)
Talented	32.2	25.3 (5.7)	312.3 (41.7)	321.5 (43.7)
Mastery	21.1	29.7 (6.1)	328.7 (22.3)	334.4 (23.0)
Levene Statistic**			3.76 (.03)	4.03 (.02)
Welch test's F Statistic**			6.28 < .01***	5.18 < .01***
Gender*				
Male	55.6	27.5 (6.3)	307.3 (35.3)	314.7 (36.4)
Female	44.4	27.8 (5.9)	316.8 (34.4)	324.2 (36.9)
Levene Statistic**			.13 (.72)	.01 (.94)
t-tests**			-1.28 (.20)	-1.22 (.23)
Kolmogorov-Smirnov Statistic**			.58 (.90)	.65 (.79)
Total average*		27.6 (6.1)	311.5 (35.1)	318.9 (36.7)

Note. *standard deviation is presented in brackets; **significance is presented in brackets; ***probability value indicating very large significance at .01 significance level.

Taking gender into consideration, we could not identify significant gender-related differences. However, results regarding the Fencing Level revealed significant differences in RST and AAR scores between groups. Dunnett's T3 post hoc test showed significant differences ($p < .01$) between Mastery and Non-fencing levels in both factors, with a large effect size of .84 for RST and a medium effect size of .71 for AAR. The mean difference found in RST scores between Mastery and Non-fencing levels was $M = 25.4$, 95% CI [6.7, 44.1], with an effect size of .91. Similarly, the AAR score difference was $M = 24.3$, 95% CI [4.6, 44], effect size of .83, favoring participants in the Mastery level group.

Temperament and character characteristics

Table 3 summarizes the basic statistics, as well as the results of our analysis regarding selected TCI factors, namely reward dependency, self-control capacity, sensitiveness, determination, self congruence, and lust for revenge.

Table 3.
Descriptive statistics and analysis results for the selected Temperament and Character Inventory (TCI) factors

Factor	Percentile Rank					
	Reward Dependency	Self-control capacity	Sensitiveness	Determination	Self Congruence	Lust for Revenge
Fencing level*						
Non-fencing	51.8 (31.1)	42.8 (25.6)	54.8 (30.7)	46.4 (24.2)	41.3 (27.1)	59.6 (27.5)
Talented	49.7 (31.1)	49.5 (24.3)	52.2 (34.6)	55.4 (25.5)	52.8 (25.4)	40.3 (33.1)
Mastery	57.7 (28.2)	58.8 (21.2)	58.1 (28.2)	70.2 (18.1)	59.6 (20.1)	43.1 (31.1)
Levene Statistic**	.45 (.64)	.66 (.52)				
ANOVA *F***	.44 (.64)	4.23 (.02)				
Kruskal-Wallis Statistic**			.08 (.96)	13.97 < .01***	6.81 (.03)	7.34 (.03)
Gender*						
Male	46.4 (28.7)	45.4 (25.2)	44.6 (28.6)	54.2 (25.3)	44.3 (25.9)	46.8 (31.6)
Female	59.8 (30.4)	52.1 (24.2)	67.2 (30.1)	54.5 (24.9)	54.6 (25.5)	53.8 (30.6)
Levene Statistic**	.26 (.61)	.14 (.71)				
t-test**	-2.14 (.04)	-1.25 (.22)				
Mann-Whitney Statistic**			-3.52 < .01***	-.01 (.99)	-1.89 (.06)	-1.09 (.28)
Kolmogorov-Smirnov *Z***	1.36 (.05)	1.15 (.15)	1.58 (.01)	2.54 < .01***	1.53 (.02)	1.79 <.01***
Total average*	52.4 (30.0)	48.4 (24.8)	54.7 (31.2)	54.3 (24.9)	48.8 (26.1)	49.9 (31.2)

Note. *standard deviation is presented in brackets; **significance is presented in brackets; ***probability value indicating very large significance at .01 significance level.

The Kolmogorov-Smirnov test showed that out of the six TCI factors, only reward dependency and self-control capacity followed a normal distribution. ANOVA was conducted for these factors, while the rest were analyzed by Kruskal-Wallis test. Taking gender into account, we performed ANOVA for the normally distributed factors, while the other factors were analyzed using the Mann-Whitney test. Results revealed that fencers obtained higher scores and lower variance on all studied TCI factors. Specifically, ANOVA and Kruskal-Wallis test revealed significant differences across the fencing level groups in four factors: self-control capacity, determination, self-congruence, and lust for revenge (see **Figure 2** for an illustration). In the case of the Kruskal-Wallis test, separate Mann-Whitney tests were performed for pairwise comparisons.

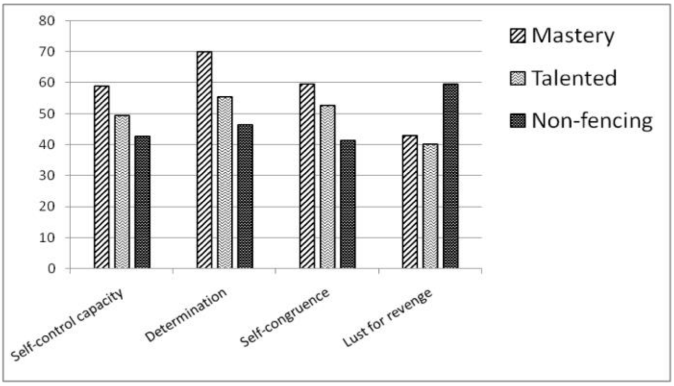

Figure 2. Mean scores for the most influential TCI factors (self-control capacity, determination, self-congruence, lust for revenge) as a function of the fencing level group (Mastery, Talented, or Non-fencing).

The results revealed that Non-fencers displayed a significantly higher desire for revenge than the other two groups (p = .026), with a small effect size of .29. Significant (p = .05 and p = .009) mean differences, M = 16.5, 95% CI [0.1, 33.1] and M = 19.3, 95% CI [4.9, 33.8], were found between Non-fencers and Mastery level participants, and between Non-fencers and the Talented group, with a medium effect size of .56 and .64, respectively. Compared to non-fencers, Fencers at Mastery level also obtained significantly larger scores on self-control capacity (p = .017), determination (p < .01) and self-congruence (p = .033), with an effect size of .55, .85, and .54, respectively. LSD post hoc test showed significant differences (p < .01) only between Mastery and Non-fencing groups in self-control capacity with a mean difference of M = 16, 95% CI [2.7, 29.4] and a medium effect size of .68, as well as in self-congruence, M = 18.3, 95% CI [4.4, 32.2] and an effect size of .77. The only significant difference (M = 14.8, 95% CI [1, 28.5]) between Talented and Mastery level was found in determination scores, with an effect size of .67.

We also identified significant gender-related differences for some of the other factors. Specifically, females were found to be more sensitive (p < .01) and reward dependent (p = .035) compared to males. Regarding sensitivity, the mean difference was $M = 22.6$, 95%, CI [10.3, 34.9], Cohen's d =.77. In the case of reward dependency, the mean difference was $M = 13.4$, 95%, CI [1, 25], Cohen's d = .45.

Associations among reactive stress tolerance (RST), associated ability to react (AAR), and temperament and character factors

In the final step of our analysis, we carried out Pearson and Spearman correlations for studying the relationships between RST and AAR, and between RST and the TCI factors. We found a strong positive relationship between RST and AAR as the Pearson correlation coefficient was just under 1, $r(88) = .98$, $p < .01$. Regarding the TCI factors, the determination ($r(88) = .20$, $p = .035$) and the self-congruence ($r(88) = .20$, $p = .042$) were found to be highly correlated with the RST scores, while the highest correlation ($r(88) = .22$, $p = .048$) was found between determination and the AAR scores.

Furthermore, a variance decomposition of the RST and AAR score was performed by applying the Contribution to Variance method. We approximated the percentage of the variance or uncertainty in RST and AAR, that is due to a specific TCI factor by squaring the Pearson correlation coefficients and normalizing them to 100%.

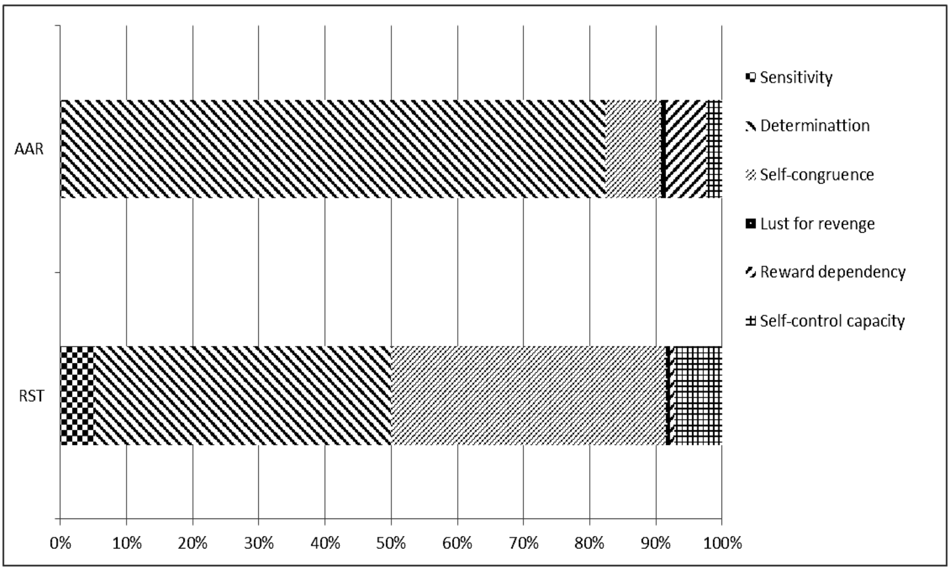

Figure 3. Variance decomposition of the reactive stress tolerance (RST), associated ability to react (AAR) scores.

Based on this analysis, we can conclude that determination and self-congruence together accounted for approximately 90% of the variance of both scores. **Figure 3** also indicates that the stronger the determination (accounting for 45% of the variance) and the self-congruence (accounting for 42% of the variance) is, the higher the RST scores. Also, determination itself (accounting for 82% of the variance) has a strong influence on the AAR scores. The RST score is also affected by sensitivity and self-control ability, while the AAR score is affected by reward dependency as well, but to a lesser extent.

DISCUSSIONS

Fencers have to be in an optimal environment and, more importantly, in an optimal mental state so that they could make the best decisions and select the action by which they can give the best (i.e., most appropriate in the given situation) hit possible. As our findings show, two personality factors can help the evolution and formation of this optimal state. These are determination and self-congruence, which were significantly associated to reactive stress tolerance and the associated ability to react, having thus a definite impact on decision making. Interestingly, our results also revealed that determination and self-congruence together accounted for approximately 90% of the variance of reactive stress tolerance, with determination having a stronger influence on the associated ability to react than on reactive stress tolerance score. However, there are also factors that put the fencers off their optimal state (opponent or sometimes the referee), and render decision making more difficult. Hence, the ability of decision making in such a situation (reactive stress tolerance) influences the success of fencers to a great extent, and also distinguishes them from average, non-fencing individuals.

Our main hypothesis was confirmed, as our results showed that fencers indeed outperformed non-fencers in reactive stress tolerance and associated ability scores, and there was a significant difference between fencers in the Talented and Mastery groups in terms of determination. Furthermore, two personality traits were identified as helpful in the decision making process. Apart from determination and self-congruence, our results show that fencers have more self-control and lower desire for revenge compared to non-fencers, but also that women are more reward dependent and more sensitive than males. These results from personality tests concerning gender broadly agree with research by Byrne and Worthy (2015), amongst others, who have researched gender differences in decision making and reward sensitivity through dynamic decision making tasks, and found that females tend to choose the optimal way in immediate rewards tasks, while males performed better in delayed rewards tasks. Taking into consideration this gender related difference, our results unravel the need for further research aiming to explore whether there should be a difference also in the way males and females are trained.

There is a concern around the retention of female athletes, and there might be answers to be found in further research.

The most interesting group in terms of differences may be the Talented group. In this respect, a longitudinal study would be needed to search for those temperament or character factors that could determine whether a Talented fencer becomes Mastery/ becomes a medalist in European/world championships or at the Olympics. We also suggest follow up studies comparing Mastery level athletes of fencing and other combat sports *of the same level*, or athletes from open-skill (e.g., karate/tae kwon do, basketball, football, handball etc.) and closed-skills sports (e.g., cycling, athletics, swimming, gymnastics) to analyze their results for the same tests. It would also be interesting to see if there are differences between invasion and combat sports athletes *of the same level*.

Most importantly, our study can represent a starting point for further studies, as it paves the way for research aiming to respond to further questions: does fencing train (or encourage) decision making under pressure by actively improving reactive stress tolerance? Or, are naturally good decision makers specifically drawn to fencing or other combat sports? In the light of these results how can coaches increase the efficiency of fencers and which abilities should be developed by psychologists for the success of these athletes? Providing answers to these questions could further aid both training elite fencers and other athletes, but also to develop strategies improving general decision making under pressure.

REFERENCES

Bailey, R., Collins, D., Ford, P., MacNamara, Á, Toms, M., & Pearce, G. (2010). *Participant Development in Sport: An Academic Review*. [Review.] Retrieved at 26 January 2016 from https://www.sportscoachuk.org/sites/default/files/Participant-Development-Lit-Review.pdf

Byrne, K. A., & Worthy, D.A. (2015). Gender differences in reward sensitivity and information processing during decision making. *Journal of Risk and Uncertainty, 50*, 55-71.

Cloninger, C. R., Przybeck, T. R., Svrakic, D. M., & Wetzel, R. D. (1994). *The Temperament and Character Inventory (TCI): A guide to its development and use*. St Louis, MO: Center for Psychobiology of Personality, Washington University.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 56,* 975-990.

Cox, R. H., Zhan, L., & YiJun, Q. (1996). Psychological skills of elite Chinese athletes. *International Journal of Sport Psychology, 27,* 123-132.

Czajkowski, Z. (2009a) The essence and importance of sense of timing in fencing. *Studies in Physical Culture and Tourism*, *16,* 241-247.

Czajkowski, Z. (2009b) Tactics in fencing: Preparatory actions. *Studies in Physical Culture and Tourism, 16*, 371-377.

Doron, J., & Martinent, G. (2015). Trajectories of psychological states of women elite fencers during the final stages of international matches. *Journal of Sports Sciences, 34*(9), 836-842.

Doğan, B. (2009). Multiple-choice reaction and visual perception in female and male elite athletes. *Journal of Sports Medicine and Physical Fitness 49*, 91-96.

Gutierrez-Davila, M., Rojas, F. J., Antonio, R., & Navarro, E. (2013). Response timing in the lunge and target change in elite versus medium-level fencers. *European Journal of Sport Science*, 13, 364-371.

Gulbin, J. P., Croser, M. J., Morley, E. J., & Weissnsteiner, J. R. (2013). An integrated framework for the optimisation of sport and athlete development: A practitioner approach. *Journal of Sports Sciences, 31*, 1319-1331.

Hanton, S., Fletcher, D., & Coughlan, G. (2005). Stress in elite sport performers: A comparative study of competitive and organizational stressors. *Journal of Sport Sciences*, *23*, 1129-1141.

Kallweit, D. (2012). *Vienna Test System: Psychological assessment*. [Manual]. Moedling: Schuhfried GmbH.

Magyar Vívószövetség [MVSZ]. *Registered fencers of Hungary by weapon, gender and between 2013-2015*. [Data set]. Retrieved 18 January 2016, from http://hunfencing.hu/

Mellalieu, S. D., Hanton, S., & Fletcher, D. (2009). *A competitive anxiety review: recent direction is sport psychology*. New York: Nova Science Publishers.

Nuri, L., Shadmehr, A., Ghotbi, N., & Moghadam, B. A. (2013). Reaction time and anticipatory skill of athletes in open and closed skill-dominated sport. *European Journal of Sport Science, 13,* 431-436.

Ong, N. C. H. (2015). The use of Vienna Test System in sport psychology research: A review. *International Review of Sport and Exercise Psychology, 8,* 204-223.

Poliszczuk, T., Poliszczuk, D., Dabrowska-Perzyna, A., & Johne, M. (2013). Asymmetry of complex reaction time in female épée fencers of different sports classes. *Polish Journal of Sport and Tourism, 20*, 25-29.

Porozov, J., Praulite, G. Spunde, A., Perepjolkina, V., Voita, V., Valevica, E., & Kaluina, A. (2011). Peculiarities of psychophysiological functions of sportsmen with different dominance of brain hemisphere. *Lase Journal of Sport Science, 2, 12-24.*

Rushall, B. S. (1990). A tool in measuring stress tolerance in elite athletes. *Journal of Applied Sport Psychology*, 2, 51-66.

Wickens, C. D., Hollands, J. G., Banbury, S., & Parasuraman, R. (2016). *Engineering psychology and human performance*. 4th ed. London, New York: Routledge.

Williams, A. M. (2000). Perceptual skills in soccer: Implications for talent identification and development. *Journal of Sport Sciences 18*, 737-750.