ORIGINAL ARTICLE

Affective temperament, coping styles and frontal functions among elite boxing and karate athletes

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Kamila Litwic-Kaminska[1ABCD], **Paulina Brzezińska**[2ABDE], **Tomasz Waldziński**[3BDE], **Aleksandra Durzyńska**[3BDE], **Błażej Stankiewicz**[4BD], **Pavol Bartík**[5BD], **Andrzej Kochanowicz**[2DE], **Jan Mieszkowski**[2,6ABCD]

[1] Faculty of Psychology, Kazimierz Wielki University, Bydgoszcz, Poland
[2] Faculty of Physical Education, Gdansk University of Physical Education and Sport, Gdansk, Poland
[3] Faculty of Health Sciences, University of Lomza, Lomza, Poland
[4] Faculty of Health Sciences and Physical Education, Kazimierz Wielki University, Bydgoszcz, Poland
[5] Department of Physical Education and Sports, Univerzita Mateja Bela v Banskej Bystrici, Banská Bystrica, Slovak Republic
[6] Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic

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Abstract

Background and Study Aim: Despite being classified into one group of combat sports, boxing and karate are two different disciplines, differing in both the technical skills required and the psychological aspects. Taking into account the insufficient interest of researchers in this issue, the aim of this study is knowledge about the difference between elite boxing and karate athletes in terms of affective temperament, styles of coping with stress and cognitive abilities, with particular emphasis on frontal functions.

Material and Methods: The sample of 52 elite combat sports male athletes, divided into two groups: boxing (n = 28) and karate (n = 24) were surveyed using self-reported questionnaires to measure affective temperament (Temperament Evaluation of Memphis, Pisa, Paris and San Diego Autoquestionnaire, TEMPS-A), coping styles (Coping Inventory for Stressful Situations, CISS), and neuropsychological tests for assess cognitive functions (Trail Making Test, TMT, The Stroop Color and Word Test, SCWT).

Results: In both disciplines, the hyperthymic temperament traits and problem-focused coping were the most prevailing. Karate competitors showed significantly higher levels of depressive temperament. Boxers achieved a higher reading speed (shorter time in the part A of Stroop test) than karate athletes. No significant differences between sports were observed in coping styles and executive functions (the TMT and part B of SCWT tests).

Conclusions: Boxers and karate athletes differ in affective temperament traits and cognitive functions. However, regardless of the discipline, athletes prefer task-based ways of coping with stress. Applying these findings to specific groups of athletes may provide important information on the psychological aspects of training in these two sports. However, this issue requires further research in a complementary approach,

Keywords: combat sports • kata • kumite • mental training • precision • self-defence • training

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Author's address: Kamila Litwic-Kaminska, Kazimierz Wielki University, Jana Karola Chodkiewicza 30 Str., 85-064 Bydgoszcz, Poland; e-mail: kamilalitwic@gmail.com

INTRODUCTION

Combat sports – competitive contact sports where two combatants fight against each other using certain rules of engagement.

Innovative agonology – is an applied science dedicated to promotion, prevention and therapy related to all dimensions of health and regarding the optimization of activities that increase the ability to survive from micro to macro scales [50, p. 274].

INNOAGON – acronym 'innovative agonology' [51].

Elite athletes in combat sports undergo rigorous physical and mental training to excel in their disciplines. Understanding the psychological dimensions of these athletes is crucial for optimizing performance and promoting overall well-being. Generally, combat sports are aimed at fighting through striking, kicking and/or throwing and athletes seek to physically defeat their opponent avoiding being defeated at the same time. However, boxing and karate are two different disciplines, differing in both the technical skills required and the psychological aspects [1-6]. Boxing is a discipline in which two competitors facing each other in a ring, fight using only their fists with punches to the body and head of their opponent. Attacks below the waist, elbow or head strikes are prohibited. The boxer has to hit his opponent accurately and at the same time avoid his punches. The fighter who knocks out his rival or wins against him on points is the winner. Precision, speed, and strength are therefore important in boxing. Otherwise, fighting in karate takes place on the mat. The athletes use punches, kicks, blocks, and dodges. The competition includes kata (sequences of precise techniques performed in a specific order) and kumite (fights with other competitors). Karate, apart from self-defence, is treated as a form of spiritual practice. Karate training is not only aimed at developing fighting skills, but also self-development and ethics. Karate places great emphasis on technique, precision, flexibility and self-discipline, as well as respect for the training partner, the rules of tradition and the shaping of personality.

The relevance of an athlete's personality is a key factor influencing their performance and development in any sport. Temperament traits influence the choice of activity forms (professional, sport, etc.) with various stimulatory value. It also plays a crucial role in an individual's ability to regulate emotions, particularly in high-pressure situations [7, 8]. Athletes who train boxing, characterized by an intense and dynamic fighting style, may display a different temperament than those who train karate, where elements of precision and controlling emotions are important. Apart from the most commonly cited temperament concepts [9], recent studies among athletes highlights the importance of affective temperament consisting of five dimensions or traits: depressive, cyclothymic, hyperthymic, irritable and anxious [10-12]. According to Akiskal's model of affective temperament, traits are on a continuum between norm and pathology, considered as predisposing to affective disorders, but in subclinical intensity, they may have adaptive properties [13, 14]. The depressive, cyclothymic, irritable, and anxious temperaments may play a negative role, being associated with poorer coping and performance in stressful situations, as well as greater susceptibility to psychiatric disorders, especially affective disorders [15, 16]. On the contrary, a hyperthymic temperament is associated with increased activity in daily life or a better ability to perform in stressful situations, indicating the particular importance of this trait in athletes [17, 11]. So far, none of the reports found have referred to martial sports. However, in a study of handball players, there were significant associations between hyperthymic temperament and high self-esteem as well as hyperthymic and cyclothymic temperament and good athletic performance. In turn low athletic performance was associated with depressive and irritable temperamental traits [18].

Direct physical contact between the two athletes makes athletes more likely to feel anxious and depressed than athletes from non-contact individual sports who have less risk of physical injury [19, 6]. A pivotal role in an athlete's ability to navigate stressors effectively plays coping style – an individual's tendency to cope in a certain way. It describes a person's habitual behaviour in stressful situations. Referring to the concept of Endler and Parkers' [20] coping styles distinguishing three stress coping styles (task-, emotion – and avoidance-oriented, the task-focused style is considered the most 'functional', i.e. allowing the most effective coping. In contrast, an emotion-focused style, which aims to reduce emotional tension, may, after prolonged use, magnify feelings of stress, cause increased tension, or depressed mood [20]. People tend to choose a dominant coping style and, in stressful situations, act accordingly. However, there may be situations in which the application of preferred strategies may be difficult

and sometimes even impossible [21]. The way of coping may depend on the characteristics of the sport, but also on individual differences in perceived stress intensity [22, 23]. It can be hypothesized assumed that boxing athletes, exposed to fast, aggressive competition and physical clashes, may prefer different stress coping strategies than karate athletes, whose performance requires more focus, precision and emotional control. Nonetheless, most studies indicate the greatest tendency of athletes towards a task-focused way of coping, also in martial sports [24-26].

Research on the effects of sport on cognitive function suggests that the specificity of training may affect cognitive performance [27, 28]. Many studies have drawn comparisons between open sports (in which athletes have to respond to constantly changing situations and external environments) and closed sports (in which athletes are confronted with more consistent and autonomous situations) [29]. Voss et al. [27] go further, stating that this division is insufficient and proposing additional differentiation into three categories: static sports (involved independently performed activities under highly consistent circumstances; e.g. running), interceptive sports (predominantly requires coordination between an athlete's body, a held instrument, and an environment, e.g. tennis, boxing) and strategic sports (requiring adaptation to highly variable situations, taking into account teammates, opponents, positions and facilities; e.g. football). According to these divisions, combat sports fall under one category, so they could be considered homogeneous. However, as suggested by Voss et al. [27], we assume that the different types of sports places characteristically different mental demands on the athlete. The literature also points out that repeated impacts to the head may be not without effect on brain activity in boxers [30, 31].

The aim of this study is knowledge about the difference between elite boxing and karate athletes in terms of affective temperament, styles of coping with stress and cognitive abilities, with particular emphasis on frontal functions.

MATERIAL AND METHODS

Participants and procedure

The study was undertaken in compliance with the Declaration of Helsinki and approved by the Bioethics Committee for Clinical Research at the Regional Medical Chamber in Gdańsk, Poland (decision no. KB-24/16).

The participants were informed of the nature and possible inconveniences associated with the experiment. The study involved a population of 52 senior category combat sports male athletes, aged 18-35 years (M = 23 ±3.29) professionally training boxing (n = 28) and karate (n = 24). All the athletes included in the study were males, aged at least 18 years and declaring participation in karate or boxing training for at least six years competing in the senior category.

There was a slight difference in the age of the boxers (18-35 years; M = 23.93 ±3.63) and karatekas (18-29 years; M = 21.92 ±2.5).

Instruments

For affective temperament assessment the Polish version of Temperament Evaluation of Memphis, Pisa, Paris and San Diego Autoquestionnaire (TEMPS-A) [14] were used. The questionnaire includes 110 items with 'Yes/No' answers that allow distinguishing five dimensions: *depressive* (related among others to the experience of guilt, tendency to pessimism, difficulties in experiencing joy, sensitivity to criticism, adaptability to the situation or level of the energy); *anxious* (a tendency to express psychological tension, in the form of psychosomatic symptoms, a higher risk of anxiety disorders, defence reactions and constant worrying); *cyclothymic* (characteristic of persons presenting frequent changes in mood, self-esteem and energy, e.g., overconfidence alternating with low self-confidence); *hyperthymic* (manifest in the force of emotions and extremal, explosive reactions); *irritable* (manifested in dysphoric, explosive reactions and anxiety).

The value of each dimension ranges from 0-1 points by dividing the score of a dimension by the number of questions it comprised. The present study's Cronbach's α for the scales ranges from 0.73 to 0.86 showing satisfactory reliability of this measurement.

Polish adaptation of Coping Inventory for Stressful Situations (CISS) [20, 32] was used to measure three types of coping styles: Task-Oriented Coping (TOC, involving using behavioural or cognitive problem-solving techniques when confronted with stress), Emotion-Oriented Coping

(EOC, related to focusing on one's emotions or emotional outbursts), Avoidance-Oriented Coping (AOC, engagement in social support or distracting with other activities). The last style includes two subscales: Distraction (DI) and Social Diversion (SDiv). The questionnaire contains 48 items with answers from 1 to 5 (from never to very often). Each of the scales can be scored from 16 to 80, where the higher the score, the higher the frequency of use of a particular strategy. The alpha coefficients for the scales in this study are good (0.80-0.89).

Trail Making Test (TMT) [33] consists of two parts used to assess psychomotor speed (Part A) and visuospatial working memory and executive function (Part B). The operational purpose of the first part is to connect as quickly as possible with a continuous line, in numerical order, the points numbered 1-25. In part B, the participant must as quickly as possibly connect in a continuous line the numbers alternating with successive letters of the alphabet according to the formula: 1-A-2-B-3-C-4-D etc. The result is the execution time expressed in seconds.

The Stroop Color and Word Test (SCWT) [34, 35] was used for evaluation of the ability to inhibit cognitive interference, which occurs when the processing of a particular stimulus feature impedes the simultaneous processing of a second stimulus feature, known as the Stroop effect. The study used two tasks. In both, the participant is supposed to read the names of the colours. In part one, the colours were written in black font, and in part two, the colours were written in different colours, and while reading, a person had to ignore the colour of the font with which the words were written. The time of task completion (in seconds) is evaluated for reading speed in part 1 and executive functions and attention performance in part 2.

In this study the paper-and-pencil versions of TMT and SCWT tests.

The statistical analyses

The analyses were performed in Statistica 13 package (TIBCO Software Inc, Santa Clara, USA). To illustrate the affective temperament, coping styles and prefrontal cortex functions descriptive statistics (mean, standard deviation, range and median) were performed. The normal distribution of variables was verified with Shapiro-Wilk's test and by skewness and kurtosis analysis. Differences between sport disciplines in all variables were tested using Student's t-test (for near-normal distributions) or Mann Whitney's U-test (for non-parametric data). Friedman's ANOVA and Wilcoxon's signed rank test were used to compare the severity of individual temperament traits and ways of coping. Spearman's correlation (r) was applied to control the relationship between age and variables under consideration as well as the association between psychological traits and prefrontal cortex functions indicators.

RESULTS

Comparing the severity of individual temperament traits, the hyperthymic temperament traits were the most prominent ($p<0.001$), both in boxers (M = 0.4 ±0.26) and karatekas (M = 0.47 ±0.20). Considering the least visible traits, we should mention in boxers – irritable (M = 0.14, ±0.15) and anxious (M = 0.13 ±0.10) and in karatekas – irritable (0.12 ±0.15). Comparing athletes from the two disciplines with each other, it can be concluded that karate players showed significantly higher levels of depressiveness ($t = -2.33$, $p = 0.024$) (Table 1).

In terms of an individual's typical way of behaving in different stressful situations (having regard to group averages), the predominant coping style, regardless of the sport, is task-focused ($p<0.001$), both in boxers (M = 61.75 ±07.92) and karatekas (M = 61.25 ±8.83). This also coincides with the result that the predominant way of coping with stress in particular athletes from both disciplines (96% of boxers and 83% of karatekas) is the task-based style. No significant differences between sports in stress coping styles were obtained (Table 1).

In the sports groups compared, no differences were observed between the mean time to complete parts A and B of the TMT test. However, discrepancies were observed in terms of the Stroop test. Boxers achieved a shorter time in part A (so they were characterised by a higher reading speed) than karate athletes ($p<0.001$). It is also possible to indicate a difference in the time obtained in Stroop part B, but only at the level of statistical trend ($p<0.1$) (Table 1).

Table 1. Descriptive statistics for affective temperament, coping styles and frontal functions in groups of boxers and karatekas.

Variable	Boxing (n = 28)			Karate (n = 24)			p
	M & SD	Median	Range	M& SD	Median	Range	
affective temperament							
Depressive	0.24 ±0.15	0.24	0-0.52	0.36 ±0.19	0.33	0-0.86	**0.024** [t]
Cyclothymic	0.21 ±0.19	0.17	0-0.67	0.26 ±0.23	0.21	0-0.86	0.334 [t]
Hyperthymic	0.45 ±0.26	0.52	0-0.76	0.47 ±0.20	0.50	0-0.76	0.711 [t]
Irritable	0.14 ±0.15	0.10	0-0.52	0.12 ±0.15	0.10	0-0.52	0.485 [U]
Anxious	0.13 ±0.10	0.15	0-0.31	0.17 ±0.16	0.15	0-0.69	0.435 [U]
coping styles							
TOC	61.75 ±7.92	61	52-78	61.25 ±8.83	60	51-80	0.830 [t]
EOC	36.07 ±8.60	33	25-56	36.42 ±11.22	32.5	19-56	0.901 [t]
AOC	38.71 ±8.96	39	23-55	39.25 ±10.02	39.5	23-53	0.840 [t]
DI	16.71 ±6.86	14.5	8-28	18.88 ±8.17	19	8-34	0.305 [t]
SD	16.61 ±3.63	17	11-23	15.13 ±3.26	15	10-21	0.131 [t]
prefrontal cortex functions							
Stroop A	19.04 ±1.06	18.98	16.90-1.30	23.30 ±4.83	21.90	16.90-34.05	**0.000** [U]
Stroop B	39.31 ±2.07	38.96	35.58-2.83	41.82 ±6.01	40.70	34.89-65.21	0.075 [U]
TMT A	23.64 ±3.77	23.65	18.90-3.20	25.24 ±5.23	24.43	19.31-41.63	0.279 [U]
TMT B	50.54 ±6.08	50.70	42.10-9.50	55.10 ±11.18	51.20	39.60-93.66	0.192 [U]

TOC Task-Oriented Coping, **EOC** Emotion-Oriented Coping, **AOC** Avoidance-Oriented Coping, **DI** Distraction, **SDiv** Social Diversion; **TMT** Trail Making Test; **t** – Student's t-test, **U** Mann-Whitney U test

Additionally, given the significant age differences between the groups (as indicated in the sample description), the relationship between age and the study variables was also controlled. None of the variables included in the study correlates significantly with age (p>0.05).

In addition, the relationships between psychological traits and indicators of prefrontal cortex functions were analysed. In karate athletes, depressive (r = 0.43, p = 0.037) and anxious (r = 0.44, p = 0.032) temperament were positively correlated with the time obtained in the SCWT test. In boxers there was a positive correlation between anxious temperament and the time in part A of TMT test (r = 0.43, p = 0.021).

DISCUSSION

The distribution of affective temperament scores indicated the highest intensity of the hyperthymic and the lowest of irritable and depressive temperament traits in karatekas and boxers. These findings align with previous research in people involved in sport, e.g. professional canoeists, non-professionals regularly performing aerobic exercises and sports pilots [12], individuals engaged in extreme or high-risk sports [10] or in a group of various athletes [11]. The obtained results suggests that both groups of athletes tended to have higher levels of energy, optimism and activity [13, 14]. In the context of sport, hyperthymic traits such as high levels of energy, resistance to stress and optimism may be associated with beneficial effects on motivation, performance, and adaptation to training and competition. A parallel can be drawn with soldiers, subjected to significant physical and psychological stress, akin to athletes. Studies on cadet officer in the Italian Air Force demonstrated high hyperthymic scores, with observed lower scores in depressive, irritable and cyclothymic traits [36]. Also, in a study among bank managers and paramedics, i.e. professions that involve high stimulation and

the need to act effectively under stress, a similar distribution of affective temperament traits was observed [11].

Given the lack of research on affective temperament in relation to martial sports, it seems valuable to refer to other personality concepts. Exploring associations with other variables, there can be found that neuroticism is positively associated with depressive, cyclothymic, irritable and anxious, and negatively with hyperthymic temperament, as well as extraversion is positively correlated with hyperthymic temperament and negatively with all other traits [17, 37]. Comparing the results of previous studies [38-40] it can be concluded that the personality profile of martial sports competitors is generally characterised by low neuroticism and high extraversion which is in line with the demonstrated associations between traits in in different personality concepts, as well as the distribution of affective temperament obtained in research on athletes. However, the research shows also many discrepancies, making it impossible to identify a homogeneous personality profile for combat sports athletes. For example, the personality of karatekas was dependent on the style in which they train [41].

In our study, we noted that karate athletes scored higher than boxers in terms of depressive temperament. This trait is characterised by pessimism and self-criticism and its high level is associated with a higher risk of depressive disorders [15]. The result obtained therefore appear to contradict previous research indicating that karate and other combat sports have a positive impact on mental health, including the reduction of depressive disorders [42]. It is important to note, however, that despite differences between disciplines, depressive temperament in karate athletes is still lower than other non-clinical populations. Looking at this trait from a different perspective, it can be considered that people with a depressive temperament are more sensitive to suffering, follow social rules and are willing to make sacrifices for others. In men, depressive temperament is also associated with work engagement [15, 11].

Personality may be determined by the specifics of the sport being trained, although the influence of athlete selection cannot be ruled out either [43]. It is important to continue research to better understand how affective temperament traits affect adaptation to training and athletic performance in different sports. In further research, it is worth focusing on understanding the underlying factors behind these differences and identifying potential areas of concern for the mental health of athletes in particular sports.

The study's result indicates that, in terms of an individual's typical way of behaving in different stressful situations, the predominant coping style is task-focused, regardless of the sport discipline. The lack of significant differences in stress coping styles between boxers and karatekas implies that, at the group level, athletes in these sports share similar tendencies in managing stressors. This finding contradicts our assumption of differences between athletes and highlights the potential universality of task-focused coping. The fact that this coping style is common regardless of the specific sport indicates the potential universality of athletes' approaches to coping with stress. This may confirm that task-focused coping is the most adaptive coping attitude widely used in different sport contexts, which is supported by a number of previous studies conducted on different groups of athletes [44, 45]. Furthermore, while group averages indicate a predominance of task-focused coping, it is important to acknowledge individual differences. Athletes may still exhibit variations in their coping styles based on personal characteristics, experiences and the nature of the stressors encountered. After all, the study revealed that there are a few per cent of athletes for whom problem-focused coping is not prevalent, indicating the ongoing need for an individual approach for each athlete.

The study's result shows that boxers achieved a significantly shorter time in part A of the Stroop Test compared to karate athletes, indicating a higher reading speed or possibly better processing speed among boxers. Additionally, there seems to be a trend ($p<0.1$), in the time obtained in the Stroop part B, suggesting potential differences in cognitive performance between the two groups.

The results do not support reports of poorer cognitive functioning in boxers exposed to repeated blows to the head [30, 31], on the contrary, pointing out the better performance of boxers. The obtained differences between disciplines may be related to the specific cognitive demands of boxing, such as quick decision-making and rapid reaction times, which are crucial in this sport. In

turn, karate may require a different set of cognitive skills, possibly more focused on precision and planned actions [46, 19, 6]. On the other hand, individual differences should be taken into account. In our study, among karate athletes, depressive and anxious temperament were positively correlated with the time obtained in the part A of SCWT test, and karate athletes scored significantly higher on depressive temperament than boxers. One could therefore wonder if the karate athletes were slower because they were calmer and more depressive [47]. It is also worth noting the existence of two karate athletes who obtained outliers compared to the rest of the group in all cognitive tasks, which affected the averages of the entire group. Thus, it is important to consider other factors that may affect cognitive performance, such as training history, experience and the general health of individual athlete [46, 19].

Although this study significantly fills the research gap in respect to the comparison of boxing and karate elite athletes in terms of affective temperament, stress coping styles, and cognitive functions, it also has certain limitations that should be noted for carrying out future research in this field. First applies to the age distribution of the subjects. There was a slight, but significant difference in the age of the karatekas and the boxers. Numerous cross-sectional studies have shown that there is a steady decline in fluency ability from 20 to 80 years of age [48]. Thus, the associations between age have been controlled and the variables studied did not show significant associations, thus rejecting the suspicion of an age effect. Nevertheless, it is worth ensuring age equivalence in subsequent measurements.

We are aware that even in-depth research into the personalities of boxers, karatekas and other combat sports athletes will not answer fundamental questions about the dehumanization of the practice of hand-to-hand combat. The question posed by Piepiora and Witkowski [49] 'Quo Vadis, karate?' it has more than just a symbolic meaning. An increasing number of researchers identifying with the new applied science, INNOAGON [50-52], provide arguments based on evidence that the pathology of camouflaged neo-gladiatorship is transferred to other areas, not only sports activity [53, 54]. An optimistic element are works whose authors provide evidence that complementary knowledge about struggle (agonology [55, 56] and innovative agonology [50-52]) can have much wider application. Among others, in many areas of public health [57-59], education, especially defence education, etc. [60, 61]. The contribution of research on combat sports athletes and hand-to-hand combat practitioners cannot be overestimated. The effects of many years of training are accumulated in the sphere of personality (in the mental layer) [1, 41, 38, 19, 5, 40], motor skills and fitness [62-65], body structure and composition [66-71], self-defence competences and survival in a broader sense [72, 60], but are also related to the epidemiology of bodily injuries and deaths [73, 74]. The innovative postulate of Litwiniuk et al. [65] concerns the creation of profiles of people practicing various forms of hand-to-hand combat based jointly on the indicators of the mentioned phenomena. This proposal becomes particularly important from the perspective of the need to expose the pathology of bloody spectacles camouflaged under the attractive name of 'martial arts'.

Another limitation is the sample size, which limited the number of factors that could be analysed. Considering factors affecting cognitive and physiological status, such as stress, during cognitive testing, would be valuable. While the difference in the time obtained in part B of Stroop test did not reach statistical significance, the trend suggests that there might be subtle cognitive differences between boxers and karate athletes. It would be interesting to explore this in future studies with larger sample sizes to determine if this trend becomes more significant.

CONCLUSIONS

In summary, boxers and karate athletes differ in affective temperament traits and cognitive functions. Regardless of the sport, athletes prefer task-based ways of coping with stress. Applying these findings to specific groups of athletes may provide important information on the psychological aspects of training in these two sports. However, this issue requires further research.

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