

ORIGINAL ARTICLE

# *Temperament and chronotype among academic athletes – perspective of the regulative theory of temperament*

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## BACKGROUND

The aim of the research was to evaluate the relationship between chronotype and temperamental traits and temperament structure specified in the Regulative Theory of Temperament among physical education students who are actively engaged in sport. The analyses were performed separately in groups of men, women, and individual and team sports representatives.

## PARTICIPANTS AND PROCEDURE

The study included 157 participants (women  $n = 35$ , men  $n = 122$ ; individual sports  $n = 88$  and team sports  $n = 69$ ). Measures used in the study were the *Formal Characteristics of Behaviour – Temperament Inventory* (FCB-TI) and the *Morningness-Eveningness Questionnaire* (MEQ).

## RESULTS

Among women and men chronotype was positively correlated with Briskness (BR) and Endurance (EN). In women chronotype was negatively related to Emotional Reactivity (ER). Sensory Sensitivity (SS) was positively associat-

ed with chronotype in men. In the individual sport group chronotype was associated with four temperamental traits: BR, EN, ER (negatively) and SS. Activity (AC) significantly correlated with chronotype in the team sport group. Two out of three indicators of temperament structure – potential for stimulation processing (MPS) and structure harmony parameter (Zh1) – were related to chronotype in both genders.

## CONCLUSIONS

The results obtained in the present research indicate that temperament is significantly related to chronotype. Evening chronotype men and women might be overstimulated and morning types might be understimulated. These data might be useful for coaches and provide a guide for further individualization of the training process.

## KEY WORDS

morningness; eveningness; individual differences; individual and team disciplines

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## BACKGROUND

### TEMPERAMENT

Temperament plays the key role in the process of an individual's adaptation to the demands of the environment. It is an important factor which regulates the course of human emotional reactions. Temperamental traits influence the choice of activity forms (professional, sport, etc.) with various stimulatory value. This phenomenon is particularly significant in types of activities which are connected with a heavy stimulatory load. Therefore, it may be expected that such types of activity will be undertaken mainly by people highly capable of processing stimulation (Strelau, 2006).

Temperament tends to be treated as an element of personality; however, some authors (especially from the biological approach) use these notions interchangeably (Strelau, 2012). Various theories describing the significance of temperament and personality have been applied with regards to sport. According to the meta-analysis carried out by Rhodes and Smith (2006), it may be assumed that the most frequent are Eysenck's PEN Model (psychoticism, extraversion, neuroticism), the five-factor model of personality by Costa and McCrae and the sixteen personality factor model by Cattell. In Poland, sport activity was also frequently studied from the perspective of the Regulative Theory of Temperament by Strelau (e.g. Bernatek, Cwyl, Dudziak, Szantarek, & Guszowska, 2006; Blecharz & Siekańska, 2007).

In this article we use *temperament* in terms of the Regulative Theory of Temperament (RTT). The author of this theory, Strelau, presents nine postulates, on the basis of which he gives a definition of temperament, according to which it refers to "basic, relatively stable, personality traits expressed mainly in the formal (energetic and temporal) characteristics of reactions and behaviour." (Strelau, 2012, p. 184). Temperament traits have different adaptive functions, being responsible for regulating the level of arousal in such a way as to maintain the individual's optimal level of stimulation. Based on his postulates and psychometric studies, Strelau distinguishes six temperamental traits:

- briskness (BR) – the disposition to react quickly, to maintain a high tempo of performing activities and to shift easily in response to changes in the environment from one behaviour or reaction to another;
- perseverance (PE) – the tendency to continue and to repeat behaviour after the termination of the stimuli or situation evoking this behaviour;
- sensory sensitivity (SS) – the capacity to perceive and react to sensory stimuli with low stimulative value;

- emotional reactivity (ER) – the propensity to react intensively to emotion-generated stimuli; expressed in high emotional sensitivity and low emotional endurance;
- endurance (EN) – the ability to react adequately in situations requiring long-lasting or highly stimulating activity and to work effectively under conditions of intense external stimulation;
- activity (AC) – the propensity to undertake behaviours providing strong external stimuli.

The first two are temporal traits, while the remaining four denote the energetic aspects of behaviour (Strelau, 1996, 2006, 2012).

Previous findings indicate that athletes reveal higher (than the general population average) BR, AC and EN as well as lower PE and ER (as cited in Zawadzki & Strelau, 1997; Blecharz & Siekańska, 2007).

### CHRONOTYPE

Chronotype refers to individual differences in the course of circadian rhythms. It is a personal, circadian pattern of activity preferred by the individual, located on the dimension morningness-eveningness (Cavallera & Giudici, 2008; Ciarkowska, 2003, 2010). It is assumed that this dimension forms a continuum from extreme morningness to extreme eveningness (Cavallera & Giudici, 2008; Natale & Cicogna, 2002). Although morningness-eveningness is defined as a continuum, individuals can be classified into different chronotypes: morning ('larks'), evening ('owls') or neither/intermediate. The last type is the most represented (Allebrandt & Roenneberg, 2008).

Chronotype is closely associated with the timing of an individual's sleep-wake cycle, e.g. the time of falling asleep and waking up or mid-sleep (the midpoint between the time of falling asleep and waking up) (Roenneberg et al., 2007). Behavioural aspects enabling determination on a continuum between morningness and eveningness are: typical hours of spontaneous awakening, the tendency of lying down for night sleep and waking up in the morning at a particular hour and time of day, subjectively perceived as optimal for the well-being and best mental performance. Morning-type individuals wake up earlier than evening types and perform mentally and physically at their best in the morning hours, but they find it difficult to stay awake at late-night hours. In contrast, evening types plan their daily activities for the afternoon or evening, and prefer to stay out late (Taillard, Philip, Coste, Sagaspe, & Bioulac, 2003).

The preferred falling asleep and waking up times are connected with the work effectiveness during particular parts of the day. The everyday demands experienced by student athletes (e.g. early hours of lectures at the university or training sessions) may distort their natural circadian rhythms, which may

lead to 'social jetlag' (the misalignment of biological and social time). Previous findings show that morning-type people, for example, sleep more regularly due to the possibility of sleeping more or less the same amount of hours every day (Fronczyk, 2001, 2012; Haraszti, Ella, Gyöngyösi, Roenneberg, & Kál-di, 2014).

#### RELATIONSHIP BETWEEN CHRONOTYPE AND TEMPERAMENT TRAITS

The prior research into the chronotype correlates indicate its relation to temperament traits acknowledged in various concepts. Initially, particular interest was aroused by its relationships with the dimension of extraversion-introversion according to Eysenck (1991). The correlation analyses suggested that evening types are more extroverted. Nevertheless, the obtained coefficients were rather low (e.g. Ciarkowska, 2003; Tankova, Adan, & Buela-Casal, 1994). The use of Eysenck's Personality Inventory (EPI), whose E-I dimension includes the subscales of impulsivity and sociability, revealed a positive correlation between these variables and eveningness (e.g. Larsen, 1985; Neubauer, 1992).

The results of research concerned with the Pavlovian dimensions of temperament (Zawadzki & Strelau, 1997) indicated a negative correlation between morningness and the mobility of nervous processes. Moreover, morning types are characterised by relatively stronger inhibition, which makes them more capable of controlling their behaviour (Ciarkowska, 2010; Mecacci & Rocchetti, 1998).

Other comparisons also employed the *Sensation Seeking Scale (SSS) Questionnaire* (Zuckerman, Kolin, Price, & Zoob, 1964). The obtained negative correlations with morningness-eveningness suggest that the stronger the evening preferences are, the stronger is the urge to seek stimuli (Ciarkowska, 2003).

The research carried out in Poland has mainly revealed connections between the chronotype and the variables measured with the *Formal Characteristics of Behaviour – Temperament Inventory* (FCB-TI, Strelau & Zawadzki, 1995) based on the RTT by Strelau. Ciarkowska (2003) reports the existence of a positive correlation between the outcome of the KRAD questionnaire (Polish version of Horne-Östberg's *Morningness-Eveningness Questionnaire*) and EN. Such a result proves that the preference of morning hours is related to a relatively stronger immunity to difficult and highly stimulant situations.

A similar relation was found in the analyses by Jankowski (2012, 2014), yet his research revealed several further dependencies. Additionally, he observed that EN, above other variables of the FCB-TI, presented the strongest relationship with evening-

ness and that this variable plays the role of a mediator between eveningness and mood. Jankowski concluded that EN accounts for a protective factor against the negative psychological consequences of social jetlag, and the lowered mood in evening types. Moreover, he figured out that temperament traits are not always linearly related to chronotype. The scores from the *Morningness-Eveningness Questionnaire* represented a linear positive relationship with BR and EN and quadratic associations with PR, ER and AC. AC is associated with chronotype in such a way that the graph takes the shape of the letter U (Morningness and Eveningness were associated with high levels of results for activity and subjects in the middle of the morningness-eveningness dimension exhibited low levels of activity), whereas PR and ER show an inverse relation (Morningness and Eveningness related to low scores in temperament traits).

Another study, by Olek (2007), showed that evening types are less brisk and more persevering and sensory sensitive than evening types. The relationship between chronotype and temperament depends on the time of exercising. In the group of women who chose physical fitness activity in the morning there was a negative correlation between PE and the result in KRAD. Among women exercising in the evening, there was a positive correlation between BR and chronotype. However, it has to be added that the obtained correlation coefficients are very low (Kendall's tau coefficients between .15 and .28).

The aim of this article is to describe the results of our research concerning the relationship between chronotype and temperamental traits in athletes who study physical education. The mentioned relations were analysed separately in men and women, as well as among representatives of individual and team sports. It was also examined whether, in this group of athletes, there are gender differences in temperament and chronotype. We also assessed whether students who are engaged in different sport disciplines differ in terms of mentioned variables.

## PARTICIPANTS AND PROCEDURE

### PARTICIPANTS

The study included 157 university students of physical education, actively engaged in sport, from Kazimierz Wielki University in Bydgoszcz (35 women and 122 men,  $M_{age} = 21.52$ ,  $SD_{age} = 1.64$ ). Individual sports (IS) were represented by 88 people, and team sports (TS) by 69 students. The types of disciplines in the IS group were e.g. athletics (short and long distance running, triple jump, pole vault), combat sports and swimming. The TS group was represented by e.g. volleyball, basketball, handball and football.

## PROCEDURE

The results presented in this article are a part of the research conducted under the Academic Sport Development Programme (Ministry of Science and Higher Education). The project was approved by the Ethics Committee for Scientific Research at Kazimierz Wielki University.

The project is divided into two stages: the first is correlational (in progress) and the second is experimental (yet to start). In this article we would like to focus only on the correlational stage, which includes three sources of data: questionnaires, tablet application and monitoring device – ACTIWATCH-2. Due to the fact that so far full data have only been obtained from questionnaires (the process of data collection from tablets and ACTIWATCH-2 is still ongoing), these methods will be presented in the *Measures* section.

The researchers set up many personal meetings with groups of physical education students to inform them about the project. The basic requirement for future participants was engagement in sport activities (obligatory sport classes at university were not taken into account). Individuals who met the requirements and were interested in participation in the project were asked to leave their e-mail address to give the researchers an opportunity to contact them. At the next stage the researchers met willing students and explained them their role in the project and the details of their participation. The students were also informed that they could withdraw at any step of the study without any consequences. Each person received a set of documents which included: study information, an informed consent form and psychological measures. After filling the documents, the consent and questionnaires were returned to the researcher. Participants were provided individual descriptive feedback about their results in the questionnaires.

## MEASURES

The set of questionnaires used in the study consisted of a number of psychological measures, but for the purposes of this article, a thorough analysis has been applied to the data obtained using only two measures. Their characteristics are described below:

*Temperament.* Jan Strelau is the author of a theory of temperament called the Regulative Temperament Theory (1996), more broadly described in the *Background* section of this paper. On the basis of this theory (Strelau & Zawadzki, 1993, 1995; Zawadzki & Strelau, 1997) a measure of temperament traits was created: the Formal Characteristics of Behaviour – Temperament Inventory (FCB-TI). The inventory contains six scales: briskness (BR), perseverance (PE), sensory sensitivity (SS), emotional reactivity (ER), endurance (EN) and activity (AC). In total, the

FCB-TI includes 120 items (with true/false style of answering and zero-one scoring). Cronbach's  $\alpha$  for all scales of the Inventory ranges from .70 to .87 (Zawadzki & Strelau, 1997). In our research, the reliability coefficient for all scales was from .72 to .82.

We also calculated three indicators of temperament structure proposed by Jankowski and Zajenkowski (2009): potential for stimulation processing (MPS) and structure harmony parameters – Zh1 and Zh2. All indicators were estimated based on standardized values of six temperament traits included in RTT (the standardization procedure included means and standard deviations from the analysed group of athletes, separate for women and men). Positive value of MPS can be interpreted as indicating a high potential of stimulation processing (a negative value means the opposite). The Zh1 indicator informs about harmony of energetic traits – a positive value of the indicator might inform about overstimulation and a negative value about understimulation. The Zh2 indicator includes information about harmony of energetic traits and BR. Interpretation of the indicator value is the same as for Zh1 (Jankowski & Zajenkowski, 2009).

*Chronotype.* The Polish language version of the *Morningness-Eveningness Questionnaire* (MEQ; Horne & Östberg, 1976) known in Poland as KRAD (*Kwestionariusz Rytmu Aktywności Dobowej*) prepared by Ciarkowska (as cited in Jankowski & Ciarkowska, 2008) is a one-dimensional measure which allows one to specify the person's sleep-wake cycle and preferred hours of functioning. The questionnaire comprises 21 items with usually four or five descriptive answers which are scored from one to four or five points. The higher the score is, the stronger is the tendency to prefer morning hours. The KRAD results also allow one to divide subjects into three types: morning, intermediate and evening. The Polish adaptation of MEQ has a satisfactory reliability level of .83 (Jankowski & Ciarkowska, 2008). Cronbach's  $\alpha$  in our study was .79.

## RESULTS

Statistical analysis was prepared in Statistica version 12. The first step was a statistical verification of gender differences in six temperament traits and chronotype. Table 1 presents descriptive statistics (mean and standard deviation) and results of Student's *t*-test. Three out of six temperament traits were significantly different in both groups. Women scored higher than men in ER and PE but men obtained higher scores in EN. Both groups had similar results for the general score in the chronotype measure. The effects size analysed with Cohen's *d* was low (for EN) and medium (for ER and PE).

The participants of the study were divided into two groups of representatives: individual and team sports.

Table 1

*Descriptive statistics of temperament traits, three indicators of temperament structure and chronotype in women and men – gender differences*

Variable	Women <i>n</i> = 35	Men <i>n</i> = 122	<i>t</i>	<i>d</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )		
BR	16.34 (2.93)	16.57 (2.95)	-.41	–
AC	12.71 (3.93)	13.26 (4.07)	-.71	–
SS	14.71 (3.01)	14.13 (3.33)	.93	–
ER	9.43 (4.97)	6.57 (4.06)	3.48**	.67
PE	13.94 (3.42)	11.90 (3.82)	2.85**	.55
EN	10.94 (4.12)	12.57 (4.09)	-2.08*	.40
MPS	.00 (.94)	.00 (.86)	–	–
Zh1	.03 (1.22)	.00 (1.04)	–	–
Zh2	.02 (.83)	.00 (.85)	–	–
Chronotype – total score	60.06 (7.44)	59.03 (7.30)	.73	–

*Note.* \*\**p* < .01. \**p* < .05. BR – briskness; AC – activity; SS – sensory sensitivity; ER – emotional reactivity; PE – perseverance; EN – endurance; MPS – potential for stimulation processing; Zh1 and Zh2 – harmony parameters.

Student's *t*-test was used to determine whether these groups differ in temperament or chronotype (Table 2). Two variables – AC and chronotype – had different mean values in both groups. The students who practised team sports (TS) obtained higher scores in AC than the participants representing individual sports (IS). On the other hand, IS students scored higher than TS students in chronotype. Table 2 also includes the effect size of obtained results, which were significant. In comparison to gender, the effect size noted for type of sport (IS or TS) was small (*d* = .35 and *d* = .39).

Another step was checking how temperament traits and temperament structure indicators are relat-

ed to chronotype. For this purpose we used Person's *r* coefficient. This analysis was carried out separately in women and men and also among representatives of individual and team sports. Table 3 shows the results of the performed analysis. For interpretation of coefficient values the guides proposed by Cohen (1988) were used.

In the group of women chronotype was significantly associated with BR (*r* = .66) and EN (*r* = .53). Women who prefer functioning in morning hours are more brisk – their reactions are quicker and they maintain higher tempo of their actions. The relation between chronotype and EN indicates that women

Table 2

*Descriptive statistics of temperament traits and chronotype in individual and team sports – group comparison*

Variable	IS <i>n</i> = 88	TS <i>n</i> = 69	<i>t</i>	<i>d</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )		
BR	16.74 (2.63)	16.25 (3.29)	1.04	–
AC	12.53 (3.93)	13.91 (4.05)	-2.15*	.35
SS	14.48 (3.28)	13.99 (3.23)	.94	–
ER	7.24 (3.84)	7.17 (5.10)	.09	–
PE	12.49 (3.86)	12.19 (3.79)	.49	–
EN	11.89 (4.15)	12.62 (4.11)	-1.11	–
Chronotype – total score	60.50 (7.47)	57.68 (6.86)	2.43*	.39

*Note.* \**p* < .05; BR – briskness; AC – activity; SS – sensory sensitivity; ER – emotional reactivity; PE – perseverance; EN – endurance.

Table 3

Correlations between temperament traits and chronotype in women and men and among representatives of individual and team sports

Variable	Chronotype				
	All participants <i>n</i> = 157	Women <i>n</i> = 35	Men <i>n</i> = 122	IS <i>n</i> = 88	TS <i>n</i> = 69
BR	.34***	.66***	.25**	.34**	.32**
AC	-.10	.07	-.14	-.07	-.06
SS	.26**	.12	.29**	.27*	.22
ER	-.16*	-.57***	-.05	-.33**	-.01
PE	-.10	-.28	-.08	-.13	-.09
EN	.29***	.53**	.23*	.42***	.15
MPS	-	.59***	.16	-	-
Zh1	-	-.41*	-.27**	-	-
Zh2	-	-.23	-.10	-	-

Note. \*\*\* $p < .001$ . \*\* $p < .01$ . \* $p < .05$ . BR – briskness; AC – activity; SS – sensory sensitivity; ER – emotional reactivity; PE – perseverance; EN – endurance; MPS – potential for stimulation processing; Zh1 and Zh2 – harmony parameters; IS – individual sport; TS – team sport.

athletes, with morning preferences, in stimulating situations take appropriate actions and demonstrate effective work in unfavourable circumstances (intense external stimulation). Another significant correlation, in this group, was noted between chronotype and ER ( $r = -.57$ ). Reactions to emotional stimuli of women who function better in the morning are less intense. These women are also less sensitive to this type of stimuli and can endure more when the situation generates emotions. Each significant  $r$  coefficient was greater than .5, which can be interpreted as a strong correlation.

BR ( $r = .25$ ) and EN ( $r = .23$ ) were also significantly related to chronotype among male athletes. Similarly to women, men who prefer earlier hours of the day are more brisk and act with higher endurance. Unlike in women, among men chronotype was associated with SS ( $r = .29$ ). This relation indicates that a preference for morning hours in men results in greater sensitivity to less intense sensory stimuli. Male athletes are able to perceive such stimuli and, in consequence, react to them. All significant correlations in this group were small.

We decided to compare correlation coefficients, in women and men, because in both groups the same significant associations were present. The difference between the coefficients was measured with Fisher's  $z$ -transformation. The first pair of coefficients referred to the relationship of chronotype and BR in men and women. The  $r$  coefficient in women was  $r = .66$  and in men it was  $r = .25$ . The difference between the two coefficients was statistically significant ( $z = 2.70$ ,  $p = .008$ ), which means that among women the correlation of chronotype and BR is high-

er than among men. The relationship between chronotype and EN in both groups was significant (women  $r = .53$ , men  $r = .23$ ), but the difference between coefficients was insignificant ( $z = 1.79$ ,  $p = .076$ ).

Correlation analysis of temperament structure indicators and chronotype showed that among women athletes higher MPS is positively related to morning preference. The Zh1 indicator was significantly associated with chronotype in men and women (but the difference between correlation coefficients was insignificant  $z = .86$ ,  $p = .391$ ). Athletes with a stronger morning preference were more understimulated.

Another analysis of correlation was prepared in groups of students who were engaged in individual (IS) or team sports (TS). In the TS group only one association was significant – chronotype and BR ( $r = .32$ ). In the IS group chronotype was related to: BR ( $r = .34$ ), SS ( $r = .27$ ), ER ( $r = -.33$ ) and EN ( $r = .42$ ). Besides SS (weak correlation), other temperament traits revealed a moderate correlation with chronotype.

## DISCUSSION

### TEMPERAMENT, CHRONOTYPE AND GENDER

One of the goals of our research was to find out if there were gender differences in temperament traits and chronotype. Prior findings suggest that women have different structure of temperament than men (Zawadzki & Strelau, 1997; Strelau, 2012). In our study women obtained higher scores than men in ER and PE and lower scores in EN. These results are consistent with data obtained using the FCB-TI

questionnaire on the validation and standardization sample (Zawadzki & Strelau, 1997). Jankowski (2012) also noted differences between genders in PE, SS, ER and EN. Furthermore, FCB-TI has separate norms for men and women (Zawadzki & Strelau, 1997), which confirms the existing gender differences, also prevalent in our research.

The obtained results raise the question why there were no discrepancies in SS, BR and AC, despite indications from the authors of the FCB-TI questionnaire for such divergences. In accordance with the assumptions of the Regulative Theory of Temperament, a particular structure of temperament leads an individual to choose activities with various levels of stimulation. Sport is such an activity that requires a large capacity for processing stimulation. The outcome of our study is rather closer to the scores given by Kłodecka-Różalska and Mroczkowska from the study on 296 athletes (as cited in Zawadzki & Strelau, 1997) than the results of the FCB-TI standardization sample.

The relationship between gender and chronotype in the prior studies is not clear. Most measures showed the advantage of eveningness in men (Adan & Natale, 2002; Natale & Di Milia, 2011; Randler, 2007; Cavallera & Guidici, 2008; Wiłkość, 2014). There are also reports indicating no differences (Ogińska, 2011; Paine, Gander, & Travier, 2006; Pracki, Wiłkość, Pracka, Dmitrzak-Weglarz, & Augustyńska, 2014). In our research, both gender groups had similar mean results in the general score in the chronotype measure. Moreover, other analyzes, have not been shown in this paper, show that both women and men had comparable distribution of three chronotypes (morning and intermediate types were represented by the largest number of athletes in comparison to evening type). The lack of differences and the distribution of results opposed to previous research (advantage of morning type over evening type) can be explained by the physical activity undertaken by the examined students. Henst, Jaspers, Roden, and Rae (2015) found that marathon runners had earlier chronotypes compared to the control population of less active individuals, suggesting that individuals who are more physically active may have earlier chronotypes. This is consistent with recent findings (Cavallera, Boari, Labbrozzi, & Del Bello, 2011; Wennman, Kronholm, Partonen, Peltonen, Vasankari et al., 2015) that eveningness was associated with higher probability of more time spent sitting, in comparison to morningness. Furthermore, social factors play an important role, especially those connected with forcing a specific daily rhythm, such as students' schedule (Ciar-kowska, 2003).

The correlation analysis, carried out on the basis of the data collected in our study, indicated that among athletes – in women and men – chronotype is related to BR and EN. Both traits were positively connected with chronotype (preference for morning

hours). This result is consistent with the data presented by Jankowski (2012). He analysed chronotype and temperament in undergraduate students. In that group morningness was correlated with EN and BR. In Olek's study (2007), morning women had a higher level of BR, which corresponds with our findings. Conscientiousness – a personality trait in the Big Five Model – was significantly related to morningness (Randler, 2008). The similarity between Conscientiousness and BR was presented by Strelau and Zawadzki (1995). On this basis it can be assumed that the result obtained in Randler's study (2008) is in line with our data. A certain similarity can be seen in the results of Adan, Lachica, Caci, and Natale (2010) regarding the association of chronotype and temperament, measured with the Temperament and Character Inventory (TCI). In this research morning-type participants presented a higher level of Self-Directedness and Persistence. These two traits, in our opinion, can be compared to FCB-TI's BR and EN. Randler and Saliger (2011) presented data confirming the relationship between morningness and Persistence. TCI variables were significantly correlated with FCB-TI traits (Hornowska, 2011), which allows us to make a comparison between our results and the data obtained from TCI in relation to chronotype. Moreover, the relation between chronotype (morning preference) and BR plays a significant role in athletes' functioning, but as our results showed, this relation is stronger in women.

Other temperament traits – ER (in women) and SS (in men) – were connected to chronotype. ER in general refers to emotional functioning of an individual (Strelau, 1996, 2006, 2012), which means that people with a low level of ER react less intensively in highly emotional situations and can endure more emotional stimuli. Our study suggests that highly reactive women prefer evening hours, or alternatively, less reactive women function better in morning hours. Depression and worse mood are presumed, in many studies, as correlates of eveningness (e.g. Jeong et al., 2015; Ottoni, Antonioli, & Lara, 2012; Park et al., 2015). The data directly related to ER and EN, in terms of RTT, indicate that they are associated with depression – ER positively and EN negatively (Hintsa, Wesołowska, Elovainio, Strelau, Pulkki-Råback et al., 2016). In the research of Jankowski (2012), SS was not significantly related to chronotype, but our findings are opposite: in male athletes, the greater the intensity of morning preference, the higher is SS.

Additional analysis of temperament structure (three indicators) gave interesting results. The relation between chronotype and potential of stimulation processing (MPS) in women was significant. We can assume that, in the analysed group, women with higher preference for morning hours have higher potential of stimulation processing. It is probably the consequence of the MPS formula which includes

EN and ER – which individually were also correlated with chronotype. Women athletes who prefer morning hours can endure more stimulation. It can be helpful in everyday functioning due to the fact that the morning oriented female academic athletes might better face the challenges of a double or even triple role: as a woman, a student and an athlete (Lance, 2004; Yukhymenko-Lescroart, 2014). In women as well as in men the Zh1 indicator was also correlated with chronotype, but the relation was negative. Athletes who prefer morning hours of functioning tend to be understimulated and those who have evening preference might be overstimulated. ‘Larks’ might need more stimulation than they are providing themselves and ‘owls’ might need to stop for a while because their temperament structure has limitations and they provide themselves more stimulation than they can handle. Additional quality analyses would have been useful to provide more precise data about how different chronotypes manage with everyday tasks and how much stimulation they have during the day or in a longer period.

#### TEMPERAMENT, CHRONOTYPE AND SPORT DISCIPLINES

We found that the groups of students practising individual and team disciplines differ in the level of the temperament trait Activity. There are no earlier studies that relate to the differences between individual and team sports in terms of the Regulative Theory of Temperament, so we refer to the reports about temperament in different disciplines in general. Bernatek et al. (2006) made a comparison between athletes training for team disciplines and combat sports. They observed the differences in four temperament traits. Team sportsmen had a higher level of ER and lower level of AC, EN and BR than combat sport competitors. In our study, in the group of individual disciplines, there are other than only combat sports. Furthermore, in our research the team athletes obtained similar results (besides PE) to the athletes in combat sports and our team sports group significantly differed in ER, PE and EN from a similar group in Bernatek and co-workers’ study. The discrepancies in the presented results should be considered with the arguments of Kosińska (1991) that specific configuration of personality traits is characteristic for individual sports.

For the interpretation of our results, we also used the report of the authors the FCB-TI about the correlations between the RTT traits and other temperamental and personality characteristics. AC is highly and positively connected with extraversion – particularly for the temperament trait measured by Eysenck’s EPQ-R (Strelau & Zawadzki, 1995). Therefore, Eagleton, McKelvie, and de Man (2007), comparing

undergraduate team and individual sport participants and nonparticipants, showed that team athletes gained higher scores in Extraversion than both individual sport participants and nonparticipants. Similar results were observed by the author of the questionnaire (Eysenck, Nias, & Cox, 1982). This is consistent with our results for the AC trait. However, it must be highlighted that the effect size of differences between groups in our study was small. We could treat the obtained results as a trend rather than a certainty. This argument and the lack of differences between results in other temperament traits is probably connected with the fact that every sport discipline has its own specific character, and is associated with various training and competing conditions. Other traits could be desirable for good performance. For example, despite the fact that among athletes those with low reactivity dominate, high reactivity may help to achieve high performance in sports requiring precise movements and sensitivity to musical rhythm (Gracz & Sankowski, 2007). Combining different disciplines in the categories – individual/team – the differences become blurred.

This study also reveals a distinction (rather weak) in the result of chronotype depending on the type of sport. Those of the participants who practise individual disciplines obtained higher results in the KRAD questionnaire, which means they can be characterized more as ‘larks’ than ‘owls’. The mean for the examined athletes, regardless of the sport type, placed them on a continuum for chronotype in neither type. Concerning the whole of the sample there was a comparable number of morning and intermediate type individuals and the fewest representatives of the evening type. Additional analyzes showed that the frequency distribution was different in groups. Among the group of individual disciplines there were the most participants representing the morning type (47.00%) and the fewest representing the evening type (16.00%). In turn, team athletes were mostly represented by neither chronotype (43.00%) or, comparably, evening (26.00%) and morning types (30.00%).

The present results are consistent with the earlier outcomes showing a small number of evening-oriented people in different groups of athletes (e.g. Kunorozva, Stephenson, Rae, & Roden, 2012; Silva et al., 2012; Zani, Rossi, Borriello, & Mecacci, 1984). Trying to interpret the obtained results we can refer to Lastella, Roach, Halson and Sargent’s (2015) outcome in sleep and wake behaviour of elite athletes from individual and team sports. They found that sportsmen from individual disciplines went to bed and woke up earlier than athletes from team sports. Because chronotype set optimal times for mental and physical performance, we assume that it might affect the choice of a particular sport by an individual depending on its scheduling. In individual disciplines there is a tendency to train earlier than in team sports.

Furthermore, we noted more significant correlation coefficients between temperament and chronotype in the individual sports group. BR, as the only trait, was associated with morningness in both groups (individual and team sports). This result may indicate that, regardless of the type of sport, greater morningness is accompanied by a higher level of BR.

The positive relationship between EN and morningness might be explained by the training regime. In individual sports, in comparison to team sports, an individual needs to motivate him/herself regardless of circumstances and the absence of other people. Vollmer and Randler (2012), in their study on chronotype and values, obtained results demonstrating that individual values (openness to change and self-enhancement) are preferred by evening-type adolescents and social values (self-transcendence and conservation) are important for the morning types. In the light of these results such values as modesty, appropriate behaviour and obedience (being a part of conservation and observed more frequently in morning types) might, in the morning type with high EN, influence their keeping commitments, including in sport and training. The data obtained by Nia and Besharat (2010) from athletes representing individual and team sports showed that individual sports representatives scored higher in Conscientiousness – a trait that is highly desirable in sport.

The negative correlation of morningness and ER in individual disciplines (IS) suggests that these athletes might be less prone to emotional stimuli and remain calm in difficult situations, unlike in the team sport group. It is possible that emotional reactions in this group are needed to mutually stimulate to action and do not depend on chronotype. When it comes to team sports, athletes, whether or not individual, are part of a group that functions on its own terms. More research is needed for better understanding of the chronotype and temperament relationship among individual and team sport athletes.

## CONCLUSIONS

To conclude our study we would like to point out the main findings and make a comment on the potential future improvements in research methods and practical application of our results.

In the analysed group of athletes, chronotype was related to temperamental traits. This knowledge might be useful for coaches who are involved in sport development of athletes. We also noted significant differences between men and women in temperament but not in chronotype. The obtained results are another argument for individualization of sport training, in terms of both temperament and chronotype, taking into account the work with men and women, and individual and team sports athletes.

In terms of chronotype, studies of other authors do not give conclusive results. In some cases, differences between genders are present, women prefer morning hours. There are also data showing that women and men do not differ in chronotype. Because of the mentioned congruency problems, there is a necessity to conduct further research which would include athletes and a comparison group of non-athletes. Controlling the two variables of gender and sport level (recreational and professional sports might differ) can help gain useful data for interpretation. This solution would allow it to be clarified whether the obtained data indicate the difference of athletes from other people.

Representatives of team disciplines tend more to undertake behaviours providing strong external stimuli in comparison to individual sportspeople. Participants who practise individual disciplines can be characterized more as ‘larks’ than ‘owls’ in comparison to team athletes.

This study has some limitations which should be pointed out. The difference in the number of women and men is the main limitation. Only 35 women athletes participated in the study, which might have an impact on the presented differential analysis between genders as well as on the correlation analysis in this group. Further studies should include similar numbers of both genders to provide more precise data. This study was quantitative, which does not always capture all relevant information that could be better analysed using qualitative methods. The combination of quantitative and qualitative methods could provide in the future the most desirable solution to analyse the temperament and chronotype among athletes. Because of the relatively small number of participants, not all statistical analyses could be performed, and certainly they would have been a source of additional information. Additionally, every sport discipline has its own specific character, which is associated with various training and competing conditions and other traits that could be desirable. Combining different disciplines in the research in the individual/team categories can blur the differences. The most relevant research should include the same number of athletes of different sport disciplines, individual and team as well.

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