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ORIGINAL ARTICLE

Personality traits, stress appraisals and sleep in young elite athletes: A profile approach

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Abstract

The aim of this study was to identify young elite athletes' personality profiles using a person-centred approach and to investigate whether the profiles significantly differ in stress and sleep. 260 athletes from a variety of sports completed a questionnaire package to assess neuroticism and conscientiousness traits, stress appraisals (i.e. intensity and directional interpretation of stress, challenge and threat appraisals), and various indicators of sleep (i.e. sleep quality, social jet lag, Ford insomnia response to stress test (FIRST)). A latent profile analysis (LPA) approach was used to identify personality profiles based on the scores of neuroticism and conscientiousness. A multivariate analysis of variance was performed to examine if the athletes belonging to different personality profiles differ on stress appraisals and indicators of sleep. Three profiles emerged: Maladaptive profile (high levels of conscientiousness and neuroticism); Highly adaptive profile (moderate level of conscientiousness and low level of neuroticism); Adaptive profile (high level of conscientiousness and moderate level of neuroticism). Results showed that athletes from the adaptive profile reported significantly lower scores of stress intensity and threat appraisal than those from other profiles. Athletes from the maladaptive profile reported significantly higher levels of FIRST than those from other profiles as well as worse sleep quality and lower levels of challenge appraisal than the athletes from the highly adaptive profile. These results suggest that investigating personality profile may be useful in identifying athletes at higher risk of stress sensitivity and worsening sleep that are likely to benefit from preventive actions (e.g. cognitive behavioural therapy interventions).

Keywords: *Conscientiousness, insomnia, neuroticism, person-centred approach, sport*

Highlights

- The present study highlights the importance of personality assessment in identifying young elite athletes at higher risk of stress sensitivity and worsening sleep.
- Athletes from the maladaptive profile (i.e. high levels of conscientiousness and neuroticism) report significantly higher levels of Ford insomnia response to stress test than those from other profiles.
- Athletes from the maladaptive profile also report worse sleep quality and lower levels of challenge appraisal than the athletes from the highly adaptive profile (i.e. moderate level of conscientiousness and low level of neuroticism).
- Investigating personality profile may be useful in identifying athletes at higher risk of stress sensitivity and worsening sleep that are likely to benefit from preventive actions.

Introduction

Practicing a sport at the highest level implies high training load, (Dumortier et al., 2018) pressure on personal relationships and performance expectations from coaches, (Botterill & Wilson, 2002; Ommundsen, Roberts, Lemyre, & Miller, 2006) and constraints on

personal life (Schaal et al., 2011). As a consequence, there is a high prevalence of poor sleep (49%) and poor mental health (14%–17%) in Olympic athletes (Drew et al., 2018). Impaired sleep, with difficulty initiating or maintaining sleep, and/or non-restorative sleep, together with impaired daytime functioning, is particularly frequent among elite athletes Gupta, Morgan, and

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Gilchrist (2017). Insufficient sleep has been linked to various negative consequences including lower athletic performance (Halson, 2008) and general health (Alvarez & Ayas, 2004). Several studies have examined potential acute and chronic factors placed on elite athletes resulting in compromised sleep, e.g. training, travel and competition (Gupta et al., 2017; Nédélec, Halson, Abaidia, Ahmaidi, & Dupont, 2015). Candidate risk factors for compromised sleep in elite athletes also include many of those factors commonly considered to influence sleep in non-athletic individuals (e.g. traits of neuroticism, hyperarousal, and the pervasive influence of psychological stress and anxiety (worry or rumination)) (Kalmbach, Anderson, & Drake, 2018). According to the Five-Factor Model of personality (FFM), (Costa & McCrae, 1992; Digman, 1990) neuroticism reflects a tendency to experience distress and anxiety and is generally associated with excessive negatively-toned cognitive activity (i.e. worrying and rumination) (John & Srivastava, 1999). Conscientiousness describes socially-prescribed impulse control, task- and goal-oriented behaviour, planning, persistence, and dependability. John and Srivastava (1999), Stephan, Sutin, Bayard, Krizan, and Terracciano (2018) examined the association between personality traits of the FFM and sleep quality in more than 22,000 middle-aged and older adults. The main results showed that low neuroticism was associated with better sleep quality and that low conscientiousness was associated with a worsening of sleep quality over time. Previous research has accordingly reported that higher conscientiousness is associated with better sleep quality (Duggan, Friedman, McDevitt, & Mednick, 2014). On the basis of the aforementioned literature, the present study focused on both neuroticism and conscientiousness based on the rationale that these two personality traits are particularly salient regarding sleep quality (Duggan et al., 2014; Stephan et al., 2018).

Individuals who are high on neuroticism tend to experience high levels of stress, have difficulties with emotion regulation and are prone to experience anxiety and increased emotionality before bed, which may disrupt sleep quality (Williams & Moroz, 2009). For example, Garde, Albersen, Persson, Hansen, and Rugulies (2011) found that higher bedtime psychological arousal was positively associated with morning ratings of poor sleep among healthy working populations. In a sport setting, Juliff, Peiffer, and Halson (2018) showed that netball athletes who have a tendency towards hyperarousal may be more susceptible to sleep complaints following an international night netball game (game starting at 18:00). However, the sample size employed in this study (i.e. twelve athletes) may have limited the significance of the results. To the best of our knowledge, no study has explored the influence of personality

traits on stress appraisals and indicators of sleep in a large cohort of elite athletes. Some researchers have begun to examine personality traits in terms of profiles using a person-centred approach in different settings (Ferguson & Hull, 2018; Fisher & Robie, 2019). A person-centred approach is a method used for identifying and describing subgroups of individuals defined by similarities among multiple dimensions of interest (e.g. neuroticism, conscientiousness). The process of involving a heterogeneous sample of individuals and forming relatively homogeneous groups serves to organize large quantities of multivariate information. Latent profile analysis (a statistical person-centred methodology) may provide an advantage over more traditional variable centred statistical techniques (e.g. regression) by assisting elite sport professionals to identify distinct personality profiles to which individuals might belong and, subsequently, to shape intervention designs (e.g. cognitive behavioural therapy) to the unique dispositions and risks of the targeted group (Kaluza, 2000).

Using a person-centred approach, the aim of this study was to: (i) examine athletes' personality profiles (i.e. neuroticism and conscientiousness); and (ii) investigate whether the profiles that emerge from the latent profile analysis significantly differ in stress appraisals and indicators of sleep. We hypothesized that athletes with high level of neuroticism and low level of conscientiousness would display high level of stress and low level of sleep quality.

Materials and methods

Participants and procedure

A total of 260 young French competitive elite athletes (116 males, 144 females; $M_{\text{age}} = 16.38$ years; $SD = 1.56$) with a mean playing experience of 7.85 years ($SD = 3.08$) participated in the study (Swann, Moran, & Piggott, 2015). Participants played team sports (30.4%: basketball, soccer, field hockey) or individual sports (69.6%: track and field, artistic gymnastics, synchronized swimming, judo, swimming, table tennis, gymnastics, figure skating, diving, taekwondo, badminton, boxing, rowing, cycling, fencing, tennis). They all competed at an international level. Athletes were recruited via coach contact when they entered the French Institute of Sport (INSEP), housing the best national athletes from several team and individual sports. Data collection occurred once during pre-season training (beginning of October 2017) at the INSEP in groups of 20–30 athletes depending on the space available in computer rooms. Athletes completed the online questionnaire package on a computer located in one of the INSEP

computer rooms. Although instructions for completing each questionnaire were contained within the questionnaire package, the researcher (MN or JD) remained in the room while the athletes completed the questionnaire to ensure all queries were responded to. Participants took between 20 and 30 min to complete the questionnaire package. Prior to participation, all athletes (or a legal representative when the athlete was under 18 years old) signed informed consent forms. The administration of the questionnaires met the criteria of free participation, anonymity and confidentiality of the answers. The protocol was approved by the local ethics committee (East III, France. Ref. 170605).

Measures

Personality traits. The French version (Rolland, Parker, & Stumpf, 1998) of the NEO Personality Inventory Revised (NEO-PI-R) (Costa & McCrae, 1992) was used to assess neuroticism and conscientiousness traits. Each of these NEO-PI-R scales contains 48 items rated on a five-point Likert scale from 0 = *strongly disagree* to 4 = *strongly agree*. Scores were aggregated to form total trait scores, respectively neuroticism and conscientiousness. Higher total scores indicate higher neuroticism and conscientiousness. The values of Cronbach's alpha were .89 for neuroticism and .88 for conscientiousness.

Stress appraisals. Athletes were asked to rate on two single-item measures stress competition in general: (a) the intensity of stress by using a version of the "stress thermometer" with a 5-point Likert scale ranging from 0 = *not at all stressful* to 5 = *extremely stressful*; (Kowalski & Crocker, 2001) and (b) the directional interpretation of stress with a 7-point Likert scale ranging from -3 = *very debilitating* to +3 = *very facilitative* (Jones & Swain, 1992; Martinent, Ferrand, Guillet, & Gauthier, 2010). In order to maintain similarity with the measure of stress competition, single-item measures were also used and adapted from the Cognitive Appraisal Scale (CAS) (Skinner & Brewer, 2002) to assess challenge threat appraisals. As such, participants indicated how they usually appraised stressful situations as a challenge and as a threat by using two single-item measures in a Likert scale format ranging from 0 = *not at all* to 5 = *very much so*.

Indicators of sleep. Participants were required to rate their quality of sleep during week nights (i.e. from Sunday to Thursday) over the previous month on the 7-point Hooper's scale (Hooper, Mackinnon, Howard, Gordon, & Bachmann, 1995). High score on the Hooper's scale indicate bad sleep quality. Social jetlag was measured as the difference in the

sleep time median - median between bedtime and get-up time - between week nights (i.e. from Sunday to Thursday) and weekend nights (i.e. Friday and Saturday) (Rutters et al., 2014). The Ford insomnia response to stress test (FIRST) is a standardized questionnaire that has been shown to be a sensitive measure of vulnerability to sleep disturbance and FIRST score has high reliability (Drake, Richardson, Roehrs, Scofield, & Roth, 2004). The FIRST includes 9 items asking about the likelihood of sleep disruption due to specific stressful situations and more broadly described periods of stress occurring during the day or evening (e.g. after getting bad news during the day, after a stressful experience in the evening). The possible responses and corresponding scores included: *not likely* = 1, *somewhat likely* = 2, *moderately likely* = 3, and *very likely* = 4. The total score ranges from 9 to 36. High scores on the FIRST indicate greater vulnerability to sleep disruption. The value of Cronbach's alpha was .75 for FIRST.

Data analysis

Firstly, a latent profile analysis (LPA) approach was used to identify personality profiles of young elite athletes based on their scores of neuroticism and conscientiousness. In LPA, an underlying grouping variable (a latent class variable such as personality profiles) can be inferred from a set of indicators (Martinent & Nicolas, 2017). A series of measurement models (from one to five classes) was conducted with Mplus Version 7.3 to select which model accurately captured the personality profiles of elite athletes (Muthén & Muthén, 2012). Since no single statistical indicator provides evidence for a good model fit, different fit indicators were used in this study: Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), Adjusted BIC (ABIC), and bootstrap likelihood ratio test (LRT). The smallest values of AIC, BIC, and ABIC provide evidence for the best-fitting model. The LRT compared a k -class model with a $k-1$ class model. A significant p -value showed that the $k-1$ class model should be rejected in favour of a k class model. Fit indices of LPAs are presented in Table I. There were large decreases for the AIC, BIC, and ABIC values between 1- and 2-class models and between 2- and 3- class models. The LRTs revealed that the 3-class model fit significantly better to the data than the 2-class model but the 4-class model did not significantly fit better to the data than the 3-class model. Based on both the interpretability of the athletes' personality profiles (i.e. the three-class solutions made theoretical sense whereas

Table I. Fit indices for the young elite athletes' personality profiles analysis models with 1–5 classes.

No. of classes	1	2	3	4	5
No. of free parameters	4	7	10	13	16
log likelihood	-2508.20	-2351.59	-2308.85	-2277.98	-22,554.98
AIC	5024.40	4717.18	4637.69	4581.96	4541.96
BIC	5038.64	4742.10	4673.30	4628.25	4598.93
ABIC	5025.96	4719.91	4641.60	4587.04	4548.21
LRT		313.22***	85.48*	61.73	46

AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; ABIC: Adjusted BIC; LRT: Bootstrap Likelihood Ratio Test. *** $p < .001$; * $p < .05$ the numbers in bold represent the selected model.

a fourth class did not add anything substantive to the understanding of profiles) and the LPA indicators, a 3-class solution was selected. Secondly, a multivariate analysis of variance (MANOVA) was performed to examine if the young elite athletes belonging to the different personality profiles identified with the LPA differ on stress appraisals (i.e. intensity of stress, directional interpretation of stress, challenge appraisal, threat appraisal), and indicators of sleep (sleep quality, social jetlag, FIRST). When a multivariate effect was significant ($p < .05$), post hoc comparisons of group means were carried out. The multivariate analyses of variance and post hoc comparisons using Tukey HSD were performed on Statistica 7.1.

Results

Latent profile analyses

Based on the personality estimates presented in Table II, the first profile was labelled maladaptive profile and included athletes who reported high level of conscientiousness and neuroticism ($n = 58$). The second profile was labelled highly adaptive and

comprised athletes who reported moderate level of conscientiousness and low level of neuroticism ($n = 100$). The third profile was labelled adaptive and included athletes who reported high level of conscientiousness and a moderate level of neuroticism ($n = 102$). The three profiles are presented in Figure 1.

Profile differences on stress appraisals and indicators of sleep

The descriptive statistics of outcomes (stress appraisals, indicators of sleep) across each athletes' personality profile are presented in Table II. We explored whether athletes belonging to various profiles differed on stress intensity and direction, challenge and threat appraisals, and indicators of sleep (sleep quality, social jetlag, FIRST). Results of multivariate analysis of variance were significant: Wilks's Lambda = .76, $F(16, 500) = 4.62$, $p < .001$, $\eta^2 = .13$. The results of univariate analysis of variance indicated that stress intensity ($p < .01$), challenge appraisal ($p < .001$), threat appraisal ($p < .01$), sleep quality ($p < .05$), and FIRST ($p < .001$) significantly differed across the athletes' profiles (Table II). Athletes from the

Table II. Personality profile differences on stress appraisals and indicators of sleep.

Variables	Profile 1 Maladaptive ($n = 58$)		Profile 2 Highly adaptive ($n = 100$)		Profile 3 Adaptive ($n = 102$)		ANOVA		Tukey's HSD
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F-value</i>	<i>p</i>	
<i>Dependant variables</i>									
Stress intensity (au)	3.03	.17	2.79	.13	2.33	.13	6.03	.003	1 > 3; 2 > 3
Stress direction (au)	0.30	.19	.54	.15	.32	.15	.71	.49	
Challenge appraisal (au)	2.21	.20	3.15	.15	2.74	.15	7.10	.000	1 < 2
Threat appraisal (au)	1.59	.16	1.58	.12	.98	.12	7.64	.001	1 > 3; 2 > 3
Sleep quality (au)	3.22	.13	2.80	.10	2.88	.10	3.39	.035	1 > 2
FIRST (au)	22.61	.60	20.00	.45	18.52	.45	15.01	.000	1 > 2; 1 > 3
Social jetlag (min)	98.83	6.35	87.44	4.83	95.1	4.79	1.18	.31	
<i>Demographic variables</i>									
Age	15.59	.14	17.86	.11	15.44	.11			
Sex (n^{girls} vs n^{boys})	43 / 15		40 / 60		61 / 41				
Type of sports ($n^{\text{individual}}$ vs n^{team})	34 / 24		100 / 0		42 / 60				
Years of practice	8.48	.40	7.49	.31	7.81	.31			

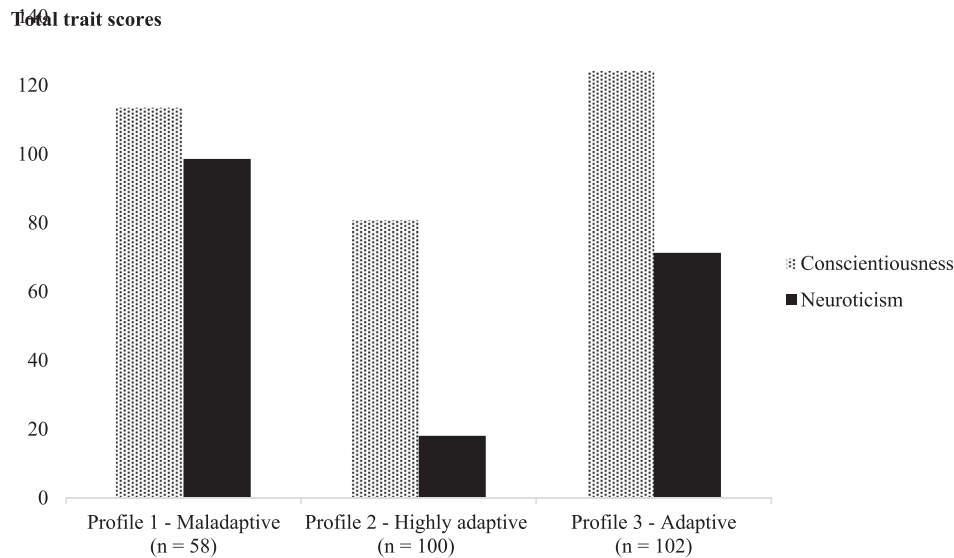


Figure 1. Estimates of young elite athletes' personality profiles for LPA model

adaptive profile reported significantly lower scores of stress intensity and threat appraisal than those from other profiles. Athletes from the maladaptive profile reported significantly higher levels of FIRST than those from other profiles as well as a worse sleep quality and lower levels of challenge appraisal than the athletes from the highly adaptive profile.

Discussion

The aim of the study was to examine young elite athletes' personality profiles using a person-centred approach and investigate whether the profiles significantly differ in stress appraisals and indicators of sleep. Our hypothesis that athletes high in neuroticism and low in conscientiousness would display high level of stress and low level of sleep quality was partially confirmed. The findings suggested that young elite athletes can be actually classified into three personality profiles: maladaptive (i.e. high levels of conscientiousness and neuroticism), adaptive (i.e. high level of conscientiousness and moderate level of neuroticism), and highly adaptive (i.e. moderate level of conscientiousness and low level of neuroticism). As a whole, athletes from the adaptive and highly adaptive personality profiles tended to appraise stressful situations more as a challenge than a threat and be less sensitive to stress than athletes from maladaptive profile. Athletes from the maladaptive profile reported significantly worse sleep quality as well as higher levels of insomnia in response to stress than those from other profiles. Thus, the maladaptive profile was associated with highly stress sensitivity and poor sleep quality. These results may provide a

deeper understanding of the relationship between personality traits, stress appraisals and sleep outcomes among young elite athletes.

Using a latent profile analysis, the present study highlighted the advantage of this approach over more traditional variable centred statistical techniques (e.g. regression) by identifying distinct personality profiles to which athletes might belong. As such, the findings provided additional insight and partial support to previous results of Duggan et al.'s study (2014) which has examined the relationships between big five personality traits (i.e. conscientiousness, neuroticism, agreeableness, extraversion, openness) and a range of factors related to sleep health in 436 university students. They showed that low conscientiousness and high neuroticism were correlated with and were the best predictors of poor sleep quality. Our results showed, using a person-centred approach, that high neuroticism associated with high conscientiousness may be more related to highly stress sensitivity and poor sleep quality in a young elite athlete population. This result differed from Duggan et al.'s study (2014) and may be explained by factors associated with athletes' difficulty regulating emotions (e.g. anxiety, stress) and behaviours (e.g. high self-control). Additionally, Dorsey and Bootzin (1997) found that people high in neuroticism were likely to complain of insomnia on self-report measures, even though polysomnographic measures indicated that they did not have impaired sleep quality. People high in neuroticism may also report poor sleep quality because they are especially sensitive to or worry about small deficits in sleep quality (Baron, Abbott, Jao, Manalo, & Mullen, 2017). In our study, the maladaptive profile also highlighted that the association

between high neuroticism and high conscientiousness led people to be more sensitive to stress which can disrupt sleep quality and impair the resilient effect of conscientiousness (self-control) in the face of poor sleep quality. Therefore, the adaptive and highly adaptive personality profiles may act as a buffer against poor sleep quality and stress sensitivity because of low to moderate levels of neuroticism associated with moderate to high levels of conscientiousness. Accordingly, Drew et al. (2018) proposed that good mental health, dispositional resilience and sleep quality appear to be leading factors involved in remaining healthy and should form part of a salutogenic programme for elite athletes. As such, future research may gain a deeper understanding of sleep quality by identifying subgroups of athletes based on their personality profiles helping elite sport professionals to better design their intervention (e.g. cognitive behavioural therapy interventions) (Kaluza, 2000). Components of sleep are not independent and are highly inter-related, suggesting the value of multidisciplinary prevention and management programmes in elite sports (Drew et al., 2018). This may be an additional value to the very emerging literature proposing a holistic approach to explain poor sleep among athletes (Juliff et al., 2018). Future research would also benefit from additional objective indices of sleep (e.g. actigraphy) to test whether the association between personality profiles and subjective sleep quality extends to objective measures of sleep.

In the present study, athletes from the maladaptive profile reported significantly higher levels of FIRST (i.e. insomnia response to stress test) than those from other profiles. It has previously been reported that insomnia may occur among elite athletes, with sleep quality being most vulnerable during periods of high-intensity training, following long-haul travel to competitions and prior to major competitive events (Gupta et al., 2017). To our knowledge, this is the first study to show that susceptibility to insomnia may also be related to athlete's personality profile. Surprisingly, athletes belonging to various personality profiles did not differ on social jetlag. Social jetlag is the discrepancy – particularly evident among evening chronotypes – between circadian and social clocks, which is measured as the difference in hours in midpoint of sleep between work days and free days (Rutters et al., 2014). Young people usually display irregular sleep-wake patterns including significant discrepancies between weekdays and weekends (Carskadon, 2011; Dumortier et al., 2018). Future studies are required to distinguish the influence of personality traits from academic/training schedule on young athletes' sleep-wake patterns.

The present results suggested that personality assessment may be useful in identifying athletes at higher risk of stress sensitivity and worsening sleep

that are likely to benefit from preventive actions. Future studies examining the longitudinal associations between these factors might seek to improve sleep by intervening on specific dysfunctional attitudes, coping styles, and behaviours associated with poor sleep. For example, cognitive processes, particularly the phenomena of not being able to shut off or manage thoughts, are thought to be an important factor in insomnia (Espie, Inglis, Tessier, & Harvey, 2001). Consequently, mindfulness interventions may be helpful for athletes who experienced difficulty switching off their thoughts when attempting to fall asleep (Janssen, Heerkens, Kuijer, van der Heijden, & Engels, 2018). This could be particularly useful to help athletes from maladaptive profile to improve their emotional regulation skills and reduce pre-sleep control strategies in order to reduce vulnerability to stress and poor sleep quality (Garland, Zhou, Gonzalez, & Rodriguez, 2016; Rusch et al., 2019).

One limitation of the present study concerns the FIRST which includes items asking about the likelihood of sleep disruption due to common stressful situations (e.g. before having to speak in public, before an important meeting the next day) (Drake et al., 2004). Future studies should establish a new specific questionnaire with the aim of sensitively measuring vulnerability to sport-specific stressful situations among young elite athletes. Similarly, athletes indicated how they usually appraised stressful competition situations in general which did not allow to capture in what extent they actually perceive stress during training and/or specific competitions.

The present study highlighted the importance of personality assessment in identifying young elite athletes at higher risk of stress sensitivity and worsening sleep. In addition to high-intensity training, long-haul travel and major competitive events, the susceptibility of young elite athletes to insomnia may also be related to athlete's personality profile. Practitioners should be aware of the relationship between personality traits, stress appraisals and sleep outcomes among young elite athletes. Future studies examining the effectiveness of preventive actions to improve sleep by intervening on specific dysfunctional attitudes, coping styles, and behaviours associated with poor sleep are warranted in the context of elite sport.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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