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Full Length Article

Associations of temperament and personality traits with frequency of physical activity in adulthood

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ABSTRACT

Temperament and physical activity (PA) have been examined in children and adolescents, but little is known about these associations in adulthood. Personality traits, however, are known to contribute to PA in adults. This study, which examined both temperament and personality characteristics at age 42 in relation to frequency of PA at age 50 (JYLS, $n = 214\text{--}261$), also found associations with temperament traits. Positive associations were found between Orienting sensitivity and overall PA and between Extraversion and vigorous PA among women and between low Negative affectivity and overall and vigorous PA among men. Furthermore, Orienting sensitivity and Agreeableness were associated with vigorous PA among men. Temperament and personality characteristics also showed gender-specific associations with rambling in nature and watching sports.

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1. Introduction

Physical inactivity is a growing societal concern that has wide-ranging consequences from both the individual as well as national and international perspectives: it is a major contributor to non-communicable diseases and the fourth leading cause of death worldwide (Ding et al., 2016; Lee et al., 2012). Moreover, physical inactivity may lead to increasing health-care costs and loss of productivity, together imposing a multi-billion-dollar economic burden on societies globally (Ding et al., 2016). Despite the numerous health benefits of being physically active (e.g. Jayakody, Gunadasa, & Hosker, 2014; Reiner, Niermann, Jekauc, & Woll, 2013; Warburton & Bredin, 2017), nearly a fourth of the world's adult population is estimated to be insufficiently active when compared against physical activity recommendations (Sallis et al., 2016). Women and older adults in high-income countries are especially at heightened risk for physical inactivity (Hallal et al., 2012; Sallis et al., 2016).

With a rapidly aging world population, there is an emergent need to focus more closely on promoting and encouraging an active lifestyle in the earlier stages of life, such as middle age. One possible way to achieve this is via effective and well-targeted health interventions. The effectiveness and functionality

of these interventions, however, depends on accurate identification of the causes underlying specific physical activity behavior (Bauman et al., 2012; Sallis, Prochaska, & Taylor, 2000; Trost, Owen, Bauman, Sallis, & Brown, 2002). To advance knowledge in this research domain, the present study investigated the contribution of temperament and personality characteristics to frequency of engagement in physical activity in middle-aged women and men. The study was based on the Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) (Pulkkinen, 2017) and utilized its two most recent follow-ups, implemented when the participants were aged 42 and 50.

Physical activity is defined as any bodily movement produced by skeletal muscles that increases energy expenditure (Caspersen, Powell, & Christenson, 1985). Although in most cases physical activity is required to sustain life, certain characteristics, like amount and mode, are a matter of personal choice, and thus display considerable intra- and interpersonal variation (Caspersen et al., 1985). Personality traits describe individuals' relatively permanent way of feeling, thinking and behaving (McCrae & Costa, 2003). The so called Big Five personality traits, Neuroticism, Extraversion, Conscientiousness, Openness to experience (henceforth Openness) and Agreeableness, are widely considered to be among the key factors contributing to an individual's physical activity level (Rhodes & Pfaffli, 2012; Rhodes & Smith, 2006; Sutin et al., 2016; Wilson & Dishman, 2015). Indeed, personality traits have been argued to contribute to the physical activity of up to one person in ten (Wilson & Dishman, 2015) and to be of even greater significance in later life

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due to reduced opportunities for staying active (Allen, Walter, & McDermott, 2017).

Systematic reviews and meta-analyses have found Neuroticism, Extraversion and Conscientiousness to be the personality traits most consistently linked with physical activity, while more inconsistent findings have been reported for Openness (Rhodes & Smith, 2006; Sutin et al., 2016; Wilson & Dishman, 2015). Agreeableness has generally been considered unrelated to physical activity level. High scores in Neuroticism have been associated with lower frequency of physical activity (Rhodes & Pfaeffli, 2012; Rhodes & Smith, 2006; Wilson & Dishman, 2015), a preference for lower-intensity exercise (Courneya & Hellsten, 1998; Hagan & Hausenblas, 2005) and increased physical inactivity and a more sedentary lifestyle (Allen et al., 2017; Sutin et al., 2016). High scores in Extraversion, Conscientiousness and Openness have been associated with higher levels of physical activity (Rhodes & Smith, 2006; Sutin et al., 2016; Wilson & Dishman, 2015) and a preference for moderate and vigorous intensity exercise (Courneya & Hellsten, 1998; Hagan & Hausenblas, 2005). With respect to mode of physical activity, individuals with high scores in Extraversion and Conscientiousness have been found to share a preference for structured group exercise and gym training, while individuals high in Neuroticism have been found to prefer exercising alone in unsupervised conditions, preferably at home (Costa & McCrae, 1992b; Courneya & Hellsten, 1998; Hagan & Hausenblas, 2005). Individuals who score high in Openness and Agreeableness, in turn, are more inclined to choose spontaneous and recreational exercise and less likely to engage in weight training (Courneya & Hellsten, 1998).

The question of the relationship between the constructs of temperament and personality traits has been extensively discussed in the literature (e.g., Shiner, 2006; Strelau, 1998). According to Allport (1937, p. 54), the founder of the trait-oriented approach to personality, “temperament refers to the characteristic phenomenon of an individual’s emotional nature... dependent on constitutional make-up”. Eysenck (1970, p. 2) also defined temperament as a “more or less system of affective behavior”. The personality traits Neuroticism and Extraversion that Eysenck identified are firmly based on individual differences in temperament. These traits are also two of the Big Five personality traits (Costa & McCrae, 1992a). The three other traits, Conscientiousness, Openness and Agreeableness, do not reflect the nature of temperament; instead, they “develop in individuals with a given temperament endowment” (Strelau, 1998, p. 56) and include “a wider range of individual differences in feeling, thinking, and behaving than does temperament” (Shiner, 2006, p. 214).

Developmentally oriented researchers (e.g., Rothbart & Ahadi, 1994) mostly consider an infant’s temperament traits to be precursors of the Big Five personality traits found in adolescents and adults. They view personality traits as the result of interaction between the individual’s constitutionally based temperament and experiences provided by the environment (Rothbart, Ahadi, & Evans, 2000). Temperament refers to fundamental and early-appearing dispositional attentional, emotional and motor processes and reactivity (Rothbart, 2001). Despite showing relative consistency and stability across situations and over time, these dispositions are further “molded” by individual experience, ultimately constituting personality. Although sharing the same developmental basis, personality goes beyond temperament by encompassing more complex processes of thinking, feeling and behaving, such as specific conditions, beliefs, values and perceptions about self and others (Evans & Rothbart, 2007; Rothbart & Ahadi, 1994; Rothbart, 2012; Shiner & Caspi, 2012). According to Evans and Rothbart (2007), the temperament and non-temperament personality domains are separable, although biologically rooted temperamental dispositions, like fear, may sometimes affect perceptions

and behavior even after personality is formed. Given that personality traits have their constitutional roots in temperament, to understand personality, one must first understand temperament (Rothbart et al., 2000; Rothbart, 2007). Similarly, understanding the associations between personality traits and physical activity also requires more extensive examination of the associations between temperament and physical activity.

The existing research on temperament and physical activity has focused mainly on young children (Irwin, Johnson, Vanderloo, Burke, & Tucker, 2015; Song, Corwyn, Bradley, & Lumeng, 2017) and on the longitudinal associations between childhood temperament and physical activity in adolescence and early adulthood (Janssen et al., 2017; Yang et al., 2017). Research on adult temperament and physical activity, nonetheless, has remained scarce. What differentiates the assessment of temperament and physical activity in early-life and adulthood, however, is the role of personality traits. Whereas in infancy and early childhood temperament is the predominant factor influencing interaction with the outer world (e.g. Rothbart, 2012), in adulthood it becomes increasingly challenging to examine temperament without paying attention to personality traits. Hence, we suggest that it is important to take both of these constructs into account when examining the adult population.

Adult temperament can be described by the four traits introduced by Evans and Rothbart (2007). These traits, namely Negative affectivity (defined by loadings on e.g. fear, discomfort and sadness), Effortful control (loadings on e.g. inhibition and focusing and shifting of attention), Surgency (loadings on e.g. sociability, positive affect and high-intensity pleasure) and Orienting sensitivity (loadings on e.g. perceptual and associative sensitivity), have been found to correlate with the five personality traits. The most consistent positive correlations have been detected between Negative affectivity and Neuroticism and between Surgency and Extraversion (Evans & Rothbart, 2007; Pulkkinen, Kokko, & Rantanen, 2012; Rothbart et al., 2000; Wiltink, Vogelsang, & Beutel, 2006). Surgency has also been reported to be less consistently, yet nevertheless positively correlated with Openness (Evans & Rothbart, 2007; Pulkkinen et al., 2012; Rothbart et al., 2000). Significant positive associations have also been found between Effortful control and Conscientiousness and between Orienting sensitivity and Openness (Evans & Rothbart, 2007; Pulkkinen et al., 2012; Wiltink et al., 2006). Of these studies, that by Pulkkinen et al. (2012) utilized the same JYLS data as the present study. The most consistent negative correlations, in turn, have been detected between Effortful control and Neuroticism (Evans & Rothbart, 2007; Wiltink et al., 2006).

Our purpose in the present study was to investigate the associations of adult temperament and personality characteristics with frequency of engagement in overall and vigorous physical activity and different types of exercise in Finnish middle-aged women and men followed longitudinally. To gain more insight into the dynamics between temperament and personality traits in adulthood, we examined their joint associations as well as associations of different combinations of temperament and personality characteristics with physical activity. We tested trait combinations that were deemed as independent from each other as possible. This is intuitively appealing, as it is likely that engagement in physical activity is dependent on combinations of characteristics rather than individual traits. Temperament and personality characteristics used in the present study were measured at age 42 and frequency of physical activity at age 50, allowing us to investigate the contribution of temperament and personality characteristics to physical activity rather than vice versa.

Based on earlier correlational evidence between temperament and personality characteristics (Evans & Rothbart, 2007; Pulkkinen et al., 2012; Rothbart et al., 2000; Wiltink et al., 2006)

and on the existing literature on the associations between personality traits and physical activity (Rhodes & Pfaeffli, 2012; Rhodes & Smith, 2006; Sutin et al., 2016; Wilson & Dishman, 2015), we expected the strongest associations between temperament traits and physical activity to be found for the traits Negative affectivity and Surgency. More specifically, we expected high scores in Negative affectivity to be negatively associated with engagement in overall and vigorous physical activity and positively associated with individually performed types of exercise. In turn, we expected high scores in Surgency to be positively associated with engagement in overall and vigorous physical activity and group-based exercise types. Additionally, we assumed that the combined associations of Negative affectivity and Neuroticism as well as those of Surgency and Extraversion would provide a clearer insight into the frequency of physical activity engagement.

Previous studies conducted across multiple samples and instruments have found that women and men score differently on personality traits (Chapman, Duberstein, Sörensen, & Lyness, 2007; Costa, Terracciano, & McCrae, 2001; Feingold, 1994; McCrae & Terracciano, 2005; Schmitt, Realo, Voracek, & Allik, 2008). Weisberg, DeYoung, and Hirsh (2011) found women to score higher than men in Neuroticism, Extraversion and Agreeableness. Moreover, in the JYLS study sample, women scored higher than men in Openness and Agreeableness at ages 33 and 42 (Metsäpelto & Pulkkinen, 2003; Rantanen, Metsäpelto, Feldt, Pulkkinen, & Kokko, 2007). In other samples, gender-specific relationships between personality traits and physical activity have been reported by Aşçı, Lindwall, Altıntaş, and Edepli Gürsel (2015), who found Openness to be negatively associated with moderate physical activity among women. Among men, they found Agreeableness and emotional stability to be negatively associated and Conscientiousness to be positively associated with vigorous physical activity. Building on this previous evidence, and to allow for any gender differences to emerge in the associations of temperament and personality traits with physical activity in the present study, we analyzed women and men separately.

2. Material and methods

2.1. Study design and participants

The present data were drawn from the ongoing Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) launched in 1968 (Pulkkinen, 2017). Thus far, the JYLS study has followed the same individuals from age eight to age 50 at six- to eight-year intervals. The initial sample comprised 12 randomly selected complete second-grade classes from the city of Jyväskylä, Central Finland. There was no initial attrition and thus all the pupils (173 girls and 196 boys, $N = 369$) in these classes participated in the study. All participants were native Finns with a mean age of 8.3 years ($SD = 0.25$ years). The majority (93.5%) were born in 1959 and the rest in 1958 and 1960.

The data used in the present study were collected from the JYLS participants at ages 42 and 50 in 2001 and 2009 (Metsäpelto et al., 2010; Pulkkinen, 2017, p. 19). The data collection in both follow-up phases was approved by the Ethics Committee of Central Finland Health Care District. In both phases, participants were first mailed an invitation letter together with a written informed consent form and a life situation questionnaire (LSQ). Participants were also invited to take part in a semi-structured interview and health examination with laboratory tests. During the interview, the participants filled out self-report inventories. Some of the inventories were also given to the participants to be filled out at home and then returned in a prepaid envelope.

By age 42, one woman and five men had died, and 15 women and five men had withdrawn from the study (Pulkkinen, 2017,

p. 19). Hence, the 2001 study population consisted of 343 participants (approx. 93% of the initial sample) of whom 285 (134 women and 151 men, 77% of the initial sample) participated, at least in part, in the data collection. By age 50, four women and eight men had died, and 20 women and 14 men had withdrawn from the study. Hence, follow-up data were available for 323 participants (approx. 88% of the initial sample) of whom 271 (127 women and 144 men, 73% of the initial sample) took part in at least one of the data collection methods. Participants in both follow-up phases were representative of the Finnish age cohort born in 1959 in, for instance, marital status, number of children and employment as reported by Statistics Finland (Metsäpelto et al., 2010; Pulkkinen et al., 2003, pp. 87–90; Pulkkinen, 2017, p. 20). The number of participants on which the present analyses are based ranged between 214 and 261 and varied depending on the measure used (women $n = 105$ –123, men $n = 88$ –138).

To analyze attrition, we first investigated how many of the 271 participants who had participated, even if only partially, in the data collection at age 50 had answered the items on overall (available $n = 261$) and vigorous (available $n = 258$) physical activity and exercise types (available $n = 214$). We then compared respondents and non-respondents on each of the physical activity variables with the full data collected from the 8-year-old participants at the beginning of the JYLS study in 1968. Five of the full-data variables were used for comparison. These were parental occupational status, school success and three indicators of socioemotional behavior, including behavioral activity, well-controlled behavior and negative emotionality (Pulkkinen et al., 2012). The attrition analyses revealed no differences between respondents and non-respondents in these five variables.

2.2. Variables

Temperament traits were assessed at age 42 using a short form of the Adult Temperament Questionnaire (ATQ, Evans & Rothbart, 2007; Rothbart et al., 2000). The short form version of the ATQ comprises 77 statements rated on a scale from 1 = *extremely untrue of you* to 7 = *extremely true of you*. The statements measure four traits, for each of which a mean score, ranging from 1 to 7, is calculated: the higher the mean score, the more dominant the trait in the respondent's temperament. The statements are distributed between the four traits as follows: Negative affectivity 26, Effortful control 19, Surgency 17 and Orienting sensitivity 15. Some of the statements are reverse-scored before mean scores are calculated. Cronbach's alphas for the four traits in our study population were 0.81, 0.79, 0.81 and 0.83 (Pulkkinen et al., 2012).

Personality traits were initially assessed at age 33 using the Big Five Personality Inventory (Pulver, Allik, Pulkkinen, & Hämäläinen, 1995), which is an authorized adaptation of the 180-item NEO Personality Inventory (NEO-PI) (Costa & McCrae, 1985). About one-fourth of the items in the adapted version are substitutes for the original US items (Rantanen et al., 2007). At age 42, used in the present analyses, a shortened version corresponding to the NEO Five-Factor Inventory (NEO-FFI, Costa & McCrae, 1989) was formed. In the Finnish NEO-FFI, more culturally applicable items have been substituted for three of the original items. Participants' responses are given on a five-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree* depending on how well they feel the statement describes them. The inventory comprises 60 items distributed equally across the five traits. A mean score is calculated for each trait. The higher the mean score, the more representative the trait in the respondent's personality. Cronbach's alphas for the traits in the present study population were: Neuroticism 0.86, Extraversion 0.79, Conscientiousness 0.78, Openness 0.80 and Agreeableness 0.79 (Pulkkinen et al., 2012).

Frequency of physical activity at age 50 was assessed with two questions drawn from the LSQ. The first question assessed the frequency of overall engagement in physical activity: "How often do you take exercise (including incidental exercise) or pursue sports in your leisure time?". The second question was designed to measure the frequency of engagement in vigorous physical activity: "How often do you exercise or do sports in your free time for at least half an hour, being out of breath and sweating?". Both questions were answered on a response scale ranging from 1 = *never* to 7 = *practically every day*.

In the interview at age 50, the participants were also asked about their frequency of engagement in 18 different types of exercise and other leisure time activities including, walking, running, swimming, rambling in nature and watching sports. The participants were asked to choose on a scale from 1 = *not at all or very seldom* to 5 = *seasonally, frequently during the peak season* which of the alternatives most accurately described their frequency of engagement in each activity. Following Kekäläinen, Freund, Sipilä, and Kokko (2019), we excluded from the analyses activities that were reported to be engaged at least monthly by less than 15% of the participants. We categorized the remaining physical activities as follows: (1) *walking*, including walking 3–4 kms a day, walking 5 kms or more at a time and Nordic walking; (2) *endurance training*, including running, skiing, swimming and cycling; (3) *group and team sports*, including ball games and structured group exercise; (4) *going to the gym*; and (5) *rambling in nature*. For present purposes, we included *watching sports* in the analyses as a sixth activity to represent physical inactivity. Instead of calculating mean values (Kekäläinen et al., 2019), we computed activities 1–3 as follows: if all a participant's responses to the exercise types were 2 (*less frequently than once a month*) or less, engagement was classed as 0 = *infrequent*. If the participant reported values of 3 (*once a month to four times a month*) or higher for at least one of the exercises, engagement was classed as 1 = *frequent*. Activities 4–6 were collapsed into binary variables using the same grouping method: values 1 and 2 were combined to describe 0 = *infrequent engagement* and values 3 through 5 to describe 1 = *frequent engagement*. Gender was also a variable in the analyses: 1 = women, 2 = men.

2.3. Statistical analyses

Descriptive characteristics of the study population were examined with frequencies, means and standard deviations. To assess for gender differences, independent samples *t*-test was used for continuous variables (temperament and personality traits and overall and vigorous physical activity) and cross-tabulation with Chi-squared test was used for categorized variables (types of exercise). All the descriptive data analyses were conducted using SPSS for Windows (version 24, IBM Corporation, 2016).

Associations between temperament and personality characteristics and physical activity variables were first assessed with correlations (see Appendices A and B). Likelihood ratio tests conducted in the Mplus statistical modeling program (Muthén & Muthén, 2017) were used to assess whether the correlation matrices were statistically significantly different between women and men for all correlations or only for correlations involving associations between the temperament and personality characteristics and physical activity variables.

The associations of the temperament and personality characteristics with frequency of overall and vigorous physical activity were analyzed in two univariate general linear models using SPSS software. The associations of temperament and personality characteristics with binomial responses of engaging in any one of the six exercise types were modeled using multilevel models for binomially distributed outcomes by allowing an unstructured correlation matrix among the activity variables. Model parameters were

estimated using the GLIMMIX procedure in SAS for Windows (version 9.4, SAS Institute Inc., 2015) using centered predictor variables. The odds ratios related to the associations of temperament and personality characteristics with the outcome variables were computed using a custom script prepared in the R programming environment (version 3.5.1, R Core Team, 2018).

Patterns of correlation are known to exist among temperament and personality characteristics, and it is also well known that correlations among independent variables in a regression model can produce misleading standard errors, test statistics and *p*-values. However, tests of sets of uncorrelated independent variables produce reliable results. Thus, based on gender-specific correlation matrices (Appendix A), we identified combinations of temperament and personality characteristics that were allowed to correlate within the combination while the correlations between the combinations were relatively low. The Wald test was used, and *p*-values were computed to assess the statistical significance of the associations of the combinations with the physical activity variables.

3. Results and discussion

3.1. Descriptive statistics and correlations

Descriptive statistics of the study population are shown in Table 1 and correlations among the study variables in Appendices A and B. On average, women scored higher than men in Negative affectivity, Orienting sensitivity, Openness and Agreeableness. The same observations for the personality traits Openness and Agreeableness have been reported previously by Rantanen et al. (2007) and Kokko, Tolvanen, and Pulkkinen (2013) with a slightly different sample. Women were also generally more physically active than men: around a third of the women in comparison to less than a fifth of the men engaged in physical activity almost every day. Moreover, around twice as many men as women engaged in physical activity less frequently than once a month. Women and men did not differ statistically significantly in their engagement in vigorous physical activity. With respect to exercise types, more women than men frequently went for walks, while more men than women frequently spent their free time watching sports. Walking was the most popular type of exercise among women and endurance training the most popular type of exercise among men.

The likelihood ratio test for the null hypothesis of equal correlation matrices across gender was largely unsupported (temperament and personality traits and exercise types: $\chi^2_{105} = 135$, $p = .026$; temperament and personality traits and frequency of overall physical activity: $\chi^2_{45} = 60$, $p = .071$; temperament and personality traits and frequency of vigorous physical activity: $\chi^2_{45} = 63$, $p = .039$). Given these results, we conducted subsequent analyses separately for women and men.

3.2. Associations with overall and vigorous physical activity engagement and exercise types

The associations of temperament and personality characteristics with overall and vigorous physical activity engagement and exercise types are presented in Tables 2 and 3 for women, and in Tables 4 and 5 for men. Among women, a unit increase in the Orienting sensitivity score was associated with reporting more frequent engagement in overall physical activity, and a unit increase in the Extraversion score was associated with reporting more frequent engagement in vigorous physical activity (Table 2). Also among women, higher scores in Extraversion and Openness were associated with an increased and higher scores in Surgency and Agreeableness were associated with a decreased likelihood of

Table 1

Characteristics of the study population at ages 42 (temperament and personality traits) and 50 (frequency of physical activity) for women (n = 109–123) and men (n = 105–138). Independent samples T-test, cross tabulation with chi-squared (χ^2) test and Fischer's exact test.

Variable	Women	Men	p-value
Temperament traits at age 42, n (%)	118 (50.6)	115 (49.4)	
Negative affectivity, mean (SD)	4.01 (0.61)	3.53 (0.70)	<.001
Effortful control, mean (SD)	4.84 (0.61)	4.76 (0.71)	.321
Surgency, mean (SD)	4.26 (0.63)	4.25 (0.71)	.923
Orienting sensitivity, mean (SD)	4.92 (0.81)	4.50 (0.80)	<.001
Personality traits at age 42, n (%)	118 (50.6)	115 (49.4)	
Neuroticism, mean (SD)	2.40 (0.61)	2.33 (0.75)	.475
Extraversion, mean (SD)	3.33 (0.53)	3.27 (0.63)	.469
Openness, mean (SD)	3.46 (0.56)	3.17 (0.60)	<.001
Agreeableness, mean (SD)	3.72 (0.54)	3.53 (0.49)	.005
Conscientiousness, mean (SD)	3.76 (0.54)	3.63 (0.52)	.063
Frequency of physical activity at age 50, n (%)			
Overall physical activity	123 (47.1)	138 (52.9)	<.001
Never	2 (1.6)	6 (4.3)	
Less than once a month	4 (3.3)	8 (5.8)	
1–2 times a month	4 (3.3)	13 (9.4)	
About once a week	10 (8.1)	18 (13.0)	
2–3 times a week	33 (26.8)	43 (31.2)	
4–5 times a week	31 (25.2)	27 (19.6)	
Practically every day	39 (31.7)	23 (16.7)	
Vigorous physical activity	121 (46.9)	137 (53.1)	.146
Never	8 (6.6)	13 (9.5)	
Less than once a month	11 (9.1)	18 (13.1)	
1–2 times a month	13 (10.7)	22 (16.1)	
About once a week	21 (17.4)	16 (11.7)	
2–3 times a week	40 (33.1)	38 (27.7)	
4–5 times a week	17 (14.0)	19 (13.9)	
Practically every day	11 (9.1)	11 (8.0)	
Type of exercise	109 (50.9)	105 (49.1)	
Walking, infrequent/frequent	9 (8.3)/100 (91.7)	26 (24.8)/79 (75.2)	.001
Endurance training, infrequent/frequent	21 (19.3)/88 (80.7)	19 (18.1)/86 (81.9)	.862
Group and team sports, infrequent/frequent	62 (56.9)/47 (43.1)	72 (68.6)/33 (31.4)	.090
Going to the gym, infrequent/frequent	77 (70.6)/32 (29.4)	72 (68.6)/33 (31.4)	.768
Rambling in nature, infrequent/frequent	58 (53.2)/51 (46.8)	63 (60.0)/42 (40.0)	.337
Watching sports, infrequent/frequent	82 (75.2)/27 (24.8)	49 (46.7)/56 (53.3)	<.001

Table 2

Regression coefficients for temperament and personality traits with frequency of overall and vigorous physical activity among **Women** (n = 110–111). Univariate general linear model.

Variable	Overall physical activity		Vigorous Physical Activity	
	Est.	[95% CI]	Est.	[95% CI]
Negative affectivity	−0.35	[−0.89, 0.19]	−0.25	[−0.90, 0.40]
Effortful control	0.03	[−0.55, 0.62]	0.28	[−0.42, 0.99]
Surgency	−0.31	[−0.89, 0.27]	−0.35	[−1.05, 0.35]
Orienting sensitivity	0.64	[0.14, 1.13]	0.43	[−0.16, 1.01]
Neuroticism	−0.15	[−0.71, 0.41]	0.19	[−0.47, 0.86]
Extraversion	0.25	[−0.44, 0.95]	0.90	[0.10, 1.70]
Openness	−0.33	[−1.07, 0.41]	−0.29	[−1.17, 0.60]
Agreeableness	−0.10	[−0.61, 0.41]	0.19	[−0.42, 0.80]
Conscientiousness	−0.02	[−0.61, 0.58]	−0.07	[−0.78, 0.64]

Note. 95% CI = 95% Confidence Interval. Statistically significant associations indicated with bold typeface.

frequent rambling in nature, the odds ratios being two to three times higher or lower than those for the infrequent group (Table 3). Further, women who scored higher in Extraversion had more than double the odds for frequent sports watching when compared with the reference group. No other statistically significant associations were observed.

Among men, a unit increase in the Negative affectivity score was associated with reporting less frequent engagement in both

overall and vigorous physical activity (Table 4). Additionally, a non-linear association was observed for Orienting sensitivity, indicating that men with mid-level scores in Orienting sensitivity were more likely to engage in vigorous physical activity than those with either lower or higher Orienting sensitivity levels. Further, a unit increase in the Agreeableness score was associated with reporting more frequent engagement in vigorous physical activity. In addition, men who received higher scores in Orienting sensitivity

Table 3
Associations of temperament and personality traits with exercise types among **Women** (n = 109). Odds ratios and 95% confidence intervals. Multilevel models for binomially distributed outcomes.

Variable	Walking OR [95% CI]	Endurance training OR [95% CI]	Group and team sports OR [95% CI]	Going to the gym OR [95% CI]	Rambling in nature OR [95% CI]	Watching sports OR [95% CI]
Negative affectivity	0.62 [0.06, 6.84]	0.76 [0.37, 1.59]	1.24 [0.72, 2.13]	1.26 [0.70, 2.29]	0.95 [0.48, 1.85]	1.65 [0.85, 3.22]
Effortful control	0.19 [0.00, 11.11]	1.60 [0.77, 3.32]	0.98 [0.55, 1.75]	1.05 [0.55, 2.02]	0.81 [0.40, 1.66]	0.98 [0.47, 2.05]
Surgency	1.00 [0.06, 17.07]	1.36 [0.62, 2.99]	1.19 [0.65, 2.19]	1.09 [0.56, 2.15]	0.34 [0.15, 0.77]	1.09 [0.51, 2.32]
Orienting sensitivity	0.16 [0.00, 34.56]	1.36 [0.56, 3.31]	0.79 [0.42, 1.51]	1.23 [0.59, 2.58]	1.38 [0.60, 3.17]	0.46 [0.21, 1.04]
Neuroticism	1.25 [0.08, 20.07]	1.03 [0.52, 2.05]	0.72 [0.40, 1.27]	0.82 [0.43, 1.57]	1.47 [0.77, 2.82]	0.98 [0.49, 1.96]
Extraversion	7.18 [0.06, 815.30]	1.83 [0.85, 3.94]	0.91 [0.51, 1.63]	1.04 [0.55, 1.96]	3.35 [1.48, 7.56]	2.56 [1.20, 5.44]
Openness	4.68 [0.04, 497.13]	0.61 [0.25, 1.47]	1.02 [0.53, 1.95]	0.82 [0.39, 1.71]	3.10 [1.32, 7.28]	0.70 [0.30, 1.63]
Agreeableness	1.54 [0.15, 15.45]	0.67 [0.38, 1.17]	1.15 [0.74, 1.80]	1.24 [0.75, 2.04]	0.46 [0.26, 0.82]	1.40 [0.80, 2.46]
Conscientiousness	2.36 [0.08, 68.84]	0.92 [0.46, 1.83]	0.89 [0.53, 1.50]	0.92 [0.52, 1.64]	1.05 [0.54, 2.05]	1.11 [0.60, 2.06]

Note. OR = Odds Ratio; 95% CI = 95% Confidence Interval. Statistically significant associations indicated with bold typeface. The reference group was the “infrequent” group.

Table 4
Regression coefficients for temperament and personality traits with frequency of overall and vigorous physical activity among **Men** (n = 100). Univariate general linear model.

Variable	Overall physical activity		Vigorous physical activity	
	Est.	[95% CI]	Est.	[95% CI]
Negative affectivity	−0.94	[−1.77, 0.12]	−1.11	[−2.01, −0.22]
Effortful control	−0.54	[−1.31, 0.23]	−0.56	[−1.39, 0.28]
Surgency	0.00	[−0.76, 0.77]	−0.33	[−1.16, 0.51]
Orienting sensitivity ^a	0.53	[−0.05, 1.11]		
Linear			4.58	[−0.31, 9.47]
Quadratic			−0.47	[−1.01, 0.07]
Neuroticism	0.05	[−0.70, 0.81]	0.24	[−0.58, 1.06]
Extraversion	0.05	[−0.82, 0.92]	0.14	[−0.80, 1.08]
Openness	−0.54	[−1.29, 0.22]	−0.46	[−1.28, 0.36]
Agreeableness	0.49	[−0.19, 1.17]	0.98	[0.24, 1.71]
Conscientiousness	−0.40	[−1.12, 0.32]	−0.35	[−1.13, 0.43]

Note. 95% CI = 95% Confidence Interval. Statistically significant associations indicated with bold typeface.

^a Wald’s test, p < .001.

Table 5
Associations of temperament and personality traits with exercise types among **Men** (n = 105). Odds ratios and 95% confidence intervals. Multilevel models for binomially distributed outcomes.

Variable	Walking OR [95% CI]	Endurance training OR [95% CI]	Group and team sports OR [95% CI]	Going to the gym OR [95% CI]	Rambling in nature OR [95% CI]	Watching sports OR [95% CI]
Negative affectivity	0.49 [0.18, 1.33]	0.81 [0.26, 2.50]	2.13 [0.84, 5.40]	1.13 [0.47, 2.71]	2.01 [0.78, 5.16]	2.83 [1.01, 7.92]
Effortful control	0.47 [0.17, 1.26]	1.63 [0.59, 4.50]	0.98 [0.44, 2.16]	1.20 [0.52, 2.79]	1.54 [0.66, 3.61]	1.36 [0.56, 3.30]
Surgency	1.00 [0.37, 2.73]	0.59 [0.18, 1.90]	1.07 [0.44, 2.16]	0.75 [0.31, 1.82]	0.48 [0.18, 1.25]	0.51 [0.20, 1.27]
Orienting sensitivity	0.94 [0.43, 2.04]	1.18 [0.49, 2.84]	1.09 [0.56, 2.12]	1.36 [0.67, 2.76]	2.42 [1.14, 5.13]	0.86 [0.43, 1.73]
Neuroticism	2.33 [0.80, 6.78]	1.11 [0.36, 3.41]	0.62 [0.26, 1.47]	0.41 [0.16, 1.05]	0.62 [0.25, 1.52]	0.72 [0.30, 1.69]
Extraversion	1.27 [0.48, 3.32]	0.73 [0.23, 2.34]	0.70 [0.28, 1.73]	1.10 [0.47, 2.56]	1.15 [0.47, 2.84]	3.26 [1.22, 8.70]
Openness	0.78 [0.36, 1.69]	1.08 [0.46, 2.54]	0.73 [0.37, 1.44]	0.57 [0.28, 1.14]	0.77 [0.38, 1.56]	0.66 [0.32, 1.36]
Agreeableness	1.48 [0.77, 2.83]	0.81 [0.40, 1.62]	1.15 [0.67, 1.98]	0.95 [0.55, 1.65]	1.23 [0.69, 2.21]	1.56 [0.89, 2.74]
Conscientiousness	1.62 [0.81, 3.23]	0.72 [0.33, 1.58]	1.18 [0.67, 2.10]	0.60 [0.33, 1.12]	1.37 [0.75, 2.51]	0.97 [0.54, 1.76]

Note. OR = Odds Ratio; 95 % CI = 95% Confidence Interval. Statistically significant associations indicated with bold typeface. The reference group was the “infrequent” group.

had more than double the odds for frequent rambling in nature when compared with the infrequent group (Table 5). Moreover, higher scores in both Negative affectivity and Extraversion were associated with an increased likelihood of frequent sports watching, the odds ratios being about threefold higher than those of the reference group. There were no other statistically significant associations.

3.3. Trait combinations

Significant correlations were observed between some temperament and personality characteristics (Appendix A): for instance, Surgency correlated with Extraversion (women $r = 0.60$, men $r = 0.74$) and Orienting sensitivity with Openness (women $r = 0.66$, men $r = 0.69$). Given that predictor correlations imply that

individual predictor associations cannot be disentangled¹, we assessed the associations of trait combinations that correlated with a reasonably high correlation estimate ($|r| > 0.33$). We formed trait combinations (see Appendices C and D) from Negative affectivity and Neuroticism, Effortful control and Conscientiousness, Surgency

¹ It is well known that collinearity adversely affects standard error estimation and testing of individual coefficient estimates. However, model-based predictions and testing parameters of correlated predictors jointly in multiple degree-of-freedom tests remain unaffected (see e.g. Harrell, 2001, pp. 64–65). Particularly when predictor correlations are present in the target group, the results of groups of predictors are to be preferred over single-predictor tests. The effect size of a joint effect is determined from the individual predictor regression coefficients or odds ratios of the predictors in that group. Reference: Harrell Jr., F. E. (2001). *Regression Modeling Strategies: With Applications to Linear Models, Logistic Regression and Survival Analysis*. New York: Springer.

and Extraversion, and Orienting sensitivity and Openness in both genders. Because, among women, Agreeableness did not correlate highly ($r = -0.17$ to 0.23) with the temperament traits, we did not include it in any combination. Among men, however, a relatively low yet statistically significant ($r = 0.35$, $p < .001$) correlation was observed between Effortful control and Agreeableness, and hence the combined association of these two traits was also tested.

Among women, the combined association of Orienting sensitivity ($B = 0.64$) and Openness ($B = -0.33$) appeared to be significant for frequent engagement in overall physical activity (Appendix C, left side). The combinations of Orienting sensitivity (OR 1.38) and Openness (OR 3.10), and Surgency (OR 0.34) and Extraversion (OR 3.35) were also associated with frequent rambling in nature. However, no statistically significant associations were found for women between the trait combinations and engagement in vigorous physical activity.

We also conducted sensitivity analyses for women (Appendix C, right side) to see whether the main results would remain unchanged for broader combinations of characteristics. The results revealed that when the combined association of Orienting sensitivity and Openness was considered in conjunction with Surgency, the association with overall physical activity no longer reached statistical significance. The association with rambling in nature decreased slightly but nevertheless remained statistically significant.

Among men, the combined association of Negative affectivity ($B = -0.94$) and Neuroticism ($B = 0.05$) was associated with overall engagement in physical activity (Appendix D, left side). The trait combination of Negative affectivity ($B = -1.11$) and Neuroticism ($B = 0.24$) also showed a significant association with engagement in vigorous physical activity, as did the combination of Effortful control ($B = -0.56$) and Agreeableness ($B = 0.98$). None of the trait combinations were associated with any of the exercise types. The sensitivity analyses (Appendix D, right side) revealed no additional associations.²

3.4. Discussion

The present study investigated the associations of temperament and personality characteristics, assessed at age 42, with frequency of engagement in physical activity, assessed at age 50, among Finnish women and men. Our main findings for the temperament traits were as follows: (1) Orienting sensitivity showed a positive association with overall physical activity engagement among women, and with vigorous physical activity engagement and an increased likelihood of frequent rambling in nature among men. As expected, (2) Negative affectivity was found to be negatively associated with both overall as well as vigorous physical activity engagement, but only among men, meaning that men who scored lower in Negative affectivity were more likely to engage in both overall and vigorous physical activity. In support of this, men who scored high in Negative affectivity were more likely to watch sports frequently, which, in this study, was seen to reflect physical inactivity. However, alternative interpretations, such as the view that watching sports reflects an interest in other people's physical activity, are possible, and thus our results suggest that Negative affectivity is associated with higher physical inactivity but also with interest in sports. Lastly, (3) Surgency was negatively associated with rambling in nature among women.

Due to the novelty of the present observations for adult temperament, we can only speculate as to their reasons. It is possible that awareness of extraneous low intensity stimulation, which

characterizes individuals who score high in Orienting sensitivity (Evans & Rothbart, 2007), leads these individuals to experience physical activity-related physical responses as particularly pleasant or satisfying, which in turn encourages them to exercise more frequently. Similarly, the positive association observed here between Orienting sensitivity and rambling in nature among men may stem from their conscious awareness of their surroundings and its visual features. Evans and Rothbart (2007) characterize individuals with high levels of Surgency as needing high levels of strength, complexity or novelty of arousal. This may help to explain why, among the present women, those with high Surgency scores showed reduced willingness to ramble in nature, as this type of physical activity does not provide them with adequate stimuli. Our observation of the negative association between Negative affectivity and overall and vigorous engagement in physical activity is in line with our study hypothesis. However, as sports can be watched either individually or in the company of a larger group of people, we are unable to provide confirmation for our hypothesis that Negative affectivity is positively associated with, in particular, individually performed exercise types. Some explanation for the negative association between Negative affectivity and physical activity engagement may be gained from the general characterization of individuals who score high in Negative affectivity: these individuals are prone to negative emotional states, such as anxiousness and self-consciousness (Watson & Clark, 1984), which, understandably, may decrease, restrict or altogether erode their willingness to participate in situations involving physical activity, as could have been the case among the present sample of men. As our results on adult temperament and physical activity are first of their kind, additional research to confirm them is clearly needed.

Our results on personality traits support earlier findings (Allen & Vella, 2015; Courneya & Hellsten, 1998; Hagan & Hausenblas, 2005) in that high scores in Extraversion were positively associated with engagement in vigorous physical activity, and that individuals with higher levels of Openness were more likely to engage in outdoor exercise. Our results did not provide confirmation for the previously found positive association between Agreeableness and recreational exercise (Courneya & Hellsten, 1998). Interestingly, we also found Extraversion to have a positive association with watching sports. Individuals scoring high in Extraversion have been characterized by gregariousness and a need for intense sensory stimuli (Costa & McCrae, 1992b; McCrae & John, 1992), needs which, as argued by Wilson and Dishman (2015), may be met by physical activity. This is not to say that the same needs could not also be satisfied by more sedentary activities, like watching a football game with friends. It is probable, therefore, that the present observation between Extraversion and watching sports relates to the social rather than the sedentary aspect of watching sports. It may also be that different lower-order facets within the Extraversion trait relate differently to different types of exercise. According to Artese, Ehley, Sutin, and Terracciano (2017), the Activity facet especially is associated with more frequent engagement in physical activity and less sedentary time when measured via an accelerometer. The same phenomenon has been noted by Vo and Bogg (2015) for self-reported physical activity. However, more extensive research on the lower-order facets of personality traits in relation to physical activity is called for.

The positive association found between Agreeableness and vigorous physical activity, despite its being surprising and in contradiction to previous findings (Aşçı et al., 2015; Sutin et al., 2016; Wilson & Dishman, 2015), is supported by Artese et al. (2017), who reported Agreeableness to be positively associated with moderate-vigorous physical activity and step counts. Our results suggest that Agreeableness might be a significant factor in physical activity, particularly among men. In the same JYLS data, Hietalahti, Rantanen, and Kokko (2016) found Agreeableness to be positively

² Further adjustments for socioeconomic factors (education, occupation, income) did not substantially alter the results.

correlated with leisure and physical fitness goals among men. Our results may, therefore, also be coincidental and reflective only of the present study population. However, considering that most of the previous studies on personality traits and physical activity have not taken gender differences into account, our results are hypothesis-generating and merit replication in a larger sample.

Our analyses on trait combinations shed light on both the relationship between adult temperament and personality traits and their simultaneous association with physical activity. Our results suggest that the women in the present study sample may be seeking something other than high intensity or strong stimulus from their physical activity. The present results also imply that these women may be looking for novel experiences when engaging in physical activity and that men with high levels of negative emotionality are at especial risk for being physically inactive. On the other hand, our results indicate that self-regulative processes are related to the ability of men to follow up on high intensity training and perhaps to inhibit the urge to cease exercise despite the unpleasant sensations possibly induced by intense physical stimulation. Although generally described by attributes such as altruism, ingenuousness and kindness (McCrae & John, 1992), our observation on the association of the trait combination of Effortful control and Agreeableness with vigorous physical activity engagement may in fact support the findings of Jensen-Campbell et al. (2002), who suggested that Agreeableness has a developmental basis in inhibition and self-control rather than social conformity. As our analyses on individual traits and trait combinations also produced slightly different results, more emphasis on examining the inter-relationships between temperament and personality characteristics is needed. Similarly, while the trait combinations presented here gained theoretical support from existing correlational evidence between temperament and personality characteristics (Evans & Rothbart, 2007; Pulkkinen et al., 2012; Wiltink et al., 2006), the novel analytic approach used merits further research.

The present findings add to the extensive line of personality research already conducted on the JYLS study population, unique in its representativeness and length of follow-up. Previous studies on the same data have linked personality traits to various meaningful aspects of adult life, including parenting (Metsäpelto & Pulkkinen, 2003; Rantanen, Tillemann, Metsäpelto, Kokko, & Pulkkinen, 2015), working life (Viinikainen & Kokko, 2012; Viinikainen, Kokko, Pulkkinen, & Pehkonen, 2010) and well-being (e.g. Kokko et al., 2013; Mälikangas et al., 2015). Our findings extend this knowledge by indicating yet another domain of these individuals' daily lives, habitual physical activity, to which individual differences in both temperament and personality traits contribute. Following Kinnunen et al. (2012), our findings also point to the utility of assessing larger groups of (temperament and) personality characteristics instead of focusing on individual traits alone.

3.4.1. Strengths and limitations

This study has several strengths. Considering that the same participants had been followed up for more than forty years, the study population was reasonably large and remarkably representative of the initial sample. Moreover, at ages 42 and 50, the initial sample was representative of the Finnish age cohort born in 1959 in, for instance, marital status, family type and employment (Metsäpelto et al., 2010; Pulkkinen et al., 2003, pp. 87–90; Pulkkinen, 2017, p. 20). Thus, the present findings can be generalized to both the rest of the 1959 age cohort and to other middle-aged Finns. This has importance from a national perspective, as these associations have not previously been studied in the Finnish population. The variables used in the study were based on two distinct data acquisition phases separating the measurements of temperament and personality characteristics at age 42 from those of

physical activity at age 50, thereby enabling us to examine the associations between the variables in the desired direction.

The study also has its limitations. The study population represented a rather isolated cultural area, which is why generalizations to other cultures and populations can only be made with caution. Although adult temperament and personality traits were assessed with different measures, the items in these measures inevitably bear similarities with one another. However, the levels at which the items describe individuals differ: whereas the items in the temperament measure attempt to capture an individual's inherent reactivity to different stimuli on a dispositional level, the items in the personality trait measure also take into account such factors as the individual's attitudes, values and beliefs. Granted that a full distinction between temperament and personality cannot be made in adulthood, assessing adult temperament is a novel initiative. Further, the physical activity variables in our data were not optimal in all regards, as these were based solely on self-reports and thus susceptible to response bias. Nonetheless, single-item self-reports have been shown to be valid and reliable alternatives for habitual physical activity assessment (Gill, Jones, Zou, & Speechley, 2012; Portegijs, Sipilä, Viljanen, Rantakokko, & Rantanen, 2017). Moreover, the range of exercise types available in the data may not have been the most suited to the present study population and further details of their nature would have been useful. As only a limited amount of prior research on the associations between personality traits and exercise types is available, our analyses have substantial added value. Nevertheless, with the present data we are unable to provide compelling support for either a hierarchical relationship between temperament and personality traits or for a causal relationship between temperament and personality traits and physical activity. To resolve this issue, a series of longitudinal follow-ups would be necessary. Last, although we tested the possible confounding effect of socioeconomic factors (and found them to be negligible), other confounders, such as health, were not included in our analyses.

3.4.2. Conclusions

The present study provided novel information on the associations of temperament and personality characteristics with physical activity in adulthood. Our results indicate that dispositional factors, such as temperament, contribute at least in part to how physically active individuals are as adults. Focusing more closely on gender-specific differences and combinations of temperament and personality characteristics might prove valuable in the future. The findings of this study can help in identifying adults who are at a heightened risk for physical inactivity and in developing gender-specific, temperament- and personality-tailored health promotion campaigns and physical activity programs.

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Declarations of interest

None.

Authors' contributions

JK analyzed and interpreted the data and was primarily responsible for the drafting of the manuscript. TT contributed to the statistical analyses and interpretation of the findings. LP launched the JYLS study in the 1960s and contributed to its original concept and design as well as its focus on personality across time. KK is cur-

rently leading the JYLS study and contributed to the topic and design of the present manuscript. All authors reviewed, critically revised and approved the final manuscript.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrp.2019.103887>.

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