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Personality and physical activity: A systematic review and meta-analysis

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ABSTRACT

Whether personality determines physical activity or its outcomes is relevant for theory and public health but has been understudied. We estimated the population correlations between Big-Five personality factors and physical activity and examined whether they varied according to sample characteristics and study features. Database searches were conducted according to PRISMA guidelines, for articles published in the English language prior to November 1st, 2013. Sixty-four studies including a total of 88,400 participants yielded effects (k) for Extraversion (88), Neuroticism (82), Conscientiousness (69), Openness (51) and Agreeableness (52). Significant mean r was found for Extraversion ($r = .1076$), Neuroticism ($r = -.0710$), Conscientiousness ($r = .1037$) and Openness ($r = .0344$), but not Agreeableness ($r = .0020$). Effects were moderately heterogeneous (I^2 range = 44–65%) and varied by sample characteristics (e.g., age, gender, or clinical status) and/or study features (e.g., measure quality or item format). This analysis expands results of previous reviews and provides new support for a relationship between physical activity and Openness. Future studies should use better measures of physical activity and prospective designs, adjust for statistical artifacts, and consider advances in the conceptualization of personality.

1. Introduction

Physical activity among adults and youths in the US is below levels recommended for health promotion (Centers for Disease Control & Prevention, 2007, 2013; Physical Activity Guidelines Advisory Committee, 2008; US Department of Health, 2010) and is a target of public health interventions, which often have modest success (Heath et al., 2012; Kriemler et al., 2011; Metcalf, Henley, & Wilkig, 2012). Factors that may modify the success of physical activity interventions, or their varying health outcomes (Bouchard, Blair, & Church, 2012) have received little study. However, theory (Eysenck & Eysenck, 1985; Gray, 1991; McCrae & Costa, 1999) and some evidence from observational studies (Rhodes & Smith, 2006) suggest that personality explains some of the natural variation in physical activity. Personality may also help explain or modify commonly reported (Asmundson et al., 2013; Cooney et al., 2013; Herring, Jacob, Suveg, Dishman, & O'Connor, 2012; Herring, O'Connor, & Dishman, 2010; Herring, Puetz, O'Connor, & Dishman, 2012; Physical Activity Guidelines Advisory Committee, 2008) associations between physical activity and several aspects of mental health (De Moor, Beem, Stubbe, Boomsma, & De Geus, 2006). Furthermore, such associations could serve as a platform from which to investigate genetic factors common to personality and physical activity (Bouchard & McGue, 2003; Bray, Hagberg, & Perusse, 2009; Dishman, 2008; Jang, Livesley, & Vernon, 1996; Riemann, Angleitner, & Strelau, 1997; Stubbe et al., 2006).

Personality consists of stable traits that are observable across ages, genders, and cultures. Generally, traits represent enduring and consistent between-person differences in predispositions for cognitions, emotions, and behaviors. The study of personality has overcome several obstacles in both the conceptualization of testable and observationally supported constructs, as well as their measurement (Eysenck, 1991; John & Srivastava, 1999). A wealth of evidence supports the existence of five primary factors of personality (Digman, 1989; Goldberg, 1993; McCrae & Costa, 1987; O'Connor, 2002), though reliance on self-report measures and factor analysis has led to some criticism of the five factor model by those in favor of theories postulating fewer primary dimensions and offering testable hypotheses about underlying physiology (e.g. Eysenck & Eysenck, 1985; Gray, 1991; Zuckerman, 2005), or by those claiming that five factors are not enough to account for important individual differences in behavior (Paunonen & Jackson, 2000). Nevertheless, most of the literature involving personality and physical activity has used either Eysenck's three factor model (Eysenck & Eysenck, 1985) or the Five Factor Model of personality (McCrae & Costa, 1999).

Physical activity is defined as bodily movement caused by skeletal muscles that results in increased energy expenditure

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(Caspersen, Powell, & Christenson, 1985), including incidental movement and purposeful exercise. Physical activity is complex. It encompasses several dimensions (frequency, intensity, duration, and mode), which presents a challenge for physical activity measurement (Tudor-Locke & Myers, 2001). The evidence on physical activity and personality is based on data collected with physical activity measures of varying quality, ranging from the use of validated recall interviews and questionnaires, single-item or author-adapted self-reports, dichotomies of active or inactive participants, to objective methods such as accelerometry.

A prior meta-analysis of 33 studies (Rhodes & Smith, 2006) reported heterogeneous correlations between physical activity and Extraversion ($r = 0.23$), Conscientiousness ($r = 0.20$) and Neuroticism ($r = -0.11$). However, heterogeneity was not quantified and there were not enough effects retrieved to permit strong tests of factors that might moderate the observed correlations. Analyses for moderation of significant associations between physical activity and personality should include tests of sample characteristics relevant to either construct as well as qualities of construct measurement that differ between studies. Furthermore, common traits, such as Extraversion and Neuroticism, measured in alignment with differing theories may reflect similar yet inequivalent psychological constructs, potentially biasing observed relationships; this possibility should be considered when aggregating effects. The aim of the systematic review and meta-analysis reported here is to estimate the population correlations between common personality factors and physical activity and to examine whether they vary according to selected sample characteristics and study features.

2. Methods

2.1. Data searches

In accordance with PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009), we conducted an extensive database search of articles published prior to November 1st, 2013. Searches of PubMed, Web of Science, Medline, PsycInfo, GoogleScholar, and SportDiscus using the search terms *exercise* or *physical activity* plus one of the following: *personality*, *big five*, *five factor model*, *extraversion*, *extravert*, *neuroticism*, *neurotic*, *emotional stability*, *openness*, *agreeableness*, *conscientiousness*, *psychoticism*, *trait anxiety*, *trait impulsivity*, *sensitivity to punishment*, *sensitivity to reward*, *positive affectivity*, *negative affectivity*, *positive emotionality*, *negative emotionality*, *BIS*, *BAS*, *behavioral inhibition*, *behavioral activation*, or *behavioral approach*. Searches were restricted to titles and abstracts containing the specified key words, and written in English. Manual searches of the references listed in retained articles were also conducted.

2.2. Selection of studies

Inclusion extended to published articles that measured physical activity behavior and one or more major personality trait, and required the use of a personality instrument with acceptable internal consistency and test–retest reliability, which has also been validated through confirmatory factor analysis. Measures of fitness were excluded as they are correlated with, though not measures of, physical activity behavior (Caspersen et al., 1985). Likewise, we excluded studies comparing athletes and non-athletes as such a dichotomization is reflective of participation in organized, competitive activities, but does not estimate overall physical activity level. To control for attenuation of effects resulting from extreme range restriction (Hunter, Schmidt, & Le, 2006), we excluded studies that used physical activity as an inclusion or exclusion factor (i.e. only recruiting athletes or sedentary people). Variables of interest were measured as continuous or discrete, comparing groups scoring high or low on the respective variable. Attempts were made to contact the corresponding author for studies that reported measuring physical activity and personality but did not report enough information to calculate effect sizes.

A preliminary examination of the search results revealed that only the traits Extraversion, Neuroticism, Conscientiousness, Openness, and Agreeableness yielded 10 or more effects. Inclusion was therefore restricted to those studies reporting effects compatible with the Five Factor Model, commonly referred to as the "Big Five" (Goldberg, 1993; John & Srivastava, 1999). This included effects for which Extraversion and Neuroticism were measured as conceptualized in the five factor model, as well as by Eysenck (1970) and Cattell (1947). A preliminary moderator analysis found no difference in effect according to personality model used for the measurement of Extraversion and Neuroticism. Therefore, effects from differing personality models were retained. Based on theoretical expectations (Eysenck, 1967; Eysenck, Nias, & Cox, 1982; John & Srivastava, 1999; McCrae & Costa, 1999) and previous reports (Rhodes & Dickau, 2013; Rhodes & Smith, 2006), we expected to find positive associations between physical activity level and Extraversion and Conscientiousness, and a negative association with Neuroticism.

2.3. Effect size calculation

Included effects were recorded independently by the first author, and represent bivariate relationships between physical activity level and the respective trait. Among cases with more than two physical activity categories, groups were collapsed to form meaningful dichotomies for effect size calculation (e.g. high or low active; active or inactive). Studies that measured physical activity using stages of change from the Transtheoretical Model (Prochaska & Velicer, 1997) were included when effects could be derived for mean differences between those in the 'action' or 'maintenance' stages and those in the 'preparation' stage or earlier, resulting in an "active or inactive" dichotomy. Sample size was used to cross-reference and confirm that data provided by authors responding to a request for more information matched the sample reported on in the respective publication.

Point biserial r was derived from effect size d for effects reported as means and standard deviations or independent samples t tests. Adjustments for false dichotomization and reports of point biserial or phi coefficients were made according to Hunter and Schmidt (1990), to derive estimates of r and its sampling error adjusted for false dichotomization of the independent and dependent variables. Insufficient reporting of reliability statistics prohibited the correction for range restriction (Hunter et al., 2006), as well as measurement error (Hunter & Schmidt, 2004). In accordance with standards for meta-analysis of r, all correlations were standardized using Fisher's z prior to aggregation and regression moderator analysis, and then were back-transformed to reflect the population correlation (Rosenthal, 1991b).

2.4. Selection and coding of moderators

Sufficient reporting allowed examination of several potential effect modifiers. See Supplemental Table 1. At least 5 effects per moderator level were required for inclusion in the moderator analyses. When necessary, groups were collapsed to accommodate the group size requirement so as to maximize the number of included effects, while preserving a meaningful comparison. In the most extreme case, the analysis for age as a moderator of the association between physical activity and both Agreeableness and Openness was collapsed to create a dichotomy (i.e. those <35, or $\geqslant$45 years of age) to compensate for the small number of effects, or complete