



## Hand-grip strength and sensation seeking

Bernhard Fink<sup>a,\*</sup>, Aicha Hamdaoui<sup>a</sup>, Frederike Wenig<sup>a</sup>, Nick Neave<sup>b</sup>

<sup>a</sup> Department of Sociobiology/Anthropology, University of Goettingen, Goettingen, Germany

<sup>b</sup> Department of Psychology, School of Psychology and Sports Sciences, Northumbria University, Newcastle upon Tyne, United Kingdom

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### ABSTRACT

Sensation seeking denotes the tendency to seek novel, varied, complex, and intense sensations and experiences, and describes the willingness to take risks for the sake of such experiences. Some studies have demonstrated correlates of both circulating and prenatal testosterone with sensation seeking. Hand-grip strength (as a measure of overall muscular strength) is also known to show associations with measures of circulating testosterone, and certain physical and behavioural characteristics, particularly in men. This study examines the possible relationship between hand-grip strength and sensation seeking, assessed via the Sensation Seeking Scale Form V (SSS-V) in 117 males aged 18–30 years. A positive and significant correlation was found between hand-grip strength and SSS-V total score and thrill and adventure seeking (TAS) after controlling for weight, height, and engagement with sporting activities. We discuss our findings with reference to other studies reporting associations between biological and personality characteristics.

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### 1. Introduction

In early foetal development the sex steroid hormones (principally testosterone [T] and its metabolites) are responsible for neurological and morphological sexual differentiation which provides the basis for subsequent observations of sexually-differentiated behaviours in adulthood (Morris, Jordan, & Breedlove, 2004; Neave, 2008). A likely explanation for sex-related differences in morphology relates to sexual selection. In many animal species males are selected to compete with one another for access to higher-investing females (Darwin, 1859); this intrasexual selection leads to the evolution of sex-dependent differences in size and strength (Andersson & Iwasa, 1996; Buss, 1995). It is also thought that T influences those behaviours that correspond to mate attraction and retention, and may include such factors as aggression, personality, sociosexual behaviours, and competitive behaviours (Neave & O'Connor, 2009).

With regard to strength, humans display marked sexual dimorphism in physical strength; males are typically stronger than females after controlling for body size and/or body weight (Miller, MacDougall, Tarnopolsky, & Sale, 1993; Musselman & Brouwer, 2005). Testosterone is strongly implicated in such differences, as this hormone is known to have potent effects on the musculoskel-

etal system, increasing lean body mass and muscular strength (Evans, 2004). Testosterone supplementation has a significant impact upon muscle size and strength and on body fat distribution (Bhasin et al., 1996), consequently, androgenic–anabolic steroids (synthetic derivatives of T) are often abused by athletes to enhance strength, endurance, and performance (Hartgens & Kuipers, 2004).

One commonly used measure of physical strength is hand-grip strength. This is simple to administer, is known to correlate with strength in other muscle groups, and displays a robust sexual dimorphism (Nicolay & Walker, 2005; Rantanen et al., 2000). However, results of intervention studies examining the effects of T supplementation on male hand-grip strength have revealed equivocal results, with some reporting a clear association between T and strength (Wang et al., 2000) and others not (Snyder et al., 1999). A possible explanation for such discrepancies is that the effects of T are thought to act during two distinct time frames, the first being during foetal life (so-called ‘organizational effects’) and again during and after puberty (so-called ‘activational effects’). Evidence for possible organizational effects of T on hand-grip strength comes from a study by Fink, Thanzami, Seydel, and Manning (2006) in which they correlated digit ratio (2D:4D) a putative marker for prenatal T exposure (Manning, 2002; McIntyre, Ellison, Lieberman, Demerath, & Towne, 2005) with hand-grip strength. Higher prenatal T exposure (a lower 2D:4D ratio) was associated with stronger grip strength in males from Germany and India.

With regard to personality, males score higher on measures of psychoticism (Eysenck & Eysenck, 1976) and in relation to the ‘five-factor model’ of personality, males score higher on ‘openness’ and ‘extraversion’, while females score higher on ‘conscientiousness’

\* Corresponding author. Address: Department of Sociobiology/Anthropology and Courant Research Center Evolution of Social Behavior, University of Goettingen, Kellnerweg 6, D-37077 Goettingen, Germany. Tel.: +49 551 39 9344; fax: +49 551 39 7299.

E-mail address: [bfink@gwdg.de](mailto:bfink@gwdg.de) (B. Fink).

and 'neuroticism' (Wiggins, 1996; Zuckerman, Eysenck, & Eysenck, 1978). There is some evidence that such factors are influenced by hormonal exposure. For example, negative relationships have been reported between neuroticism and circulating T in males (Dabbs, Hopper, & Jurkovic, 1990); positive associations have been demonstrated between T and dispositional dominance (Sellers, Mehl, & Josephs, 2007), supporting the notion that certain aspects of personality have biological foundations (Zuckerman, 1991).

One aspect of personality that has received particular attention has been 'sensation-seeking'. This trait has been defined as the tendency to seek out novel and intense experiences, and the willingness to take risks to achieve such experiences. Males score higher on sensation seeking (Zuckerman et al., 1978), and links have been established between certain risk-taking behaviours (e.g. gambling, alcohol abuse, multiple sexual partners) and circulating T (Dabbs & Morris, 1990; Mazur, 1995). The most commonly used measure of sensation seeking is the SSS-V (Zuckerman, 1979) and various studies have reported associations between circulating T and performance on this task (Bogaert & Fisher, 1995; Daitzman & Zuckerman, 1980; Daitzman, Zuckerman, Sammelwitz, & Ganjam, 1978; Gerra et al., 1999). However, such findings are not consistent, because other studies find no relationship between T and scores on this task (Rosenblitt, Soler, Johnson, & Quadagno, 2001). Interestingly, one study has also demonstrated an association between prenatal T (via the measurement of 2D:4D ratio) and certain aspects of sensation seeking in males (Fink, Neave, Laughton, & Manning, 2006) such that higher levels of prenatal T were positively associated with boredom susceptibility and the total score of sensation seeking.

As there appear to be links between T and physical strength, and T and sensation seeking in males, the aim of this study was to examine possible relationships between physical strength and sensation seeking. Thus, hand-grip strength was assessed in a sample of 117 German males, and the same participants were asked to complete the standard measure of sensation seeking, the SSS-V.

## 2. Materials and methods

### 2.1. Participants

Our initial sample was 147 men, mainly undergraduate and graduate students who were recruited at the local campus of the Georg-August University of Goettingen (Germany). All participants gave their informed consent before taking part. Statistical analyses were only conducted for those males who claimed to be heterosexual and right handed. Furthermore, we excluded participants who reported injuries to their arms or hands that may have compromised their grip strength. Thus, our final sample comprised 117 men aged 18–30 ( $M = 23.79$ ,  $SD = 2.69$ ).

### 2.2. Measures

First, isometric hand-grip strengths of the right and left hand were measured twice (with a rest of one minute in-between) using a dynamometer with the handle adjusted to the second position (Jamar dynamometer, Sammons Preston, USA). Participants were asked to perform a maximum force trial for each hand. For the statistical analysis, we calculated the arithmetical mean of first and second right- and left-hand measurements and considered them separately in associations with sensation seeking scores (rather than using right-left differences, see Armstrong & Oldham, 1999).

Second, all participants were asked to complete a questionnaire containing background information about their age (years), weight (kg) and height (cm) along with questions regarding their sexual orientation (hetero-/homo-/bisexual/no answer), handedness

(right/left/no preference), relationship status (single/relationship < 1 year/relationship > 1 year/married), and engagement with sporting activities (daily/3–4 times a week/1–2 times a week/occasionally/never).

Third, participants were administered the German translation of the Sensation Seeking Scale Form V (SSS-V; Zuckerman et al., 1978; translated by Beauducel, Strobel, & Brocke, 2003). The SSS-V contains 40 items comprising 10 items each in four subscales: 'thrill and adventure seeking' (TAS) assesses the desire to participate in dangerous sports and other activities involving speed and possible bodily harm; 'experience seeking' (ES) measures the seeking of new experiences in a non-conformist manner; 'disinhibition' (DIS) taps interest in socially and sexually disinhibited activities; and 'boredom susceptibility' (BS) taps restlessness and intolerance for the routine and repetitive. In addition to the scores of the subscales, which can vary between 0 and 10, the SSS-V provides a total score (varying from 0 to 40) by summing the scores of the four subscales. The original SSS-V scale has been used in numerous studies and has demonstrated consistent sex differences across a number of populations (Byrnes, Miller, & Schafer, 1999; Zuckerman et al., 1978). Its validity has also been shown in a non-clinical college student sample (Roberti, Storch, & Bravata, 2003), and similar reports exist for the German version of the scale (Deckers & Ruch, 1992; Hegerl, Prochno, Ulrich, & Muller-Oerlinghausen, 1989) with reliabilities (Cronbach's alpha) reported by Beauducel et al. (2003) as follows: TAS .80, ES .61, DIS .69, BS .46, total score .82. In our sample the reliabilities were as follows: TAS .71, ES .49, DIS .74, BS .34, total score .77.

## 3. Results

### 3.1. Descriptive statistics

Body height of male participants ranged from 170 to 204 cm ( $M = 182.79$ ,  $SD = 7.45$ ), weight from 55.0 to 130.0 kg ( $M = 78.68$ ,  $SD = 12.92$ ), and hand-grip strength (arithmetical mean of first and second measures) from 34.50 to 73.50 kgf ( $M = 55.08$ ,  $SD = 9.09$ ) for the right hand and 26.50 to 73.50 kgf ( $M = 51.69$ ,  $SD = 9.23$ ) for the left hand.

### 3.2. Correlations

There was a significant positive correlation between right and left-hand measures of hand-grip strength ( $r = 0.85$ ,  $p < .0001$ , one-tailed). Furthermore, both right and left-hand-grip strength were significantly positively correlated with weight, height, and sporting activities (weight: right hand  $r = 0.24$ , left hand  $r = 0.32$ ; height: right hand  $r = 0.18$ , left hand  $r = 0.191$ ; sporting activities: right hand  $r = 0.21$ , left hand  $r = 0.27$ ; all  $p < 0.05$ , one-tailed). There were also significant positive correlations between certain elements of sensation seeking and engagement with sporting activities (total score:  $r = 0.28$ , TAS:  $r = 0.28$ , DIS:  $r = 0.30$ ; all  $p < 0.05$ , one-tailed).

We therefore calculated partial correlations, controlling for weight, height and sporting activities, when testing the association of hand-grip strength and sensation seeking scores (see Table 1). Hand-grip strength of the right and left hand correlated positively and significantly with TAS and the sensation seeking total score (see Figs. 1 and 2), but no significant associations were detected with the scores of the other SSS-V subscales. Testing these associations with stepwise linear regression analyses confirmed the (only) positive association of right and left-hand-grip strength with TAS and weight (right hand: TAS  $beta = .28$ ,  $p < .001$ ; weight  $beta = .24$ ,  $p < .01$ ; left hand: TAS  $beta = .24$ ,  $p < .01$ ; weight  $beta = .32$ ,  $p < .001$ ).

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