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Short Report

Physical Strength and Dance Attractiveness: Further Evidence for an Association in Men, But Not in Women

BETTINA WEEGE,[1] MICHAEL N. PHAM,[2] TODD K. SHACKELFORD,[2] AND BERNHARD FINK[1]*
[1]*Institute of Psychology and Courant Research Center Evolution of Social Behavior, University of Göttingen, Göttingen, Germany*
[2]*Department of Psychology, Oakland University, Rochester, Michigan*

Objectives: Physical strength provides information about male quality and can be assessed from facial and body morphology. Research on perception of dance movements indicates that body movement also provides information about male physical strength. These relationships have not been investigated for women.

Methods: We investigated relationships of handgrip strength (HGS) and dance attractiveness perception in 75 men and 84 women.

Results: We identified positive relationships between HGS and opposite-sex assessments of dance attractiveness for men but not women.

Conclusions: The replication of previous research investigating relationships between dance attractiveness and physical strength in men corroborates the hypothesis that dance movements provide information about male quality. We argue that these relationships are interpretable in contexts of inter- and intra-sexual selection. Am. J. Hum. Biol. 27:728–730, 2015.

Physical strength is sexually dimorphic. Men are typically stronger than women (Hoffman et al., 1979), particularly in upper body muscularity. Men have 75% more muscle mass than women (Lassek and Gaulin, 2009). Muscular strength is correlated positively with measures of male health (e.g., bone-mineral density: Kritz-Silverstein and Barrett-Connor, 1994; physical functioning: Fredericksen et al., 2002; cardiorespiratory fitness: Vaara et al., 2012) and negatively with male mortality (Rantanen et al., 2000). Isen et al. (2014) concluded from analyses of 2,513 adolescent twins that the additive genetic variance of handgrip strength (HGS; a correlate of upper body muscularity; Wind et al., 2010) is higher in men than in women. Although heritability of HGS is high in both sexes, Isen et al. suggested that male strength shows greater phenotypic variance due to sex-related genetic expression, rendering men more susceptible to androgenic effects on the development of HGS.

People can accurately assess male strength from facial and body images and use this information to evaluate male fighting ability (Sell et al., 2009). Research has also documented associations of HGS and male facial configuration (Windhager et al., 2011) with physically strong men having round faces, wide eyebrows and a prominent jaw outline. Additionally, Fink et al. (2007) found that women rated faces of physically strong men as attractive, dominant and masculine. Preliminary investigation about whether dynamic cues (i.e., body movement) provide information about physical strength suggests that this is the case, at least in men. Hugill et al. (2009) reported a positive correlation of HGS and female perceptions of dance attractiveness and assertiveness in men. McCarty et al. (2013) found that male HGS correlated positively with female (and male) dance quality judgments. Physically stronger men displayed larger, more variable and faster movements of their arms. Taken together, these findings suggest that information about male strength is not only present in static representations of facial and body morphology but also in body movement, such as dance.

This study aimed to replicate previous reports on relationships of male HGS and dance movement perception, and extend this to the study of women. Hugill et al. (2009) and McCarty et al. (2013) reported associations of HGS and dance attractiveness/quality in men only; thus, it is not known whether such relationships are generalizable to women. Given Isen et al.'s (2014) data on sex differences in the development of HGS and Sell et al.'s (2009) report on the adaptive consequences of assessing strength from static cues, we hypothesized that this would not necessarily be the case, i.e., we expected to find positive relationships between HGS and opposite-sex assessments of male (but not female) dance attractiveness.

MATERIALS AND METHODS

Participants were 80 men and 86 women, aged 18−42 years, recruited mainly from the student population at Northumbria University (UK) as part of a larger study on body movement. They reported to be non-professional dancers and not affected by injuries that might influence their natural movements.

Handgrip strength (HGS; kgf) was measured with a hand dynamometer (Takei Kiki Kogyo K.K., Japan), twice for each hand, and the grand mean of the two left and two right HGS measurements was used in the analysis. Body height (cm) and weight (kg) were measured to calculate body mass index (BMI)—a positive correlate of HGS (Chandrasekaran et al., 2010)—using Quetelet's equation [BMI = mass (kg)/height $(m)^2$].

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*Correspondence to: Bernhard Fink, Institute of Psychology and Courant Research Centre Evolution of Social Behavior, University of Göttingen, Kellnerweg 6, D-37077 Göttingen, Germany.
E-mail: bernhard.fink@ieee.org

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TABLE 1. Descriptive statistics of HGS, body height, weight, and BMI of male (n = 75) and female (n = 84) dancers

	Male dancer			Female dancer		
	Min	Max	Mean (SD)	Min	Max	Mean (SD)
HGS (kgf)	13.88	59.25	37.33 (8.60)	10.75	44	23.25 (5.68)
Height (cm)	163	192.6	176.61 (6.65)	148	176.5	164.32 (6.46)
Weight (kg)	51.7	127.3	77.08 (12.93)	39	102.5	62.14 (10.79)
BMI	17.95	41.57	24.68 (3.81)	16.03	35.68	22.99 (3.53)

Dance movements were recorded with an optical motion capture system (Vicon, Oxford, UK) running Vicon Nexus software. Thirty-nine reflective markers were attached to each participant's major joints and body parts (Plug-in-gait marker set). Participants were instructed to dance for 30 s to a basic drumbeat as they would in a nightclub. Dance recordings were then applied onto size- and shape-standardized, gender-neutral humanoid characters using Motionbuilder (Autodesk, San Rafael, CA) and rendered as 773 × 632 pixel video clips. Fifteen-second sequences were isolated from the middle of each dance video (same location in the video for all dancers) for the subsequent rating study (see also Hufschmidt et al., 2015; Weege et al., in press). The recordings of two women for which technical problems in post-processing of dance movements occurred were excluded from the rating study.

Dance videos were shown to 50 male and 40 female students at the University of Göttingen (Germany), who were asked to judge the attractiveness of the dancers on a Likert-type scale (1 = "very unattractive"; 7 = "very attractive"). Video clips were presented to opposite-sex raters in randomized order on a 15.4" laptop computer. The judgments of four non-heterosexual raters (by self-report) were excluded prior to analysis, reducing the sample of raters to 49 men aged 19−30 years ($M = 23.71$, SD = 2.82) and 37 women aged 17−46 years ($M = 23.96$, SD = 4.82).

Five male dancers were not heterosexual (by self-report) and their reports were excluded prior to analysis. The final sample of dancers was 75 men (aged 18−42 years, $M = 21.76$, SD = 4.09) and 84 women (aged 18 to 41 years, $M = 20.61$, SD = 3.80).

RESULTS

Table 1 presents descriptive statistics of anthropometric measurements (HGS, height, weight) and indices (BMI) of dancers. Female attractiveness ratings of male dancers ranged from 1.86 to 4.78 ($M = 3.27$, SD = 0.67) and male attractiveness ratings of female dancers ranged from 1.73 to 5.29 ($M = 3.67$, SD = 0.76). There was high inter-rater reliability among raters' attractiveness assessments of dancers (Cronbach's alpha; female raters = 0.89, male raters = 0.91).

Lilliefors tests indicated no significant deviation from normal distribution for HGS measurements ($Zs < 0.07$, $Ps > 0.20$) and attractiveness ratings ($Zs < 0.10$, $Ps > 0.05$). BMI of male and female dancers was not normally distributed ($Zs > 0.10$, $Ps < 0.03$) due to outliers identified by visual inspection of histograms. We therefore log (base 10) transformed BMI (into BMI_{log}) for analysis. BMI_{log} showed no significant deviation from normality ($Z < 0.10, P > 0.07$).

Zero-order correlations revealed a positive correlation of HGS with dance attractiveness in men ($r = 0.27$, $P < 0.01$, one-tailed), but not in women ($r = 0.002$, $P = 0.49$, one-tailed). HGS correlated positively with BMI_{log} in both male and female dancers ($rs > 0.30$, $Ps < 0.01$). BMI_{log} showed no correlation with dance attractiveness in men ($r = 0.02$, $P = 0.42$, one-tailed) or women ($r = -.009$, $P = 0.47$, one-tailed). Recalculating the relationships between male and female HGS and attractiveness ratings of their dances by conducting partial correlations (r_p)—thus controlling statistically for the affect of BMI_{log} on HGS—revealed similar results as with zero-order correlations (men: $r_p = 0.27$, $P < 0.01$; women: $r_p = 0.01$, $P = 0.48$, both P one-tailed).

DISCUSSION

The results support the hypothesis that men's but not women's dance movements convey information about physical strength (Hugill et al., 2009; McCarty et al., 2013). Women judge physically stronger dancers (measured by HGS) to be more attractive. Previous studies have reported female preferences for male facial and body cues that signal physical strength (Fink et al., 2007; Sell et al., 2009), and geometric morphometric investigation indicates that HGS is related to specific male facial configurations (Windhager et al., 2011). The current results corroborate the finding that men's dance movements provide information about physical strength.

This seems plausible for two reasons. First, male dance may signal information about health—a quality that women prefer in mates. Second, dance may signal information about male competitiveness and strength—a quality that influences male−male fighting ability. Our results on opposite-sex attractiveness assessments of dances do not permit conclusions about male perception of other men's competitiveness (regarding fighting ability), and this is an avenue for future research. However, the two scenarios are not necessarily mutually exclusive, given that women prefer men who have attained status, or those who signal the capacity to achieve status via social dominance. Attractiveness assessments alone do not explain whether women consider a man's dance attractive because attractiveness assessments signal male quality in terms of health and "good genes" or cues of social dominance. Moreover, in this study we asked only opposite-sex individuals to judge dance attractiveness. It remains to be investigated whether men's assessments of other men's dances follow those of women. Future research should ask both sexes explicitly about perceptions of, for example, fighting ability, dominance, and masculinity, in addition to attractiveness.

In this context, it is noteworthy that in addition to physical strength, research has documented positive relationships of women's assessments of the attractiveness and assertiveness of men's dances (Hugill et al., 2009) and also positive associations of dance attractiveness and sensation-seeking (Hugill et al., 2011). Given Isen et al.'s (2014) conclusions about stronger genetic and androgenic influences on HGS development in men than in women, information about male dominance and status from dance may also be mediated by androgen action. Fink et al. (2007) reported that digit ratio (2D:4D)—a proxy of prenatal androgenization—correlates with women's attractiveness, masculinity, and dominance assessments of men's dances. Men with lower 2D:4D (high prenatal testosterone) were judged higher on these attribute, suggesting an

organizational effect of testosterone on men's dance quality. Likewise, 2D:4D correlates negatively with HGS in men (but not in women) (Fink et al., 2006; Hone et al., 2012). Recent research further shows that HGS correlates positively with gender identification from men's (but not women's) dances (Hufschmidt et al., 2015). In conclusion, these findings suggest that dance movements convey information about male strength through the effects of prenatal androgenization on strength and that such information is not present in women.

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LITERATURE CITED

Chandrasekaran B, Ghosh A, Prasad C, Krishnan K, Chandrasharma, B. 2010. Age and anthropometric traits predict handgrip strength in healthy normals. J Hand Microsurg 2:58–61.

Fink B, Thanzami V, Seydel H, Manning JT. 2006. Digit ratio (2D:4D) and hand grip strength in German and Mizos men: cross-cultural evidence for an organising effect of prenatal testosterone on strength. Am J Hum Biol 18:776–782.

Fink B, Neave N, Seydel H. 2007. Male facial appearance signals physical strength to women. Am J Hum Biol 19:82–87.

Fredericksen H, Gaist D, Petersen HC, Hjelmborg J, McGue M, Vaupel JW, Christensen K. 2002. Hand grip strength: a phenotype suitable for identifying genetic variants affecting mid- and late-life physical functioning. Genet Epidemiol 23:110–122.

Gallup AC, White DD, Gallup GG. 2007. Handgrip strength predicts sexual behavior, body morphology, and aggression in male college students. Evol Hum Behav 28:423–429.

Hoffman T, Stauffer RW, Jackson AS. 1979. Sex differences in strength. Am J Sports Med 7:265–267.

Hone LSE, McCullough ME. 2012. 2D:4D ratios predict hand grip strength (but not hand grip endurance) in men (but not in women). Evol Hum Behav 33:780–789.

Hufschmidt C, Weege B, Röder S, Pisanski K, Neave N, Fink B. 2015. Physical strength and gender identification from dance movements. Pers Indiv Dif 76:13–17.

Hugill N, Fink B, Neave N. 2009. Men's physical strength is associated with women's perceptions of their dancing ability. Pers Individ Dif 47: 527–530.

Hugill N, Fink B, Neave N, Besson A, Bunse L. 2011. Women's perception of men's sensation seeking propensity from their dance movements. Pers Individ Dif 51:483–487.

Isen J, McGue M, Iacono W. 2014. Genetic influence on the development of grip strength in adolescence. Am J Phys Anthropol 154:189–200.

Kritz-Silverstein D, Barrett-Connor E. 1994. Grip strength and bone mineral density in older women. J Bone Miner Res 9:45–51.

Lassek WD, Gaulin SJC. 2009. Costs and benefits of fat-free muscle mass in men: relationship to mating success. Evol Hum Behav 30:322–328.

McCarty K, Hönekopp J, Neave N, Caplan N, Fink B. 2013. Male body movements as a possible cue to physical strength: a biomechanical analysis. Am J Hum Biol 25:307–312.

Rantanen T, Harris T, Leveille SG, Visser M, Foley D, Masaki K, Guralnik JM. 2000. Muscle strength and body mass index as long-term predictors of mortality in initially healthy men. J Gerontol A Biol Sci Med Sci 55: 168–173.

Sell A, Cosmides L, Tooby J, Sznycer D, von Rueden C, Gurven M. 2009. Human adaptations for the visual assessment of strength and fighting ability from the body and face. Proc Biol Sci 276:575–584.

Vaara JP, Kyröläinen H, Niemi J, Ohrankämmen O, Häkkinen A, Kocay S, Häkkinen K. 2012. Associations of maximal strength and muscular endurance test scores with cardiorespiratory fitness and body composition. J Strength Cond Res 26:2078–2086.

Weege B, Barges L, Pham M, Shackelford TK, Fink B. Women's attractiveness perception of men's dance movements in relation to self-reported and perceived personality. Evol Psychol Sci (in press).

Wind AE, Takken T, Helders PJ, Engelbert RH. 2010. Is grip strength a predictor for total muscle strength in healthy children, adolescents, and young adults? Eur J Pediatr 169:281–287.

Windhager S, Schaefer K, Fink B. 2011. Geometric morphometrics of male facial shape in relation to physical strength and perceived attractiveness, dominance and masculinity. Am J Hum Biol 23:805–814.