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Short Communication

Handedness and sex roles: Mixed-handers are less sex-congruent stereotyped

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ABSTRACT

Previous research reported that non-right-handers display a less sex-congruent stereotyped sex-role identity (i.e., women portray themselves as more masculine, men as more feminine) than right-handers. However, classification of handedness was based on arbitrary criteria and did not distinguish between left-handedness and mixed-handedness among non-right-handers. We present data from two large and independent middle-European samples, a discovery (n = 7658) and a replication (n = 5062) sample. Using latent class analysis for handedness classification, it is shown that mixed-handedness, rather than left-handedness, is the driving factor underlying associations between handedness and sex-role identity. We discuss our findings with regard to the Geschwind–Galaburda theory of cerebral lateralization and the need to evaluate the contribution of sexual orientation on this association in future research.

1. Introduction

There is some evidence that left-handed women report higher masculinity and lower femininity than right-handed women, and left-handed men lower masculinity and higher femininity than right-handed men (Casey & Nuttall, 1990; Lippa, 2003; Nicholls & Forbes, 1996). Both findings are compatible with the Geschwind–Galaburda theory of cerebral lateralization (Geschwind & Galaburda, 1987), which posits masculinization of female left-handers and an increased likelihood for homosexuality in male left-handers because of shared effects of high intrauterine levels of testosterone that are assumed to slow left brain hemisphere maturation and to promote left-handedness. There is direct (Lombardo et al., 2012) and indirect (Beaton, Rudling, Kissling, Taurines, & Thorne, 2011) evidence on associations of intrauterine testosterone levels with brain development and left-handedness in men, and on non-right-handedness with homosexuality in both men and women (Lalumière, Blanchard, & Zucker, 2000).

However, a growing body of research highlights that not left-handedness, but rather inconsistent or mixed-handedness, may be of importance with regard to associations of non-right-handedness with bisexuality and homosexuality (Blanchard & Lippa, 2007), but also with cognitive performance and other psychological domains, such as risk perception and sensation seeking (for an overview, see Prichard, Propper, & Christman, 2013). Yet, classification of handedness usually does not rely on latent variable modeling (e.g., latent class analysis), but rather on arbitrary criteria (Beaton, 2008), and frequently also fails to unambiguously distinguish mixed-handedness from left-handedness. Furthermore, the dominance of right-handedness in the population (about 90%) lowers statistical power and demands large sample sizes.

The present study addressed the shortcomings of prior research with regard to handedness classification and ensured high statistical power. We assessed hand preference in two large discovery and replication samples and used latent class analysis for classification. Right-, mixed-, and left-handedness were differentiated on an empirical basis and examined with regard to their associations with masculinity and femininity, controlling also for possible cohort effects.

2. Methods

2.1. Participants

Descriptive characteristics of the discovery and replication samples are given in Table 1. The samples consisted in majority of Austrian and German participants with a broad age range and slightly more women than men. Participants with other nationalities were with highest proportions Italian (1.4%), Turkish (0.6%), and Romanian (0.4%). Samples differed with regard to nationality

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Table 1
Sample characteristics.

	Discovery sample	Replication sample
n	7658	5062
Women, *n* (%)	4456 (58.2%)	2749 (54.3%)
Age, range (years)	18–89	18–92
Interquartile range	22–35	22–48
Mean (*SD*)	30.24 (12.62)	35.74 (16.05)
Nationality, *n* (%)[a]		
Austria	5339 (70.0%)	3415 (67.7%)
Germany	1773 (23.2%)	1310 (26.0%)
Other	514 (6.7%)	316 (6.3%)

Note. [a]*n*s = 7626 and 5041 due to missing data.

($\chi^2(2) = 12.63$, $p < .001$) and sex ($\chi^2(1) = 18.69$, $p < .001$). Participants in the replication sample were on average also 5.5 years older ($t(12718) = 21.56$, $p < .001$, $d = 0.39$). However, given the large sample sizes, statistical tests were overpowered with regard to these differences.

2.2. Measures

2.2.1. Lateral preference inventory (LPI)

We used four items out of the 12-item LPI handedness scale (Coren, 1993): hand preference with regard to writing (Item 1), throwing a ball to hit a target (Item 3), using a knife to cut something without simultaneously using a fork (Item 6), and using a hammer to drive a nail into something (Item 7). Items were chosen to assess adult writing hand and with respect to broad trait coverage (vs. redundancy), item performance indicators, and balance of fine- versus gross-motor skills. Response options were *left*, *either*, and *right*, coded −1, 0, and +1 for the computation of a total score. With this scoring, Cronbach α of the scale was .91 in the discovery and .92 in the replication sample (.91 in the combined samples).

2.2.2. Sex-role identity scale (SRIS)

Global self-concepts of masculinity (M) and femininity (F) were assessed with the SRIS (Storms, 1979), comprising three items each for M and F, rated on a 5-point scale. The SRIS provides an economic, but reliable and valid assessment of sex-role identity. Item contents relate to how masculine (feminine) respondents perceive themselves, how masculine (feminine) respondents act, appear and come across to others, and how masculine (feminine) respondents perceive their personality. Items do not explicate, or define, specific meanings or concepts of 'masculine' and 'feminine'. The SRIS was translated into German in the course of another study (Kastlunger, Dressler, Kirchler, Mittone, & Voracek, 2010), using the parallel blind technique (Behling & Law, 2000). There exists at least one independent validation study conducted in Germany (Eckloff, 2003). Moreover, the SRIS has been applied in a number of further countries outside the US (and the UK), for example, in Italy (Kastlunger et al., 2010), Sweden and Israel (Carlsson & Barnes, 1986), China (Zheng, Lippa, & Zheng, 2011), and South Africa (Sandfort, Baumann, Matebeni, Reddy, & Southey-Swartz, 2013).

We computed M and F scores by averaging ratings across respective items and also computed M–F (subtracting F from M scores), a bipolar measure of masculinity–femininity, ranging from +5 to −5. In the present study, men and women in the two samples differed with large effect size in M (men: $M = 3.64$, $SD = 0.80$; women: $M = 2.05$, $SD = 0.85$; $t(12503) = 107.35$, $p < .001$, $d = 1.94$), F (men: $M = 1.95$, $SD = 0.82$; women: $M = 3.89$, $SD = 0.76$; $t(12462) = -136.97$, $p < .001$, $d = -2.48$), and M–F (men: $M = 1.69$, $SD = 1.36$; women: $M = -1.85$, $SD = 1.40$; $t(12400) = 140.90$, $p < .001$, $d = 2.55$). Cronbach α in M, F, and M–F was .94, .96, and .95, similar to studies from other countries. M and F scores correlated in the two samples with −.78 and −.74, respectively, similar to other studies and the original study of Storms (1979).

2.3. Procedure

The data were collected in the course of a larger project on individual differences variables by a multitude of data collectors. Waves of data collection for the discovery and the replication sample were temporally separated and independent from each other regarding the data collectors involved. Participants were approached on a personal basis, using word-to-mouth and personal contacts. Participation was voluntary, anonymous, and participants were not remunerated for participation.

2.4. Analysis

Handedness preference ratings were examined with latent class analysis (LCA; Collins & Lanza, 2010). LCA is based on a latent variable model wherein associations between observed variables are explained by a number of discrete latent classes. LCA is similar to cluster analysis, but differs in being based on a probabilistic model for pattern identification, rather than using measures of similarity or dissimilarity. LCA has been utilized in studies on handedness before (e.g., Dragovic & Hammond, 2007). For handedness classification, the main advantage of utilizing LCA lies in being able to determine on an empirical basis the actual number of distinct classes (i.e., handedness groups) and to reduce classification error (i.e., misclassification). We evaluated the fit of 1-, 2-, 3-, and 4-class models, determining empirically the smallest number of latent classes that explained the data best. With regard to the discrete nature of handedness (Dragovic & Hammond, 2007), items were treated as nominal. For assessment of model fit, the Bayesian information criterion (BIC), based on the log-likelihood value of the model, percentages of classification error, and the likelihood-ratio goodness of fit statistic (L^2) were used. LCA was conducted with Latent GOLD 4.5. Identified latent classes were used in ensuing analyses with regard to handedness.

Associations of handedness with masculinity, femininity, and M–F were examined with analysis of covariance, examining the factors handedness class, participant sex, and sample (discovery vs. replication), thereby testing the generalizability of our results. Age was included as a covariate in these analyses. Significance was set at $p < .05$.

3. Results

3.1. Handedness classification

A 3-cluster solution fitted the data best in both samples, according to BIC and percentages of classification error (Table 2). Mean posterior assignment probabilities of participants to classes indicated high classification certainty (Class 1: 99.4% and 99.4% in the discovery and the replication sample; Class 2: 96.9% and 96.9%; Class 3: 89.4% and 90.0%). Class 1 subsumed right-handers and had class sizes of 89.5%, 95% CI = [88.7–90.3%], in the discovery sample and of 89.0% [88.0–90.0%] in the replication sample. Class 2 subsumed left-handers, with class sizes of 7.7% [7.1–8.3%] and 8.4% [7.6–9.3%], respectively. Class 3 subsumed mixed-handers, with class sizes of 2.8% [2.3–3.4%] and 2.6% [1.9–3.3%], respectively. Right-handers almost exclusively preferred their right hand (response probabilities ⩾ 97%). Right-hand preference was also frequently reported by both left-handers and mixed-handers with regard to some items of the LPI (highest in writing: 19% and 25% in Class 2 in the two samples, 66% and 56% in Class 3). However, whereas left-handers otherwise preferred their left hand (response