A Taxonomy of Self-Estimated Human Performance

The General Factor ί

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Abstract. Previous research often examined self-estimated intelligence in relation to academic models of human cognitive ability or popular models of intelligence (e.g., Gardner's (1983) multiple intelligences). The present study employed a different concept of ability, namely, Fleishman's (1975) structure of human performance, to investigate the psychometric structure of self-estimates. A structural equation model generally confirmed Fleishman's apriori taxonomy. In addition, the structure of self-estimated abilities closely resembled models of measured cognitive ability (e.g., Carroll, 1993) and one latent trait, termed general factor ί, was identified. Modest sex differences in self-estimated ability were confirmed in favor of men; however, the latter were noteworthy only for the domains of spatial orientation and physical strengths. Implications for research and practice are discussed.

Keywords: Fleishman's taxonomy, human performance, self-estimated ability, psychometric structure, sex differences

Introduction

Over the past 25 years, there has been a vast amount of studies investigating self-estimates of intelligence. Hundreds of participants of both sexes and from different national, social, educational, and occupational backgrounds estimated their own IQ scores on ability scales such as verbal, logical, and musical intelligence (see Furnham, 2001, for a detailed review). Three core findings summarize the results. First, self-estimated and measured intelligence only share little variance and meta-analytic evidence suggests a correlation coefficient of .30 (Mabe & West, 1985). Second, men more than women tend to overrate their intelligence and abilities; such sex differences are consistent across cultures (e.g., von Stumm, Chamorro-Premuzic, & Furnham, 2009). Third, means of self-estimated intelligences vary across countries, whereby Asians show greater humility compared to Europeans or Americans (e.g., Furnham, Rakow, Sarmany-Schiller, & De Fruyt, 1999).

Although the existing body of research evidence is abundant, for two reasons it seems premature to conclude that there is little left to discover about people's self-estimated competencies. On the one hand, it has been proposed that lay concepts of intelligence influence how people evaluate others as well as themselves, and such evaluations may turn into public beliefs with considerable social, educational, and occupational consequences (Ackerman & Wolman, 2007; Beyer & Bowden, 1999). Furthermore, self-estimated ability influences performance expectations and evaluations, which in turn affect achievement reflecting self-fulfilling prophecies (Chamorro-Premuzic & Arteche, 2008; Chamorro-Premuzic & Furnham, 2006; Dweck, 1999; Pomerantz & Ruble, 1997). Thus, self-estimates of abilities may shape both intra- and interpersonal perceptions and determine individual differences in performance outcomes.

The second reason derives from the methodological and statistical concerns of previous research. Most investigations incorporate self-ratings on ability scales drawn from three models of intelligence, including Sternberg's (1985) triarchic model of successful intelligence, Gardner's multiple intelligences (1983), and Salovey and Mayer's (1990) emotional intelligence (e.g., Petrides, Furnham, & Martin, 2004; von Stumm et al., 2009; but see Sternberg, Conway, Ketron, & Bernstein, 1981, for a different approach). There is, however, little evidence to suggest that the models cited above are relevant for lay people's self-evaluation of ability, or that they constitute a comprehensive taxonomy of abilities. Furthermore, only very few studies set out to explore the structure and intrarelations of self-estimates, and if so predominantly relied on principal components analysis (PCA) and multiple regression models (e.g., Bennett, 1996; Furnham, Tang, Lester, O'Connor, & Montgomery, 2002; Petrides & Furnham, 2000). Recently, von Stumm et al. (2009) reported differences in the means and variances of self-estimated ability across 12 nations; previous PCA rarely

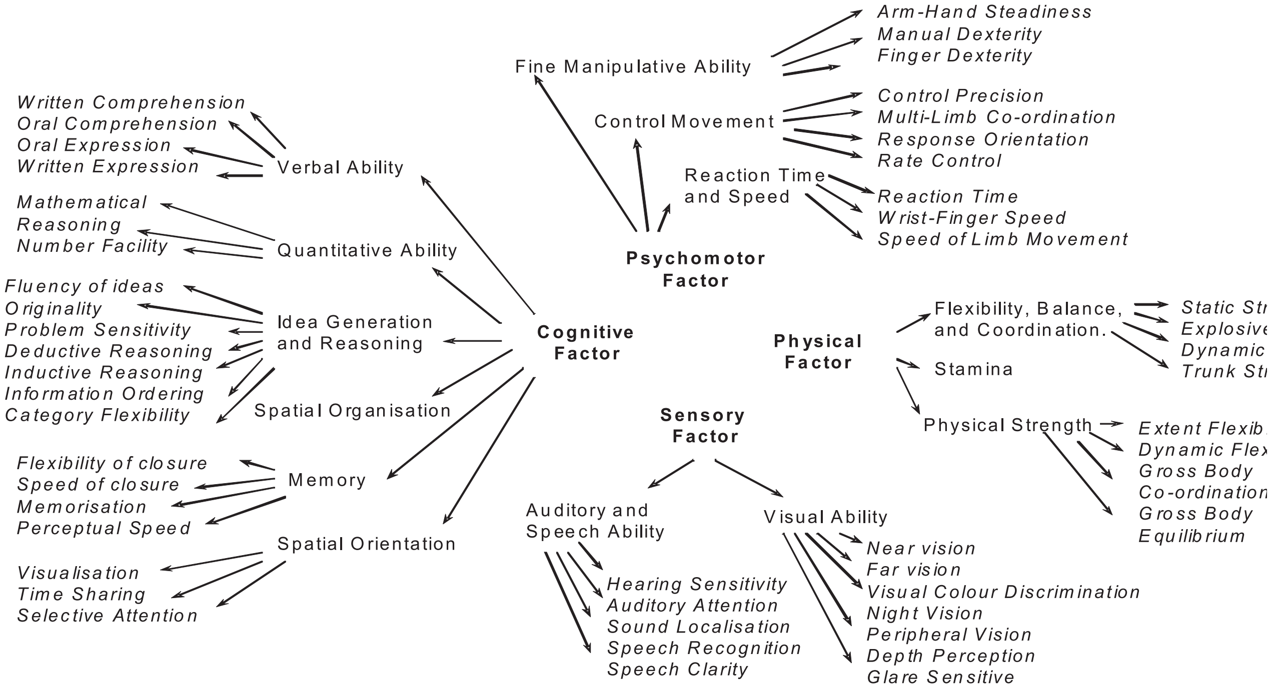

Figure 1. Schematic representation of Fleishman's taxonomy of human performance.

attended to such discrepancies. Also, results of multiple regression analysis were often distorted by effects of multicollinearity (see Kline, 1988, for the pitfalls of multivariate statistics).

The current study aims to overcome these methodological and statistical issues by investigating self-estimated abilities within a different, more comprehensive taxonomy of human performance applying confirmatory factor analysis and structural equation modeling.

A Taxonomy of Human Performance

Starting in the 1950s and extending over a lengthy period, Fleishman (1975, 1982) and colleagues (Fleishman & Mumford, 1991; Fleishman, Mumford, Weeks, & Harding, 1987) developed a comprehensive framework of job-related abilities including 52 competencies with four higher-level factors of cognitive, psycho-motor, physical, and sensory abilities.

Each factor is theoretically derived from 14 apriori second-order categories, which in turn consist of 52 of lower (first)-order job-related abilities (see Figure 1). Fleishman (1967) aimed "to define the fewest independent ability categories which might be most useful in describing performance in the widest variety of tasks" (p. 352). For each ability, a behaviorally anchored rating scale was developed that included (a) carefully developed construct definitions, (b) distinctions from similar abilities, (c) definitions of high and low levels of each ability requirement, and (d) task anchors to provide raters with examples of everyday tasks that reflect high, moderate, and low levels of each ability. The subsequent so-called Fleishman Job Analysis Survey (Fleishman, 1992) has high internal consistency, interrater reliability (Fleishman, 1988), and construct and predictive validity (Fleishman & Mumford, 1988). Fleishman's (1975) approach distinguishes between abilities, which refer to a more general capacity of performance in a variety of human tasks, and skills, which are defined as level of proficiency on a specific task or group of tasks. In sum, Fleishman's taxonomy of human performance includes abilities and skills that are more strongly associated with performance in everyday tasks – in both working and home environments – than, for example, Carroll's (1993) factors of human intelligence. Therefore, it seems plausible that laypeople's self-ratings on Fleishman's concrete set of abilities and skills are more informative than self-evaluations on rather abstract, research-oriented intelligence scales.

This study investigates self-ratings on Fleishman's taxonomy in a sample of 229 British people. It is hypothesized that men will have a tendency to give higher estimates of their abilities and skills than women. Furthermore, it is expected that self-estimates can be modeled according to Fleishman's hierarchical taxonomy, whereby four intercorrelated higher-order factors of cognitive abilities, psychomotor abilities, physical abilities, and sensory abilities will emerge.

Table 1. Means (*SD*) of self-estimates on Fleishman's 14 apriori categories for both sexes

Grouped Fleishman abilities	Men		Women		*d*
Verbal abilities	111.85	(10.48)	108.04	(8.59)	.40
Idea generation and reasoning abilities	111.48	(9.34)	105.65	(9.13)	.63
Quantitative abilities	109.22	(12.81)	104.56	(12.85)	.36
Memory	106.70	(9.97)	104.11	(8.22)	.28
Spatial orientation	106.86	(11.11)	102.99	(8.81)	.39
Fine manipulative abilities	105.27	(12.31)	103.57	(10.83)	.15
Control movement abilities	105.38	(9.57)	103.02	(9.31)	.25
Reaction time and speed ability	108.98	(10.39)	107.24	(9.99)	.17
Physical strength abilities	104.07	(11.89)	98.93	(10.73)	.45
Flexibility, balance and coordination	102.44	(10.98)	102.08	(10.11)	.03
Visual abilities	103.94	(9.55)	101.33	(9.23)	.28
Auditory and speech abilities	105.12	(9.48)	104.77	(9.87)	.04
Spatial organization	108.48	(13.34)	99.99	(12.38)	.66
Stamina	101.72	(16.20)	98.43	(13.32)	.22

Note. Ability scores are the mean scores for participants in each category. *d* refers to the effect size of sex differences indicated by Cohen's *d*.

Method

Participants

A total of 229 participants took part in this study (101 males and 128 females). The mean age was 23.83 years (*SD* = 8.95), the range from 18 to 75. 80% of the participants were aged 25 years and below, and 73.3% of participants were university students.

Questionnaire

All participants completed a 3-page questionnaire based on Fleishman's Job Analysis Survey. A normal distribution bell curve of ability scores of the general population was shown, which included a mean score of 100 and extended over six standard deviations (–45 to +45 points). Each indicated scale score was labeled with a brief description; a score of 115 was referred to as "high average" and a score of 85 as "low average." This was followed by Fleishman's 52 job-related abilities, each with operational definitions adapted from Fleishman (1992). For example, Verbal Comprehension was defined as "The ability to understand spoken English words and sentences." and Selective Attention was operationalized as "The ability to concentrate on a task one is doing. This ability involves concentrating while performing a boring task and not being distracted."

Finally, participants completed a demographic profile including details on their education and occupation.

Procedure

Two-thirds of participants were recruited at several UK universities, and one-third was invited electronically to complete an online version of the questionnaire. Participants completed the questionnaire in their own time; where possible, participants were fully debriefed. No financial or other compensation was offered for taking part in this study.

Results

The 52 abilities were classified into 14 second-order categories, using Fleishman's apriori classification structure. Table 1 shows the means and standard deviations of self-estimates for sexes separately.

A series of independent sample *t*-tests showed significant sex differences for eight ability categories ($p < .05$); however, effect sizes of such sex differences were small in most cases with the exception of Idea Generation and spatial organization with medium effect sizes (Cohen's $d > .60$ in both cases).

Confirmatory Factor Analysis (CFA)

CFA was conducted to test the extent to which Fleishman's hierarchical model explained the structure of the 14 categories of self-estimated ability (see Figure 2). To this end, the four higher-order factors were extracted using maximum likelihood estimation in AMOS 5.0 (Arbuckle, 2003; Byrne, 2001). Furthermore, the four latent factors of cognitive, psycho-motor, physical, and sensory domains were allowed to correlate.

The model's goodness of fit was assessed via the χ^2 statistic, the goodness-of-fit index (GFI) and its adjusted version (AGFI), as well as the root mean square error of approximation (RMSEA) and the parsimony goodness-

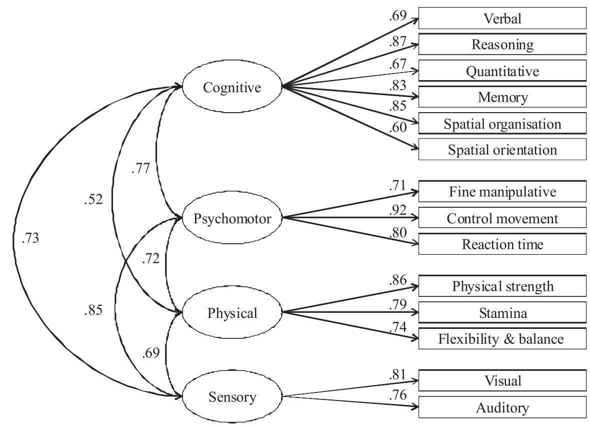

Figure 2. Modelled self-estimates of Fleishman's taxonomy of human performance. *Note*. Cognitive, Psychomotor, Physical, and Sensory refer to the four higher-order factors of human performance. Double-headed arrows indicate freely estimated correlations. All paths are significant at $p < .01$.

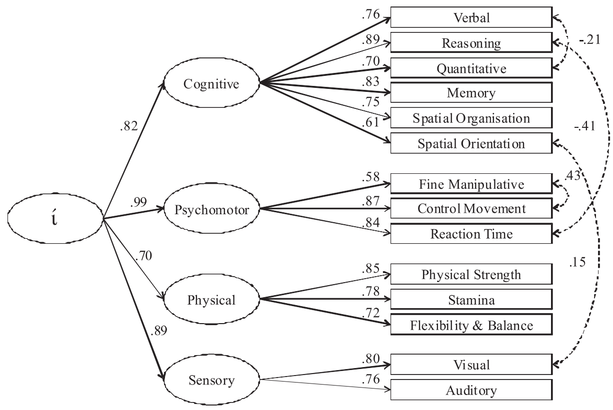

Figure 3. The ί factor model. *Note*. Double-headed arrows indicate freely estimated correlations. All paths are significant at $p < .01$. ί is the general factor of self-estimates.

of-fit index (PGFI) (Kelloway, 1998; Loehlin, 1987; Maruyama, 1998). The fit for the hypothesized model was somewhat poor: χ^2 (df = 71) = 163.5, $p < .01$, GFI = .91, AGFI = .87, RMSEA = .08 (low = .06, high = .09), PGFI = .62., with all factor loadings significant at $p < .01$ (Figure 2). Correlations among the four higher-order factors ranged from .52 to .85, suggesting an underlying general factor of self-estimates. Thus, a hierarchical, three-level model, was fitted to the data with the 14 ability categories at the third (lowest) level, the four latent traits at the intermediate level, and one factor on top, which will be referred to as ί. The fit for this model was also slightly inadequate: χ^2 (df = 76) = 182.7, $p < .01$, GFI = .89, AGFI = .87, RMSEA = .08 (low = .06, high = .09), PGFI = .62. In line with modification indexes, correlations between error variances of verbal and quantitative, reasoning and reaction time, fine manipulative and control movement, and spatial orientation and visual abilities were allowed. The model (shown in Figure 3) was well-fitting: χ^2 (df = 72) = 128.6, $p < .01$, GFI = .94, AGFI = .92, RMSEA = .05 (low = .02, high = .06), PGFI = .64 (note that significant χ^2 values are not unusual in well-fitting models[1], Byrne, 2001).

All loadings were higher than .58, and the four higher-order factors loaded above .70 onto ί with psychomotor and sensory abilities showing the highest loadings. Intercorrelations at the level of the 14 dimensions showed that spatial orientation and visual ability were modestly related after accounting for the higher-order factors of cognitive and sensory abilities. There was also a modest positive association between fine manipulative and control movement skills (accounting for the general psychomotor factor). After accounting for the general cognitive ability factor, quantitative and verbal abilities were negatively, albeit moderately, correlated, indicating that once participants were "matched" in their general estimates of cognitive abilities, higher estimates of verbal were associated with lower estimates of quantitative abilities, and vice-versa. A similar association was found between reasoning and reaction time, i.e., after removing the general variance attributable to the cognitive and psychomotor factors, higher estimates of reasoning were linked to lower estimates of reaction time and vice-versa.

Finally, sex differences were examined within a new model. The hypothesized model included paths from sex to ί only, but did not fit the data well: χ^2 (df = 85) = 185.1, $p < .01$, GFI = .90, AGFI = .86, RMSEA = .07 (low = .06, high = .09; PGFI = .64). Modification indices suggested three additional parameters, namely, from sex to the cognitive factor, to the spatial orientation, and the physical strength dimension to attain adequate model fit: χ^2 (df = 82) = 147.1, $p < .01$, GFI = .93, AGFI = .90, RMSEA = .05 (low = .04, high = .07, PGFI = .63). All three paths were significant at $p < .05$ and ranged from .15 to .17, indicating higher means for men.

Discussion

The findings of the current study are two-fold. On the one hand, the structure of self-estimates of ability was found to be closely related to the psychometric model of human cognitive abilities (e.g., Carroll, 1993). Fleishman's apriori classification of human performance was confirmed by a structural equation model, whereby variances in self-estimates were adequately represented by four correlated latent traits extracted from 14 level factors. From

[1] *Non*significant, rather than significant, χ^2 values are indicative of good fit.

the substantial intercorrelations of the cognitive, psychomotor, sensory, and physical factors emerged one underlying general dimension, termed ί. The final model's (Figure 3) structure closely resembles of Carroll's (1993) model of psychometric intelligence, which also comprises three strata. Carroll (1993) found a factor of general intelligence *g* at the top and eight lower-order factors, which were derived from more than 40 distinctive level factors, at the second stratum. Akin to general intelligence, self-estimates entail a "positive manifold." For example, individuals who perceive their verbal ability as high also estimate their auditory and psychomotoric abilities as elevated. However, once the general variance – factor ί – is accounted for, self-estimates of more distinct abilities (i.e., reaction time and reasoning) were found to be negatively correlated. That is, albeit self-estimates of ability follow the mathematical principles of measured intelligence, individuals perceive personal weaknesses and strengths after a general factor is extracted.

The second finding showed men's tendency to estimate their abilities higher compared to their female counterparts. This is largely in line with previous research (e.g., Furnham, 2001) and confirms stable sex differences in self-estimates across concepts of intelligence or taxonomies of abilities. When sex was examined within the structural model of self-estimates as moderating variable, it had a negligible effect on ί but significant effects on the second-order factor of cognitive abilities and also on the level factors of spatial orientation and physical strength. Such differences are very well documented in the research literature of self-estimated *and* of measured intelligence: Since the 1970s (Maccoby & Jacklin, 1976; see also Jensen, 1998), it is accepted that men tend to exceed women in visuo-spatial and mathematical abilities. The latter two abilities largely define the cognitive factor, so that sex had a particularly strong effect on this factor. Thus, previous research on self-estimates of intelligence has traditionally found the greatest sex differences in ratings of spatial and mathematical ability. Considering the given physiological sex differences (i.e., men's average height and weight compared to women's), it does not come as a surprise that females estimate their physical strength as lower than that of males. At best, this result may indicate a certain extent of realism of men and women when estimating their abilities.

The current study suffers from one major limitation: Fleishman's (1992) abilities were only estimated but not actually measured. Thus, it remains speculative whether this taxonomy of human performance results in more accurate self-estimates than traditional ratings on intelligence scales. Future research must continue to venture beyond traditional assessment methods and aim to investigate self-estimates in contexts that are less academically defined but of greater relevance to laypeople.

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