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Gender differences in self-estimates of general, mathematical, spatial and verbal intelligence: Four meta analyses

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ABSTRACT

Four meta-analyses were conducted to examine the magnitude of sex differences in self-estimates of general, mathematical/logical, spatial and verbal abilities. For all but verbal ability males gave significantly higher self-estimates than did females. The weighted mean effect size *d* for general intelligence was .37, for mathematical .44, for spatial .43 and for verbal .07. As these were significantly heterogeneous, homogeneity analysis was performed to identify moderating factors. These included age, instruction type, country and dominating author's gender. The outcomes were discussed in terms of possible causes of this phenomenon and some concerns about the interpretation of the results were raised.

1. Introduction

Over the past three decades, differential psychologists have reported relatively consistent sex differences in self-assessed intelligence, defined as people's estimates of their own cognitive abilities on a standardised IQ scale in comparison to the overall population (Chamorro-Premuzic & Furnham, 2005). Specifically, males tend to rate their intelligence higher than females (e.g., Beloff, 1992; Bennet, 1996; Furnham & Rawles, 1995, 1999; Hamid & Lok, 1995; Hogan, 1978; 1980; see review: Furnham, 2001). This effect has replicated cross culturally with one recent study comparing twelve nations from four continents (Von Stumm, Chamorro-Premuzic, & Furnham, 2009). It is an area of research that has continued to attract attention and replication in many different countries (Furnham & Shagabutdinova, 2011; Kudrna, Furnham, & Swami, 2010; Perez, Gonsalez, & Beltran, 2010; Stieger et al., 2010; Swami & Furnham, 2010; Yousefi, 2009). It relates partly to the literature on lay conceptions of intelligence (Neto, Mullett, & Furnham, 2009; Sternberg, Conway, Ketron, & Bernstein, 1981) and the question of the correspondence between the lay and scientific literature.

There are, however, two research traditions which inform this research area. The *first* is the extensive and long-standing research on sex differences in both self-esteem (a person's sense of their self-worth) and self-efficacy (a person's perception of their ability to reach a goal) (Bandura, 1997). In both areas researchers have made distinctions like academic vs social self-efficacy and body vs interpersonal self-esteem but the extensive literature has tended to show consistent sex differences in many "facets" of self confidence/efficacy/esteem: males tend to have higher self-esteem and self-efficacy beliefs than females. An earlier meta analysis by Kling, Hyde, Showers, and Buswell (1999) showed that the overall effect size for global self-esteem was 0.21, with a small difference favouring males. However it should be noted that many studies show content-specific differences in gender differences with some favouring females and others males. Further the results of a recent meta-analysis has shown that gender differences vary substantially (in both direction and magnitude) in many domain specific self-esteem facets (Gentile et al., 2009).

There is also evidence that there are sex differences in many aspects self-perceived self-confidence with females expressing lower self-confidence despite the empirical evidence of their competence (Blanch, Hall, Roter, & Frankel, 2008). As to self-efficacy, most studies report that boys and men tend to be more self-confident than girls and women in mathematics, science and technology (Pajares, Miller, & Johnson, 1999; Pajares & Valiante, 2001; Wigfield, Eccles, & Pintrich, 1996).

The relationship between self-estimated intelligence and academic achievement as well as test performance is moderate (Ackerman & Wolman, 2007; Furnham, Moutafi, & Chamorro-Premuzic, 2005). This is to be expected given that self-estimated intelligence appears to be a trait-like cognitive variable: that is it is consistent over time and across situations, akin to cognitive style. There is also evidence that it is systematically related to the Big Five personality dimensions and general intelligence (Furnham, 2005ab).

Various theories (e.g. attribution theory social cognitive theory, social learning theory) have been developed to account for these

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robust findings. It may be predicted therefore that males would have consistently higher self-estimates of general intelligence than females.

The *second* area is the highly disputed research on sex differences in cognitive ability (intelligence). There seems to be general agreement that there are negligible sex differences in general intelligence (Colom, Juan-Espinosa, Abad, & Garcia, 2000; Mackintosh, 1998, Spelke, 2005) but that there are consistent but small differences on certain specific subtests measuring numerical or spatial intelligence (Else-Quest, Hyde, & Linn, 2010; Lynn, 1998; Mackintosh, 1998). The disagreement that exists occurs over the size of the differences that exist with Lynn (1999) suggesting a 4–5 IQ point differences in adults in favour of males (Lynn, 1999) and effect sizes as high a d = .61 for mental arithmetic (Lynn, 1998; Lynn & Irwing, 2008). A question remains as to the effect sizes for self-estimates of general as well as specific “intelligences”.

Despite speculation as to the causes of these differences (e.g., differences in “real” aptitudes or achievement, cultural stereotypes, and personality traits) (see Chamorro-Premuzic & Furnham, 2005 for a review), the magnitude of this sex difference remains to be established, and a number of studies have failed to replicate this effect (Byrd & Stacey, 1993; Furnham, 2005a, 2005b; Furnham & Budhani, 2002). Given that self-estimates of intelligence have been found to affect academic performance independently of (“tested”) cognitive abilities (Chamorro-Premuzic & Furnham, 2006; Chamorro-Premuzic, Harlaar, Greven, & Plomin, 2010), and in light of the widely accepted claim that self-perceptions of ability (e.g., academic self-concept, self-assessed intelligence, and self-concept of ability[1]) are an essential component of motivation (Eccles et al., 1983), determining individual differences in intellectual investment and willingness to learn (Ackerman & Wolman, 2007), it is important to provide an accurate quantitative estimate for these sex differences. Thus the current meta-analysis set out to estimate the effect sizes of sex differences in self-estimates of general (g), mathematical/logical, spatial and verbal intelligence.

There are a number of reasons for selecting these particular abilities. Studies utilising multiple regression show that mathematical, spatial and verbal ability constitute the best predictors of one's self-estimated general IQ (Furnham, 2001). In addition, an abundance of literature, including seminal publications such as Anastasi (1958) and Maccoby and Jacklin (1974), regard sex differences on these dimensions as “well established”, which is often interpreted as “large” (Hyde, 1981). Such views have long been available to the general public, most likely shaping lay peoples' perceptions. Moreover, several meta-analyses of sex differences in psychometrically-derived scores on these abilities (maximal performance or traditional ability tests) have been conducted, only partially supporting beliefs of sex differences in abilities. Moderate differences favouring males ($d = .37$) have been found on spatial (Voyer, Voyer, & Bryden, 1995) and very small ($d = .14$) on mathematical intelligence (Else-Quest et al., 2010; Hyde, Fennema, & Lamon, 1990). On verbal abilities the disparity in favour of females was very small ($d = -.11$) which, according to the authors (Hyde & Linn, 1988) should be interpreted as a lack of difference.[2]

It seems worthwhile to compare the effect size of sex differences in self-estimates (if they are indeed found) with sex differences in “actual” or psychometrically tested abilities. These comparisons seem particularly interesting given some researchers' (Furnham & Rawles, 1995) suggestions that males' higher estimates of mathematical and spatial intelligences reflect a real disparity in their respective IQ scores.

In addition to estimating mean effect sizes of sex differences in intelligence estimates the present study aims to identify possible moderating variables. There were variations in the results obtained so far and previous meta-analyses of sex differences in different spheres have shown that a large number of factors can influence the direction and magnitude of the effects (Hyde et al., 1993; Eagly & Carli, 1981). Also, as suggested by Furnham (2001), varying accuracy of IQ estimates poses questions about causes of variations and “a close examination of the conditions and instructions under which participants make self-estimates of intelligence may give a clue as to how they make their self-estimate” (p. 1400).

1.1. Sample of studies

The studies analysed here come from three sources: (a) a computerised literature search of the PsychINFO database; the keywords *intelligence(s)* and *multiple-intelligence(s)* were crossed with *estimates* and *self-estimates* with the Boolean operator AND. Using PsychINFO, which includes unpublished dissertations, enabled to address the “file drawer” problem — the risk of overestimating effect size due to the tendency of publishing mostly studies that reported significant differences. However, the search yielded no such relevant studies; (b) examining all the articles found with the Social Science Citation Index (available via Web of Science database) in order to locate further studies citing them; (c) searching references of the articles retrieved in the first two steps; (d) obtaining relevant in press articles directly from the researchers conducting research in this field. Only empirical studies reporting original research results were included.

Caution was exercised to retain the independence of the estimates (Hedges & Becker, 1986). Within the analysis of self-estimates of specific cognitive abilities, only one effect size was calculated for a given sample. If multiple estimates of a given construct were provided (e.g. estimates of different aspects of verbal ability like verbal comprehension and verbal fluency) they were averaged. The same was done if the original sample was split and separate estimates were given for resulting sub-samples (e.g. participants with high and low education). For general intelligence, if the study reported two scores – estimated by the participants and derived from averaging their self-estimates of multiple intelligences – only the first score, the actual self-estimate, was included. If authors reported the results before and after the removal of outliers, only the latter score was taken, unless it was stated that the removal of outliers did not change the results' pattern. At the same time, independent effect sizes from one article (e.g. for different ethnic or age groups) were included. In addition, the majority of studies are included in the analysis of self-estimates of more than one cognitive ability.

Altogether, 73 relevant articles including 93 studies were identified. Whenever it was impossible to get hold of the article or it did not report the data necessary for computation of the effect size, the authors were contacted – either in person or via email – and the relevant information was requested. Two articles and data for 3 studies were obtained in this way. The articles which were inaccessible or for which it was not possible to obtain necessary data were excluded from the analysis. The resulting 53 articles (74 studies) yielded 205 independent effect sizes – 37 for overall IQ, 55 for mathematical, 56 for spatial and 57 for verbal intelligence – that entered the meta-analysis.

1.2. Coding the studies

For all studies the following information was coded: (a) number of male and female subjects; (b) all statistics on sex differences in self-estimates of intelligence, including means, standard deviations, F, t and chi square tests with df and p value; (c) the nationality/ethnicity

[1] Despite the semantic overlap between these concepts, differential and educational psychologists have highlighted differences among these constructs (see Marsh, 2007; Peterson & Whiteman, 2007). In the present study we focus on self-estimates of ability or self-assessed intelligence (Chamorro-Premuzic & Furnham, 2005), though similar sex differences have been reported for other ability self-concept constructs.

[2] It should however be noted that these are only general estimates of the effect sizes which were found to be highly heterogeneous indicating that the “intelligences” in question consisted of a number of more specific sub-types of relevant abilities.