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Exploring attitudes towards gender and science: The advantages of an IRAP approach versus the IAT ☆

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ABSTRACT

Previous research indicates that educational courses and occupations tend to become associated with one gender more than another. This can be seen within the fields of science, technology, engineering and math (STEM) in particular, with men often more strongly associated with these areas than women. Even when individuals claim to hold gender-neutral beliefs about STEM, research has found they may still hold implicit beliefs that are gender-biased. Two implicit measures, the Implicit Relational Assessment Procedure (IRAP) and the Implicit Association Test (IAT), were compared to assess attitudes towards women and science-based versus liberal arts college subjects. The results of the IAT suggested a tendency to associate 'men' rather than 'women' with 'science' for both male and female participants. The IRAP produced a more complex pattern of results, with females showing a tendency to pair men with science *and* with liberal arts, whereas the males showed a more neutral effect. The findings have implications for those concerned with addressing the gender imbalance in STEM careers.

1. Introduction

Gender as a social structure is both embedded within, and shares connections between individual beliefs, social interactions and culture (Risman, 2004; see Riegle-Crumb, King, Grodsky, & Muller, 2012). While not all women share the same beliefs, traits etc., just as not all men do, certain assumptions are made about the traits or dispositions of males and females. For example, research has found that there can be an expectation that females should be communal (e.g. nurturing, passive) and males should be agentic (e.g. autonomous, dominant; Eagly & Karau, 2002). Such gendered beliefs and stereotypes can have a pervasive influence on the lives of males and females (Lane, Goh, & Driver-Linn, 2012), influencing both behaviour and attitudes. Greenwald and Banaji (1995) described attitudes as "favourable or unfavourable dispositions towards social objects, such as people, places and policies" (p. 7). Stereotypes about what is deemed to be gender appropriate or inappropriate behaviour can affect individuals' attitudes towards a number of life choices and may become embedded at an early age. For example, an interaction between parents' gender stereotypes and their child's sex can influence the parents' beliefs about their child's mathematic ability. In one study parents with traditional gender stereotypes had a stronger belief in their son's math ability and were less confident in their daughter's math ability regardless of the children's actual ability (Jacobs, 1991). In turn, this also influenced the child's self-perception of their mathematic ability (Jacobs, 1991), demonstrating how a person's beliefs may impact other individuals as well as the person themselves.

In Western culture women described as being intelligent are perceived to be less likeable (Szymanowicz & Furnham, 2011). Some women may publicly under-estimate their intelligence, and choose careers of less prestige with lower pay (Konrad, 2003) in an attempt to reduce the risk of social rejection and maintain their femininity (Szymanowicz & Furnham, 2011). The endorsement of such stereotypes may also impact upon women who do not choose to work within stereotypically female domains or conform to a traditional notion of femininity. Perceptions that women are more likely to have communal qualities (Eagly & Karau, 2002) may be problematic for women in leadership roles where success is more associated with the possession of agentic qualities. Based on this it is perhaps unsurprising then that women in positions of authority tend to be attributed typical masculine traits rather than those perceived as more feminine, such as warmth and nurturing (Rudman & Kilianski, 2000).

The tendency to associate such traditional masculine and feminine traits with specific careers can result in the belief that certain genders are better suited to certain occupations (White & White, 2006). The imbalance between the numbers of females versus males in a particular occupation can reinforce these beliefs;

☆This research was conducted by the first author as part of her undergraduate degree.

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in contrast, stereotypes can become gender neutral for occupations where there are equal numbers of females and males (White & White, 2006). The disparity in gender within a field is particularly seen within science, technology, engineering and math (STEM) fields, where females continue to be underrepresented (National Science Foundation, 2008). A contributing factor in this under-representation is thought to be the presence of gender stereotypes (e.g. Schiebinger, 2010; ScienceGrrl, 2014; Zecharia, 2014). The possession of stereotypically masculine traits has become associated with achievement in STEM (Margolis, Fisher, & Miller, 2000; see Gatta & Trigg, 2001), endorsing a masculine image for these areas (e.g. Faulkner, 2006; ScienceGrrl, 2014). There is, for example, the 'boy wonder icon' and the stereotypical image of the male computer hacker (Margolis et al., 2000; see Gatta & Trigg, 2001). Media coverage in the 1980s and 1990s of studies purportedly demonstrating that males were biologically better at mathematics than females allowed such findings to infiltrate popular culture despite the studies being flawed (Gatta & Trigg, 2001). As noted by Gatta and Trigg (2001) although scientific research institutions subsequently stated that there was not sufficient evidence to claim the existence of biological differences in math ability, this was not as widely reported by popular media. Such 'evidence' may promote a view that men are perhaps naturally better at STEM subjects.

The under-representation of women in STEM, in combination with these gender and STEM stereotypes, has been shown in countries across Europe including Ireland and the UK (Accenture, 2014; ScienceGrrl, 2014; She Figures, 2009; WISE, 2012), and across America (see Gatta & Trigg, 2001; Morgan, Gelbgiser, & Weeden, 2013). While this research is situated within a Western-style culture, this under-representation is a global issue and also found in non-Western areas (see Schiebinger, 2010; Sinnes, 2004). Such an under-representation can lead to a reduced sense of belonging among females already working in these areas (see Lane et al., 2012; Murphy, Steele, & Gross, 2007). It is therefore of vital importance to fully understand the factors that contribute to this under-representation including the suggested influence of gender stereotypes.

Women leave STEM jobs at twice the rate of men, and few women reach senior positions (Belkin, 2008) or positions of decision-making power (Schiebinger, 2010). The resulting lack of female role models in the sciences may, in part, explain the finding that school-aged girls have less positive attitudes towards science even when achieving better grades than their male peers (Catsambis, 1995). Together with reduced levels of interest in computer science (Cheryan, Plaut, Davies, & Steele, 2009) and science and math (Murphy et al., 2007), such attitudes may ultimately affect future career choices. Of course the under-representation of females in science could be explained by their preference for non-science areas (Ceci & Williams, 2010) and the need to balance career with family-life (Sonnert & Holton, 1995). This has led to some researchers suggesting that while there is gender disparity in academic science, there is not gender discrimination (Berezow, 2011). Yet this suggestion does not fully address the difficulties associated with attracting and retaining women in STEM careers.

A recent study found that both male and female science faculty members rated a male applicant as more hirable and competent for a laboratory manager position than an identical female applicant (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012). Letters of recommendation written for students within chemistry and biochemistry were more likely to attribute natural ability as the explanation for male students' achievements and used more 'stand-out adjectives' for males than for females (Schmader, Whitehead, & Wysocki, 2007). Yet another study found that even with identical CVs male applicants were more likely to be hired than female applicants by both men and women academics (Steinpreis, Anders & Ritzke, 1999). It seems that while individuals may explicitly claim not to hold gendered science stereotypes they may still hold implicit beliefs that potentially result in attitudes and behaviours that adversely affect females. Such implicit beliefs are particularly difficult to shift as they are "learned early and reinforced often" (Lane et al., 2012, p. 231).

As discussed above there is evidence to suggest that gender stereotypes exist within STEM. The influence that these stereotypes have on the attitudes individuals hold regarding men and women's suitability and/or capability in these academic areas may be a contributing factor in the under-representation of women in STEM fields. However, attitudes have traditionally been assessed by self-report measures, such as questionnaires, which are associated with some difficulties. First, self-reports are often influenced by social desirability concerns, and open to faking, distortion and self-presentation bias (Egloff & Schmukle, 2003). Second, some cognitive and affective processes are thought to operate outside of conscious awareness, and/or influence behaviour in an automatic manner (De Houwer, 2002). Self-reports therefore may not be the optimum measure of the strength of socially sensitive attitudes. Thus explicit measures may not provide the best basis upon which to assess the influence of gender-science stereotypes on attitudes towards individuals, particularly women, in STEM-related fields of study or employment.

1.1. *Measuring implicit attitudes*

A number of alternative, implicit measures have since been developed that are thought to 'tap into' automatic attitudes and beliefs, providing advantages over traditional self-report measures. One of the most popular is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The IAT is a reaction-time based computer task during which respondents are asked to sort words or pictures into categories. The basic premise is that respondents will respond quicker when the concepts to be sorted are similar or associated in memory than when the concepts are unrelated or dissimilar. In relation to gender and science, research typically finds that response latencies are faster when 'male' and science subjects (e.g., physics) and 'female' and arts subjects (e.g., history) must be categorised together than when 'male' and arts and 'female' and science are paired together. This finding is very robust, with approximately 70% of more than half a million online IATs showing this pattern of responses (Nosek et al., 2009). White and White (2006) found largely congruent results between implicit and explicit measures for some gender stereotyped occupations, for example engineer was viewed as masculine and school teacher, feminine. However, unlike the explicit measure, the IAT produced a male bias for a less obviously stereotyped occupation (accounting), emphasising that implicit measures can provide additional information regarding bias that is not always captured by explicit, self-report measures.

Despite the popularity of the IAT in social psychology research, the IAT is not without its limitations. Specifically, the associations found for any concept are always relative (De Houwer, 2002). For example an IAT effect for science over arts could indicate a neutral attitude towards science and a negative attitude towards arts, or a positive attitude towards science and a neutral attitude towards arts. Hence the standard IAT does not provide a measure of the precise nature or directionality of the studied associations (Barnes-Holmes, Waldron, Barnes-Holmes, & Stewart, 2009; see De Houwer, 2003). In a meta-analysis by Oswald, Mitchell, Blanton, and Jaccard (2013) the IAT's predictive validity based on examining correlations with criterion measures was found to be poorer than had previously been reported by Greenwald, Poehlman, Uhlmann, and Banaji (2009). This has raised concern about the IAT and its dual-category format as a measure of prejudice (see Oswald et al., 2013). On a related note, Blanton and Jaccard (2006) argue that there is no empirical support for assuming that a score of zero on the IAT reflects an absolute neutral point (i.e. no preference for one