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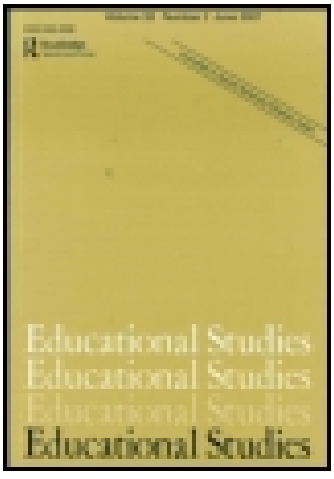

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REPORT

"I'm not scientifically gifted, I'm a girl": implicit measures of gender-science stereotypes – preliminary evidence

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Students often have a negative view on science, particularly women. Furthermore, academic level in math and science is usually considered as an innate ability. The aims of the study were to create an Implicit Association Test (IAT) in order to highlight the stereotype that science is innate, to identify if the gender of the participants impacts the results of this implicit measure and to compare self-report and implicit measures. Results showed that (1) science and innate are more easily associated in the IAT than liberal arts and innate, (2) women have a higher association of science and innate than men in the IAT (that is not the case in self-report measures).

Keywords: Implicit Association Test; science; gender; implicit theories; stereotype

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The stereotype that academic level in math and science is an innate and stable ability is relatively widespread (Rattan, Good, and Dweck 2012). Math–science ability is often viewed as a talent, something that one is either born with or not, which leads some students to say: *I'm not a math or a science person*. That is in line with implicit theories of intelligence (Dweck and Molden 2005), which describe what individuals think about the nature of science intelligence. It is not reality, but rather personal beliefs. Two conceptions were identified: an entity theory (intelligence is considered as innate, stable, a gift, a talent) and an incremental theory (intelligence is considered as improvable, linked with work and effort). In the school context, literature reviews (e.g. Dweck and Molden 2005) showed that incremental theory was related to adaptive outcomes, whereas entity theory was a negative predictor of student performance. Moreover, another stereotype is common in the educational context: men would have a higher level in math and science than women (Nosek, Banaji, and Greenwald 2002), whereas there is no effective difference in terms of mathematical performance between them. This math–gender stereotype is detrimental for female achievement and motivation in math tasks. A large body of literature already exists concerning the relationships between gender and math/science. However, self-reported measures are not totally suitable to assess implicit social cognition and stereotypes, which are not accessible to conscious introspection (Nosek, Banaji, and Greenwald 2002). In order to be favourably viewed by others, social desirability would inhibit some women from explicitly declaring that they

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considered that math and science are not for women. This could be a potential source of distortion of self-reported measures. Consequently, an original tool – the Implicit Association Test (IAT) – was created to provide a computer-based measure of strengths of automatic associations, in order to evaluate implicit cognitive constructs and stereotypes (Greenwald, Nosek, and Banaji 2003). Math–gender stereotypes were studied with IAT measure (e.g. Nosek, Banaji, and Greenwald 2002; Cvencek et al. 2011). Results showed that there were strong implicit, unconscious and automatic associations between men and science, and between women and liberal arts. But, up to date, no IAT existed to study the stereotype that science is innate. The aims of this study were (1) to establish a first version of this IAT, (2) to identify whether the gender of the participants impacts the results of this implicit measure and (3) to compare the results with both explicit and implicit measures.

Methods

Stimuli and pilot test

Twenty-eight nouns were used as lexical stimuli. The 14 target words from the Nosek, Banaji, and Greenwald (2002) IAT were used in this study: seven *science discipline* words (biology, physics, chemistry, mathematics, geology, astronomy and engineering) and seven *liberal arts discipline* words (philosophy, humanities, arts, literature, English, music and history). The fourteen *innate* and *acquired* attribute words were selected from a pilot study. Fifty undergraduates were solicited to rate seven *innate* attribute words (reflex, genetics, birth, chromosome, organic, genes and maternity) and seven *acquired* attribute words (education, learning, training, work, formation, learnt and development) for the degree to which they were innate-related or acquired-related. The word length (in French language) was controlled by counting the numbers of letters, and there were no significant differences, ($t(12) = -0.78$, $p = 0.45$), between *innate* words ($M = 8.29$, SD = 1.70) and *acquired* words ($M = 9.14$, SD = 2.34). The *innate* words were rated as more innate-related ($M = 1.89$, SD = 1.07) than were the *acquired* words, and the *acquired* words were rated as more acquired-related ($M = 4.37$, SD = 1.01) than *innate* words.

Design and procedure

Data were collected in France, from 75 undergraduates (37 women, 38 men, mean age = 22.31), who had not followed specific studies in science or liberal arts. Innate-science IAT was performed on a personal computer with a 15-in. monitor using Inquisit 3 software. Participants placed one finger on the *E* key (the left key) of the keyboard and another finger on the *I* key (the right key). IAT consisted of seven stages of word categorisation trials. In the first training block, they were instructed to respond by pressing a key (e.g. their left key) each time an item that represented the category *innate* (e.g. *chromosome, genetics*) appeared in the centre of the screen, or the other key (e.g. their right key) each time an item that represented the category *acquired* (e.g. *learning, development*) appeared. After that, participants practiced sorting in the same way with *science* words (e.g. *mathematics, physics*) and *liberal arts words* (*philosophy, literature*). Two of the four categories were paired onto the same response key. We study the difference in response latency between the average speed to respond to *science-innate* items and *liberal arts-acquired* items when they

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were paired together, and the average speed to respond to *science-acquired* items and *liberal arts-innate* items when they were paired together. The difference was taken as an implicit assessment of preference.

Measures

The innate-science IAT presented earlier was used. An IAT score, *D,* was calculated using the algorithm of Greenwald, Nosek, and Banaji (2003). In order to highlight implicit theories of science ability with self-reported measure, Cury et al.'s (2006) scale was used. Internal consistencies were high for entity ($\alpha = 0.89$) and incremental ($\alpha = 0.90$) theories.

Results

According to Greenwald, Nosek, and Banaji (2003), the IAT score revealed a medium to strong sized automatic association between *science* and *innate* ($D = 0.41$). A one-way ANOVA conducted on IAT score revealed a significant effect of gender ($F(1, 73) = 6.60$, $p < 0.02$). Newman–Keuls test shows that women ($D = 0.55$, SD = 0.37) have a higher association between *science* and *innate* than men ($D = 0.33$, SD = 0.38, $p < 0.02$). The IAT score revealed a medium to strong association between *science* and *innate* for women, and a slight to medium association for men. Furthermore, IAT score is positively correlated with explicit entity theory ($r = 0.43$, $p < 0.001$) and negatively related with explicit incremental theory ($r = -0.32$, $p < 0.01$). Finally, two one-way ANOVAs conducted on explicit measures revealed no significant effect of gender on explicit entity theory ($F(1, 73) = 0.40$, $p = 0.53$) and explicit incremental theory ($F(1, 73) = 0.11$, $p = 0.74$).

Discussion

Firstly, this preliminary study showed for all participants that *science* and *innate* are more easily and automatically associated in the IAT than *liberal arts* and *innate*. This association is consistent with explicit literature, in which science is more linked with the entity theory of intelligence than liberal arts (Rattan, Good, and Dweck 2012). Math skills are often considered as innate abilities. The second finding of our study highlighted that gender impacts the results of the IAT measure. Women have a stronger implicit association between *science* and *innate* than men. The present study evidenced that IAT showed differences between men and women, whereas self-reported measures of implicit theories of science intelligence did not. Even although questionnaires were anonymous, some women did not dare to confess that they think that science ability is innate, for fear of being negatively judged by others or corresponding to the stereotype that science is only for men. Using an IAT, this phenomenon related to social desirability may be overcome. If only self-reported measures were used to highlight this stereotype, the risk of leaving out some women affected by this stereotype is high. IAT seems to be a complementary tool, because stereotype can be divided in two joint processes, one explicit, conscious and controlled, and the other implicit, unconscious and automatic (Cvencek et al. 2011). These preliminary results need to be extended by further studies, based on a larger sample, on a test–retest procedure and on the use of other self-reported measures,

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such as perceived competence in math/science. IAT offers a different and promising perspective for the measure of women's science stereotypes in educational contexts.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Nicolas Mascret is a university lecturer at Aix Marseille Université in France. His research interests include implicit theories, achievement goals and stress.

François Cury is a university professor at Aix Marseille Université in France. His research interests are in the area of psychology and social psychology, especially achievement motivation and implicit theories.

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