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Empathizing, systemizing, and career choice in Brazil: Sex differences and individual variation among areas of study

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ABSTRACT

Individual variation in sexually dimorphic cognitive capacities for understanding people (empathizing) and things (systemizing) is related to career choice: individuals in careers dominated by women tend to exhibit higher empathy than individuals in male-dominated careers, who tend to score higher in systemizing. We tested this pattern in a Brazilian population. In Study I, using University public data (1980–2015), we found that exact sciences attracted significantly more males, whereas humanities and bio-sciences attracted more females throughout the 35-year period. Further, during the time period studied, there was a consistent growth of interest in both men and women in studying both exact sciences and humanities. In Study II, using the GLM analysis of an undergraduate sample of 248 men and 325 women, we replicated the sex differences in empathizing and systemizing, and found that, regardless of sex, individuals in humanities and bio-sciences score higher on empathizing and lower on systemizing than those in exact sciences. These results corroborate the sexually dimorphic pattern in career choice and in empathizing-systemizing, and show the importance of cognitive style as one of the factors related to university majors.

1. Introduction

At least once in a lifetime most people make a study/career choice and this decision has the potential to influence one's life outcomes. Many factors are found to influence career choice, such as competitiveness (Buser, Niederle, & Oosterbeek, 2014), acculturation, family background, the level of confidence and interest in the given field (Tang, Fouad, & Smith, 1999), and sex (Halpern et al., 2007).

In spite of intrasexual individual variation, men and women have, on average, different occupational interests (Halpern et al., 2007). A recent meta-analysis (Su, Rounds, & Armstrong, 2009) including more than 503 thousand individuals showed that on the things–people dimension, men on average indicated higher preferences for working with things than women, whereas women on average preferred more working with people. The effect size of this difference was large (Cohen's $d = 0.93$). This study also found that on the hexagonal RIASEC model (Holland, 1997), men showed stronger interests for Realistic (working with things and gadgets or working outdoors; $d = 0.84$) and Investigative (interest in science, including mathematics, physical and social sciences, and biological and medical sciences; $d = 0.26$) types of careers, whereas women showed stronger interests in the dimensions of Artistic (interest in creative expression, including writing and the visual and performing arts; $d = 0.35$), Social (interest in helping people, $d = 0.68$), and Conventional (interest in working in well-structured environments, especially business settings; $d = 0.33$). Similar sex differences were found in a world-wide BBC study sampling more than 255 thousand participants online (Manning, Reimers, Baron-Cohen, Wheelwright, & Fink, 2010).

One of the factors that has been found to influence both the sex difference and the intrasexual individual variation in study/career preference/choice is the cognitive style related to empathizing and systemizing abilities (e.g. Billington, Baron-Cohen, & Wheelwright, 2007; Wright, Eaton, & Skagerberg, 2015). Every individual possesses some degree of cognitive capacities for understanding both people/feelings and things/systems. Empathizing is defined as an ability that enables people to understand and better deal with a person's emotions and thoughts (Baron-Cohen, 2002; Baron-Cohen, Knickmeyer, & Belmonte, 2005; Baron-Cohen & Wheelwright, 2004), and it allows for comprehension and prediction of the social world (Baron-Cohen, Richler, Bisarya, Gurunathan & Wheelwright, 2003). Systemizing permits individuals to comprehend or construct systems (Baron-Cohen, 2002;

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Baron-Cohen et al., 2005), and it enables understanding and foreseeing the inanimate world (Baron-Cohen et al., 2003).

Empathizing and systemizing differ, on average, between men and women: women tend to score higher on empathizing than men (d = .55; Wright et al., 2015), and men tend to score higher on systemizing than women (d = .50; Baron-Cohen, 2002; Wakabayashi et al., 2007; Wright et al., 2015). Therefore, individuals with more empathic cognitive style are supposed to prefer career areas that have proportionally more women, and generally require understanding of other people. On the other hand, individuals higher on systemizing are supposed to prefer careers that have high proportion of men, and require comprehension of inanimate systems.

Billington et al. (2007) replicated sex differences in areas of study, showing that 70.1% of the humanities students in the UK were women and 59.1% of the science students were men. They also replicated the sex differences in empathizing and systemizing, with women scoring, on average, higher on the first, and men on the latter. Moreover, this study reported that, regardless of sex, individuals higher on systemizing were more likely to enter physical sciences, and individuals higher on empathizing had higher probability of choosing to study humanities. In the same line, two studies carried out in the UK (Wheelwright et al., 2006) and Belgium (Focquaert, Steven, Wolford, Colden, & Gazzaniga, 2007) also found that individuals in the humanities possessed a cognitive style that is more empathizing-driven than systemizing-driven, while individuals in sciences possessed rather the systemizing-driven cognitive style. Finally, Manning et al. (2010) reported that in a cross-cultural sample of mostly white North American and Western European populations both men and women who scored higher on systematizing compared to empathizing tended to work in occupations with lower proportion of females.

However, there is still lack of evidence as to whether empathizing-systemizing and study/career choice are related with each other in other than North American and Western European populations. A few studies on a Portuguese speaking population (Brazil and Portugal) reported sex differences in empathy and/or systemizing similar to the previous research (e.g., Milfont, Coelho, Pessoa, & Gouveia, 2012; Rodrigues, Gonçalves, Lopes, & Santos, 2010). We might thus expect that there would be a similar link between empathizing-systemizing and career or study choice in this population. Interestingly, for socio-historical reasons, the areas of studies in Brazil are divided differently than in the previously studied countries. In particular, humanities and social sciences are treated together as humanities, whereas sciences are divided into bio-sciences and exact sciences. Little is known about how bio-sciences fit into the systemizing-empathy cognitive model. Brazil thus offers a unique opportunity to investigate this question.

1.1. Aims

The main aim of this study was to test whether individual variation in empathizing and systemizing cognitive styles would be related to choice of study area, that have, on average, different frequency of male and female students. Here we focused not only on humanities and hard sciences, but also on biology. To do this, we firstly tested frequency of men and women applying for undergraduate study areas divided into three main areas — humanities, biological and exact sciences — on two Brazilian samples. To obtain representative data, we analyzed a large public dataset containing information about the number of male and female applicants for the three study areas between 1980 until 2015. On a smaller sample of men and women, we further replicated this aim using a questionnaire method, and tested further for sex differences in empathy and systemizing. Finally, we tested whether students from humanities, biological and exact sciences differ in their self-reported empathy and systemizing, irrespective of their sex.

2. Study I

2.1. Methods

To test for differences in frequency of men and women applying for undergraduate study areas, we gathered public data available online from the website of the University Foundation for University Entrance (*Fundação Universitária para o Vestibular*, FUVEST). FUVEST is a Brazilian autonomous institution connected to the University of Sao Paulo (USP), that runs the entrance examinations to USP, and in the eighties also the entrance examinations for University of Campinas (UNICAMP) and Sao Paulo State University (UNESP), two other public Sao Paulo State universities. The foundation possesses statistics about the number of men and women who applied for each undergraduate course and each grand study area from 1980 until 2015, except between 1986–87 and 1991–94 when the sex of the students was not recorded. By this method, we obtained data from 30 years, for a total of 4,046,205 undergraduate applicants (Table 1, Fig. 1).

FUVEST divides the undergraduate programs into humanities (such as history, arts, music, law, economy, journalism, pedagogy, languages, tourism, philosophy, geography, etc.), bio-sciences (such as sports, psychology, pharmacy, veterinary, medicine, odontology, biology, phonoaudiology, nursing, nutrition, etc.), and exact sciences (such as civil, electric, mechanic engineering, statistics, computation, geology, mathematics, physics, chemistry, etc.). Thus, the applicants were divided into these 3 main study areas (Table 1, Fig. 1).

The demographic data of students applying for undergraduate courses offer a powerful measure of motivation and capability to follow an area of career, given that it is data about real-life choices. FUVEST's exam is considered the most competitive entrance examination in the country, and one of the most demanding, usually lasting several days. In Brazil, the best and most important universities, such as the universities included in this study, are public, either federal or state, the offered education is of high quality, and no tuition is charged. This explains why these universities are the most desired places to study and hence, it is very difficult to be admitted.

2.2. Analyzes and results

Spearman's non-parametric correlations showed a positive correlation between year and number of female applicants in humanities (ρ = .698, N = 30, $p < .001$) and exact sciences (ρ = .709, N = 30, $p < .001$), while there was no correlation in bio-sciences (ρ = .313, N = 30, p = .092). Similarly, in men year positively correlated with number of applicants in humanities (ρ = .442, N = 30, p = .014) and exact sciences (ρ = .411, N = 30, p = .024), but negatively in bio-sciences (ρ = −.433, N = 30, p = .017). Thus, year entered into the subsequent analyses as a covariate. To further explore these results, we computed percentages of male and female applicants for each year, and ran non-parametric correlations between the year and sex proportion. The correlations were significant and positive for percentage of female applicants (and thus negative for percentage of male applicants) in all three areas, namely Humanities (ρ = .436, N = 30, p = .016), Bio-sciences (ρ = .723, N = 30, $p < .001$) and Exact sciences (ρ = .826, N = 30, $p < .001$).

To analyze the possible differences between men and women applying for different study areas, we performed a multivariate General Linear Model (GLM) with number of male and female applicants for each study area as dependent variables, sex as a factor (coded as 1 = males, 2 = females), and year as a covariate. The test of Between-Subject Effects revealed strong effect of sex in all three areas, namely humanities ($F = 32.065$, df = 1, 59, $p < .001$, $\eta_p^2 = .360$), bio-sciences ($F = 256.705$, df = 1, 59, $p < .001$, $\eta_p^2 = .818$), and exact sciences ($F = 217.776$, df = 1, 59, $p < .001$, $\eta_p^2 = .793$). Exact sciences attracted significantly more males, whereas humanities and bio-sciences attracted more females throughout the 35 years period.