



# Male brain type women and female brain type men: Gender atypical cognitive profiles and their correlates



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## ABSTRACT

Gender differences exist in abilities, interests, and occupations. According to the Empathizing-Systemizing theory, the reason for all gender differences lies in the relative weights of two cognitive processes: women empathize more, which is useful in understanding people, while men systemize more, which means interpreting phenomena as rule-based systems. The terms “male and female brain type” refer to a heightened preference for one process over the other. We aimed to find out whether the gender atypical groups of male brain type women and female brain type men are more similar to the opposite sex than to their own in terms of a range of social, cognitive and personality variables. Female and male brain type groups were identified and compared within both genders in an online study ( $N = 2983$ ). The results show there are female brain type men and male brain type women, who are characterized by qualities more often associated with the opposite sex, and who have not been reached by prior research. Thus, these findings demonstrate that cognitive type is a more powerful predictor of certain characteristics than is biological sex.

## 1. Male brain type women and female brain type men: gender atypical cognitive profiles and their correlates

It is often proposed that men and women think differently or have different ways of perceiving and making sense of things. For example, femininity is commonly associated with emotions and masculinity with logic. Femininity and masculinity are perceived to entail different skills, interests, and vocations (see e.g., Baron-Cohen, 2002, 2003; Nettle, 2007). The influence of socially prescribed, gender-based norms and expectations is a widely researched topic, but the kinds of cognition that could play a role in producing observable gender differences are not well understood.

Gaining more information concerning gender-dependent cognition can develop our view of how gender-related social phenomena are created. For example, a gender-based division still exists among occupational fields. In the USA, women's representation is still the highest in people-focused fields (e.g. helping professions such as clinical psychology, and clerical work) and the lowest in science, technology, engineering, and mathematics (STEM) fields (National Science Foundation, 2017).

Different explanations have been offered for this traditional division between men's and women's occupations. For example, lack of early experience with topics such as engineering and physics, and gender gaps in self-efficacy have been offered as explanations of why women

are underrepresented in STEM fields (Cheryan, Ziegler, Montoya, & Jiang, 2017). However, there are likely to still be unidentified structures underlying the gender segregation in working life. New approaches that go beyond the superficial level of biological sex and address cognitive structures have been called for (Lai et al., 2012). This is crucial for both scientific and practical reasons: knowledge guides the efforts and social policies designed to increase equality. The study at hand aims at increasing our understanding of gendered phenomena by investigating *empathizing* and *systemizing* (Baron-Cohen, 2002, 2003). Previous work has investigated whether these are among the cognitive mechanisms mediating sex differences in career choices (Wright, Eaton, & Skagerberg, 2015) but the present study is the first to focus on the psychological profiles of people who differ from the cognitive profile typically associated with their gender.

### 1.1. Systemizing and empathizing as the essential difference

Baron-Cohen (2003) has proposed the “Empathizing-Systemizing” theory as an explanation for psychological sex differences. According to this theory, empathizing and systemizing are not merely psychological dimensions that correlate with other attributes, but rather they are the fundamentally significant cognitive dimensions that create gender differences and comprise the essential difference between men and women.

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Empathizing is defined as the “drive to identify another person's emotions and thoughts, and to respond to these with an appropriate emotion” (Baron-Cohen, 2002, p. 248). This allows a person to predict human behavior and care about others' feelings. On average, women empathize more than do men (Baron-Cohen, 2002).

The concept of systemizing is derived from the concept of folk physics. Systemizing has been defined as “the drive to analyse the variables in a system, to derive the underlying rules that govern the behavior of a system” (Baron-Cohen, 2002, p. 248), where a system is anything that takes inputs and delivers outputs, for example mathematics or libraries (Baron-Cohen, 2002; Wakabayashi et al., 2007). On average, men spontaneously use systemizing more than do women (Baron-Cohen, 2002).

Both systemizing and empathizing allow us to make sense of events and form reliable predictions, but they are useful in different contexts (Baron-Cohen, 2002). Systemizing allows one to understand the physical world. Empathizing, in turn, is the most powerful way of understanding and predicting the social world and human behavior. Because of this, differences in systemizing and empathizing may lead to different abilities, which vary in usefulness among different occupational fields.

### 1.2. The male and female brain types

The concept of brain type (Baron-Cohen, 2002) refers to the relative weight of the two key dimensions in an individual's characteristic way of making sense of things: We all have both systemizing and empathizing skills and interests, but for some individuals, one dimension is more developed than the other. The relative development of empathizing and systemizing leads to categories, such as the female brain type, where empathizing is more developed than systemizing, and the male brain type, where systemizing is more developed than empathizing.

Importantly, Baron-Cohen (2002) does not suggest a categorical difference between men and women. On the contrary, his central claim involves average differences: because more men than women have the systemizing brain type, and more women than men have the empathizing brain type, this creates gender differences in population averages. In the present study, we are going to focus for the first time on the individuals who are not representative of the average, but who show a cognitive profile atypical of their gender: women with a systemizing, “male” brain type, and men with an empathizing, “female” brain type. This will provide a crucial test of whether cognitive types indeed explain—better than biological sex—why individuals have the characteristics that they do.

### 1.3. Known gender differences

Men on average have been found to have a preference for working with things, while women prefer working with people (Su, Rounds, & Armstrong, 2009), and a systemizing profile is associated with studying physical sciences, while an empathizing profile is more common among humanities students (Billington, Baron-Cohen, & Wheelwright, 2007). Thus we hypothesize that even among women, the male brain type is associated with working in systemizing-focused fields, and that even among men, the female brain type is associated with working in empathizing-focused fields. In addition, we hypothesize that compared to female brain type women, male brain type women have received higher grades in mathematics and physics, and that compared to male brain type men, female brain type men have received lower grades in mathematics and physics.

Women, on average, have stronger aesthetic, artistic and social interests while men have more practical and investigative interests, and stronger interests in technology (Su et al., 2009). Here we hypothesize that individuals exhibiting the gender atypical brain types will have hobbies that are more in line with those of the opposite sex than with those of the individuals exhibiting the typical brain types.

On average, women focus more on the quality of social relationships and report higher connectedness and empathy within relationships than do men (Baron-Cohen & Wheelwright, 2004). As empathizing has been associated with more social support and with the maintenance of larger numbers of social relationships (Nettle, 2007), we hypothesize that in both genders, the female brain type will be associated with increased social connectedness when compared to the male brain type.

Finally, one possible factor contributing to observed sex differences is sex role identity. Sex role identity has been classically defined as an acquired self-concept of an individual's degree of masculinity or femininity (Kagan, 1964), and it has been found to influence the development of same-sex-typed attributes (Reilly & Neumann, 2013). Therefore, we hypothesize that the male brain type groups score higher in masculinity and lower in femininity than female brain type groups, and vice versa, within both genders.

In sum, the topic of this study is whether women exhibiting a cognitive profile typical of men have qualities typically associated with men; and similarly, whether men exhibiting a cognitive profile typical of women have qualities that are more often associated with women.

## 2. Method

### 2.1. Participants and procedure

The participants were 2983 Finnish volunteers (65% female, mean age 28 years,  $SD = 8.87$ , range 15–69) who were recruited from internet discussion forums, student mailing lists, and a research volunteer pool. Of the participants, 27% were working, 64% were students, and 9% were otherwise occupied.

The recruitment messages included a hyperlink to the online questionnaire. Participants were informed that the study concerned thinking and personality. Of the 3086 people who originally participated in the study, 105 were excluded: Two because their comments revealed that they had not completed the survey seriously, and 103 because of missing information.

### 2.2. Measures

#### 2.2.1. Empathizing and systemizing

We used the 15-item version of the Empathy Quotient (EQ) scale (Muncer & Ling, 2006). The EQ-Short ( $\alpha = 0.81$ ) measures cognitive empathy, social skills, and emotional reactivity. Systemizing was assessed using the 18-item version of the Systemizing Quotient (SQ) scale (Ling, Burton, Salt, & Muncer, 2009). The SQ-Short ( $\alpha = 0.85$ ) focuses on technicity, topography, DIY and structure. On both the EQ and the SQ, the original scoring method was used, whereby the 4-point response scale (1 = *strongly disagree*, 4 = *strongly agree*) was converted into scores of 0, 0, 1, and 2. The sums of these scores were then calculated. In cases with < 25% of the answers missing, missing values were substituted with the participant's average score. The distributions of these variables among each sex are presented in Figs. 1 and 2.

To operationalize the male brain type and the female brain type, SQ and EQ scores ( $r = -0.14$ ,  $p < 0.001$ ) were converted onto the same scale. Following Wakabayashi et al. (2006), brain type scores were then calculated by subtracting EQ scores from SQ scores. The distributions of the brain type variable are presented in Fig. 3.

Following Baron-Cohen (2002), this brain type measure was used to identify four groups of participants for closer analysis: 994 female brain type women, 132 female brain type men (brain type  $\leq 1$  SD below the mean), and 152 male brain type men (brain type  $\geq 1$  SD above the mean). In the case of male brain type women, the group of women scoring  $\geq 1$  SD above mean proved too small (47 people), wherefore the 90th percentile point, located 0.80 SD above the mean, was substituted as the cut-off point, resulting in 201 male brain type women to analyze.

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