

Calculating Empathy-Systemizing (E-S) ‘Brain Types’ from the EQ-10 and SQ-R-10

David M. Greenberg¹, Varun Warriar¹, Carrie Allison¹, & Simon-Baron-Cohen¹

¹Autism Research Centre, Department of Psychiatry University of Cambridge

Empathy and systemizing are two important dimensions of the mind. Empathy is the ability to recognize what another person is thinking or feeling, and to respond to their state of mind with an appropriate emotion. Systemizing is the drive to analyse or build rule-based systems. These two dimensions are not unrelated and together can help explain key individual differences in cognition, personality, emotion and behavior.

The Empathizing-Systemizing (E-S) theory of typical sex differences predicts that women, on average, will score higher than men on tests of empathy, whilst men, on average, will score higher on tests of systemizing. This theory has been confirmed in more than half a million people.

The Extreme Male Brain (EMB) theory of autism predicts that autistic people, on average, will show a masculinised shift on these two dimensions: namely, that they will score lower than the typical population on tests of empathy and will score the same if not higher than the typical population on tests of systemizing. This theory has been confirmed in over 30,000 autistic people.

Empathy and systemizing have not only been shown to be important in understanding typical sex differences and autism, but have also been used to explain differences in occupation, learning, cognition, and even musical behavior.

When our team conducts research into psychological differences, we use both empathy and systemizing measures together so that we can calculate a person’s ‘brain type’ (also called cognitive ‘brain type’, cognitive profile, or cognitive style). By combining scores, we can classify each person into one of five brain types. This explains more about the individual than if we were to simply use their empathy or systemizing scores alone. The five brain types are:

Extreme Type E ($E \gg S$)
 Type E ($E > S$)
 Type B (balanced, $E = S$)
 Type S ($S > E$)
 Extreme Type S ($S \gg E$)

Evidence from genetics, neuroscience, and psychology, has shown that there is a biological and a social basis to E-S brain types. For example, differences between Types E and S have been found in both brain structure and function, and E and S scores are associated with both common genetic polymorphisms, and prenatal sex steroid hormones, such as testosterone. In addition, social

experience has long been shown to influence individual differences in empathy. It is likely there is an important learning component to systemizing too, although this has been less well studied.

The full versions of the EQ and SQ-R are 60 and 75-items respectively. However, with 10-item versions of each measure developed and validated, researchers will find it easy to measure and calculate brain types. We encourage researchers to use both the EQ-10 and the SQ-R-10 in tandem in their research, and to calculate brain types.

Brain type classifications are based on an individual's D-score, which is the standardized difference of their empathizing and systemizing scores. This procedure was first published in 2005 and 2006 based on full versions of the EQ and SQ-R. Below is a step-by-step procedure on how to calculate brain types based on the EQ-10 and SQ-R-10.

Step 1: Calculate raw scores for the EQ-10 and SQ-R-10 separately using the instructions found here: https://www.autismresearchcentre.com/arc_tests.

Step 2: Standardize the EQ-10 and SQ-R-10 raw scores across the whole sample using the means from your sample as represented in the formula below.

$$E = (EQ-10 - \langle EQ-10 \rangle) / 20$$

$$S = (SQ-R-10 - \langle SQ-R-10 \rangle) / 20$$

Please note that if your sample of participants is small, atypical, or from an uncommon geographic region, you may decide to use means for the EQ-10 and SQ-R-10 that have previously been published. If you choose to do so, we recommend that you use the means published in Greenberg et al. (2018) in the *Proceedings of National Academy of Sciences*. Those means are based on data from 671,606 people primarily from the UK aged 16-89.

Step 3: Calculate D-scores for each participant by subtracting the standardized systemizing score (S) from the standardized empathy score (E), represented in the formula below.

$$D = S - E$$

Step 4: Brain types are then assigned to each participant based on their D-score. In the final step, use the chart below to assign brain types.

Brain type	D percentile (per)
Extreme Type E	per < 2.5
Type E	2.5 ≤ per < 35
Type B	35 ≤ per < 65
Type S	65 ≤ per < 97.5
Extreme Type S	per ≥ 97.5

Researchers who have inquiries about using the EQ-10, SQ-R-10, and calculating brain types, should contact any of the authors of this document.

Key reference: Greenberg, DM et al. Testing the Empathizing-Systemizing theory of sex differences and the Extreme Male Brain theory of autism in half a million people. PNAS; 12 Nov 2018; DOI: 10.1073/pnas.1811032115

