

## EMPATHIZING – SYSTEMIZING THEORY IN ROMANIAN UNIVERSITY CONTEXT

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**Abstract:** *222 students of Transilvania University of Braşov, from Humanities and Sciences faculties, with the average age of 23.07 years ( $SD = 3.92$ ), out of which 88 (39.6%) males, 134 (6.4%) females, were investigated with four questionnaires destined to measure autism quotient (AQ), empathizing quotient (EQ), systemizing quotient (SQ) and the score for Reading the Mind in the Eyes Test (RMET). The study objectives were to investigate the relationships between variables, to determine psychometric qualities for some of the four questionnaires that were used in the Romanian university population context, to test the hypothesis of gender and specialisation differences for some variables and to propose a new method to determine the five categories of brain types. The results highlight psychometric qualities that are poorer than the initial ones of some of the used instruments, but they confirm the hypothesis of gender and of specialisation for some of the study variables in accord with data of other studies. The method of determining the five brain types proves to be more operational but congruent and highly correlated with the one that Goldenfeld et al. proposed.*

**Keywords:** *empathizing; systemizing; autism; eyes test; theory of mind;*

### 1. Introduction

The past three decades have underlined an increased interest of researchers for both understanding autism and creating some valid psychometric instruments which should be able to show it up. According to DSM-IV (1994), individuals form Autism Spectrum Conditions (ASC) have severe social difficulties and an obsessive pattern of behaviour, as well as a stronger drive to systemize (Baron-Cohen et al. 1999, Baron-Cohen et al. 2001). Thus in 1985 Baron-Cohen formulated and went on to test the “mind blindness” theory of autism. This is a theory that connects autism to the difficulty that persons with ASC have in developing a theory of mind. According to Premack & Woodruff (1978), “theory of mind” consists in the ability to attribute mental states to oneself or another person’s behaviour. Theory of mind is also understood as “mentalising”, “mind reading”, “social cognition” or “social intelligence”.

Empathizing-systemizing theory (Baron-Cohen, 2002) establishes useful distinctions in our understanding of different types of mind, the two key modes of thought being empathizing and systemizing. Empathizing is a specific component of social cognition consisting in the drive to identify another person thoughts and emotions, and to respond with appropriate emotions (Goldenfeld, Baron-Cohen, and Weelwright, 2005). Systemizing is the drive to understand the rules governing the behaviour of a system which allows one to predict and control such system. ASC is measurable using the Autism Spectrum Quotient (AQ). Empathizing and Systemizing, measured using the Empathizing Quotient (EQ) and Systemizing Quotient (SQ) questionnaires, are two dimensions involved in an operational definition of autism. In accordance to Baron-Cohen et al. research empathizing is largely but not completely independent of systemizing: autism involves weak empathizing alongside intact or superior systemizing. Baron-Cohen et al. (2007) published “Reading the Mind in the Eyes” test (RMET, revised by Baron-Cohen et al., 2001), which is a measurement of adult “mentalizing”, is in the same time an advanced test of theory of mind. Typical sexdifferences

have been reported for total score of RMET, females being in advantage. In the same time, individuals with ASC show much more difficulty in reading mind in the eyes (Baron-Cohen et al., 2015; Montgomery et al., 2016).

The Cambridge School surveys so far which is grouped around Baron-Cohen, have heeded not only on autism and its associated concepts but also on creating adequate psychometric instruments like AQ, EQ, SQ, RMET. The initial variants of these instruments have known re-elaborations which have resulted in significantly psychometric ameliorations. They have generated studies concerning their psychometric qualities, extensions from adult population to adolescents or from Anglo-Saxon population to other population categories. Some studies have investigated the relationships between these variables, taken by twos or threes, and others (Weelwright et al., 2006), have conducted to a classification of five different 'brain types' based on difference scores between SQ and EQ, which broadly correspond to the male- and female-typical brain, as the extremes of this difference, and a final brain type which is balanced. The present survey studies all the four variables that we mention which are used in a research on a Romanian student population to investigate not only their psychometric qualities but also the relationships between variables. Secondarily I tested the possibility of a simpler approach to determine the type of brain with its five variants – extremely systemizing, systemizing, balanced, empathizing and extremely empathizing.

The present study has the following objectives:

- a. To investigate the relations between Empathizing Quotient (EQ), Reading the Mind in the Eyes Test (RMET), Systemizing Quotient (SQ) and Autism Quotient (AQ) in Romanian academic population context. In particular, we wanted to test on our sample whether AQ score could be predicted from EQ and SQ scores.
- b. To confirm previous sex differences reported using EQ, SQ, AQ and RMET on our sample.
- c. To test the hypothesis according to which the students who take sciences programmes (engineering, computer science) will score higher at SQ and AQ, while the humanities students (psychology, sciences of education and philology) will score higher at EQ and RMET.
- d. To analyse the relationship between two methods to calculate the proportion of subjects scoring in each of the five "brain types": Extreme Type S (Systemizing), Type S, Type B (balanced brain, S=E), Type E (Empathizing) and Extreme Type E. Apart from the classic method (described by Goldenfeld, Baron-Cohen and Weelwright in 2006) we suggest a simpler alternative method of performing this sharing by using z scores standardization for Empathizing and Systematizing variables.

## **2. Method**

### *2.1. Participants*

The 222 participants are students of Transilvania University of Braşov, aging between 18 and 39 years, average age 23.07 years and SD 3.92. Out of them, 88 (39.6%) were of masculine gender and 134 (60.4%) of feminine gender. In the sample structure were 161 (72.5%) students representing Humanities specialisations (psychology, sciences of education and philology) and 61 (27.5%) students representing Sciences specialisations (engineering and computer science). Participation was willingly approved and anonymous, and the students received a bonus for filling in the four pencil-and-paper instruments.

## 2.2. Instruments

Baron-Cohen (2002) argues that two key modes of thought are systemizing and empathizing. Systemizing is the drive to understand the rules governing the behaviour of a system which allows one to control or predict such system. Baron-Cohen (2003) conceptualizes empathy as a specific component of social cognition, defining it as the drive to identify another person's emotions and thoughts, and to respond to these with an appropriate emotion. The Empathy Quotient (EQ) is a questionnaire which was explicitly designed to have a clinical application and to be sensitive to a lack of empathy as a psychopathological feature. Similarly to Systemizing Quotient (SQ), the EQ was designed to be short, easy to use and to score instrument. Both SQ and EQ consist of 60 questions, divided into 40 items tapping systemizing/empathizing and 20 filler items. The filler items were included to distract the participant attention from a relentless focus on empathy. Each of the 60 SQ and EQ items is scored with 1 point if the respondent records the empathic behaviour mildly or 2 points if the respondent records the behaviour strongly. Both SQ and EQ have a forced choice format, and can be self-administered.

“Reading the Mind in the Eyes” Test (RMET) – or “The Eyes Test” – is an expression of adult “mentalising”. RMET Revised Version consists of 36 photographs of the eye-region of the face of different actors and actresses. The participant is asked to choose which from four words best describes what the person is feeling or thinking. To accomplish this purpose the participant has to put him in the mind of another person (“mentalising”), reason for which Baron-Cohen et al. (1997) described RMET as an advanced theory of mind (TOM) test. “Mentalising” means mind reading and supposes social intelligence, which overlaps with the term “empathy”. From the first version of RMET results indicate that women score slightly but significantly higher than men. In the revised form of RMET Baron-Cohen et al. (2001) limited the items to complex mental states to make the task much more challenging, increasing the likelihood of obtaining a greater range of performance.

The Autism Spectrum Quotient (AQ, Baron-Cohen and Wheelwright, 2006) measures the degree to which any adult of normal IQ possesses traits related to the autistic spectrum. The AQ scores range from 0 to 50, the higher the score, the more autistic traits a person possesses. Previous research indicates that AQ score was successfully predicted from EQ or EQ scores.

## 3. Results

### 1. AQ from EQ and SQ

The descriptive statistics for students in humanities, in sciences and in total are summarized in Table 1 below.

Table 1. Means and SD for SQ, AQ, EQ and RMET for Humanities, Sciences and total

Degree	Sex	<i>n</i>		SQ	AQ	EQ	RMET
Humanities	Male	59	Mean	32.56	21.00	36.53	22.56
			SD	6.77	6.32	8.62	2.83
	Female	102	Mean	25.76	17.66	44.39	25.39
			SD	9.59	4.15	8.91	3.31
Sciences	Male	29	Mean	36.79	18.66	35.07	23.41
			SD	11.19	5.16	8.86	3.11
	Female	32	Mean	26.81	16.72	41.25	25.44
			SD	8.87	5.31	7.51	2.77
Humanities +	Male	88	Mean	33.95	20.23	36.05	22.84

Sciences			SD	8.65	6.03	8.67	2.94
	Female	134	Mean	26.01	17.43	43.64	25.40
			SD	9.40	4.45	8.67	3.18
Total	Male +	222	Mean	29.16	18.54	40.63	24.39
	Female		SD	9.89	5.30	9.42	3.33
			Skewness	0.35	0.93	0.07	-0.06
			Kurtosis	0.59	2.71	-0.12	-0.76

As you can notice in the above table, there are clear indications with regard to the normality of distribution for all the four instruments that were used, skewness and kurtosis inserting – with a single exception – in the values within the -1 and +1 interval. The scores of AQ questionnaire present symmetry of the left tail with the right one of distribution but it tends to overcrowd the data on the centre providing a leptokurtic distribution.

In order to answer the first objective of the present research there was carried out an exploratory factor analysis on the total scores of the four questionnaires. One factor with an eigen value greater than 1 was extracted, accounting 40.04% of the total variance. This factor accounted for 54.4% from EQ scores, 54.1% from RMET scores, 41.5% from AQ scores and only 10.2% from SQ scores. The EQ and RMET have a strong positive loading on the factor (0.74), the AQ has a strong negative loading on the factor (-0.64), and the SQ has a weak negative loading on the factor (-0.32). These results suggest that it is most appropriate to create a model which predicts AQ score based only on EQ and RMET scores.

**Table 2. Means and SD for AQ, EQ, and RMET and correlations between variables of regression models**

Variables	Mean	SD	1	2	3
1. AQ	18.54	5.30	-	-.27	-.23
2. EQ	40.63	9.42		-	.34
3. RMET	24.39	3.33			-

**Table 3. The results of hierarchical regression analyze explaining scores for Autism Spectrum Quotient (AQ)**

Variables	B	SE B	$\beta$
First model			
EQ	-.15	.04	-.27**
Second model			
EQ	-.12	.04	-.21**
RMET	.21	.11	-.16*

Note:  $R^2 = 0.28$  for first model;  $\Delta R^2 = 0.023$  for the next model ( $p = .02$ ); \*  $p < .05$ ; \*\*  $p < .01$ .

Though both models that result are statistically significant, it can be appreciated that their predictive force is low. Thus, the second model, that simultaneously takes into consideration EQ and RMET in AQ prediction, explains only 10 percent from the variance of dependent variable. Using the parameters generated in the model AQ scores can be estimated using the formula:  $AQ = 29.969 - 0.12EQ - 0.26RMET$ .

## 2. Gender differences for AQ, SQ, EQ and RMET

Previous research has shown that there are significant differences by sex at AQ, SQ, EQ and RMET scores. Hoekstra, Bartels, Cath, and Boomsma (2008) reported that men scored at AQ higher than women, and sciences students higher than non-sciences students. Preti, Vellante,

Baron-Cohen, Zucca, Petretto and Masala (2011) found that females scored at EQ higher than males, and more males than females scored lower than 30, the cut-off score that best differentiates autism spectrum conditions from controls. A study carried by Auyeung, Allison, Wheelwright and Baron-Cohen (2012) found that similar patterns of sex differences were observed in children, adolescents and adults, suggesting that the behaviours measured by EQ and SQ are stable across time. In a similar study Baron-Cohen, Bowen, Holt, Allison, Auyeung, Lombardo, Smith, and Lai (2015) found significant difference for RMET scores between controlmales and females, and absence of such differences in males and females with autism.

**Table 4. Sex differences for AQ, SQ, EQ and RMET**

Variables	Categories	<i>n</i>	Mean	SD	Difference	t test	sig.
AQ Autism Spectrum Quotient	Male	88	20.23	6.03	2.79	3.97	$p < .001$
	Female	134	17.43	4.45			
SQ Systemizing Quotient	Male	88	33.95	8.65	7.94	6.35	$p < .001$
	Female	134	26.01	9.40			
EQ Empathy Quotient	Male	88	36.05	8.67	-7.60	6.38	$p < .001$
	Female	134	43.64	8.67			
RMET Reading the Mind in the Eyes Test	Male	88	22.84	2.94	-2.56	6.05	$p < .001$
	Female	134	25.40	3.18			

In our study all the four instruments produce significant differences after the gender criterion. In accord with the previously presented studies, boys score significantly higher at AQ and at SQ, while girls have significantly higher scores at EQ and RMET. This fact constitutes a supplementary argument concerning the validity of empathizing – systemizing theory which is the frame for a sexual typology of brain. This thing is also sustained by the exploratory factor analysis, which we presented previously, carried out on the scores of the four instruments. Out of it there results only one factor with an eigen value greater than 1, accounting 40.04% of the total variance.

### 3. Degree differences for AQ, SQ, EQ and RMET

In a study destined to predict autism spectrum quotient from systemizing quotient and empathy quotient, Wheelwright, Baron-Cohen, Goldenfeld, Delaney, Fine, Smith, Weil, and Wakabayashi (2006) conducted separate ANOVAs with between-subject factors of Degree (physical science vs. biological science, vs. social science vs. humanities) and Sex (males vs. females). They found significant main effect of Degree and Sex for both AQ and EQ. The Degree by Sex interaction was found insignificant.

**Table 5. Degree differences for AQ, SQ, EQ and RMET**

Variables	Categories	<i>n</i>	Mean	SD	Difference	t test	sig.
AQ Autism Spectrum Quotient	Humanities	161	18.88	5.29	1.24	1.56	$p > .05$
	Sciences	61	17.64	5.29			
SQ Systemizing Quotient	Humanities	161	28.25	9.24	-3.30	2.06	$p = .042$
	Sciences	61	31.56	11.15			
EQ Empathy Quotient	Humanities	161	41.51	9.56	3.20	2.28	$p = .024$
	Sciences	61	38.31	8.69			
RMET Reading the Mind in the Eyes Test	Humanities	161	24.35	3.42	-0.12	0.24	$p > .05$
	Sciences	61	24.48	3.09			



Though the correlations between variables indicate an association between AQ and SQ – on one side – and EQ and RMET – on the other side – in the present study only the scores at Systemizing and Empathizing variables differentiate clearly after academic degree. This suggests an interesting research area and practical application of Systemizing – Empathizing theory in vocational counselling and guidance.

4. Two methods to determine the five “brain types”

Goldenfeld et al. (2005) suggested an algorithm to determine the cognitive “brain types”. The first step consists in obtaining standardized scores for both EQ and SQ according to the two formulae:  $E(\text{standardized}) = [EQ_{\text{observed}} - \langle EQ \text{ mean for typical population} \rangle] / \text{maximum attainable score for EQ}$ ;  $S(\text{standardized}) = [SQ_{\text{observed}} - \langle SQ \text{ mean for typical population} \rangle] / \text{maximum attainable score for SQ}$ . The standardized E and S variables from the previous step were used to produce a difference score (D). The new variable is defined as follows in the second step:  $D (\text{difference between the normalized EQ and SQ scores}) = (S - E)/2$ . In the third step, cognitive “brain types” were numerically assigned according to the percentiles on the group on “D” scale as follows: the lowest scoring 2.5% were classified as Extreme Type E (Extreme Empathizing); participants who scored between the 2.5th and 35th percentiles were classified as Type E (Empathizing); those scoring between the 35th and 65 percentile were classified as Type B (Balanced); those defined by scores between the 65th and 97.5th percentile were classified as Type S (Systemizing) and the top 2.5% were classified as Extreme Type S (Extreme Systemizing). The four cut-off points delimitating the five brain types are indicated from Frequencies table for D.

The alternative algorithm used in our research is based on the same sequence of three steps, but the manner to standardize variables is different. To standardize E and S we simply used z scores delivered from *Descriptives* menu from SPSS. Next, we determined the D with the same formula indicated by Goldenfeld and al. (2005), finally classifying the participants an accord with the four cut-off (2.5%, 35%, 65% and 97.5%) percentile points for D. The results of two classificatory methods are presented in the Table 6 below.

Table 6. Percent of 222 participants with each “brain type” measured in D

Brain type	D Percentile (per)	Initial method of classification				New method of classification			
		Males	Females	Humanities	Sciences	Males	Females	Humanities	Sciences
	N	88	134	161	61	88	134	161	61
Extreme E	per < 2.5	0	5	5	0	0	5	5	0
Type E	2.5 ≤ p < 35	7	66	56	17	8	69	58	19
Type B	35 ≤ p < 65	24	42	50	16	22	36	45	13
Type S	65 ≤ p < 97.5	53	20	49	24	54	23	42	25
Extreme S	per ≥ 97.5	4	1	1	4	4	1	1	4

The Pearson r correlation of 0.98 between the initial and the new method of classification indicates 96 percent of overlapping between their results. Analysing distributions for the four categories resulted from initial and new method (males, females, students from Humanities and Sciences, Table 6 from above) the overlapping between them appears as very large too. ANOVAs one-way conducted on the AQ and RMET with initial and new method of “brain type” classification provide very similar results. So, for AQ initial

classification  $F(4,221) = 3.13$ ;  $p = .016$ , and for RMET  $F(4,221) = 7.15$ ;  $p < .001$ . For AQ in new classification  $F(4,221) = 3.10$ ;  $p = .016$ , and for RMET  $F(4,221) = 7.88$ ;  $p < .001$ .

As it results from Table 6 and from Figure 1, females are found mostly in the category of Empathizing cognitive type while males in Systemizing type. The extreme categories of this typology are also associated in majority with gender, females with Extreme Empathizing type, and males with Extreme Systemizing type. This thing is in accordance with the research data so far.

After academic degree, humanities are assigned in similar proportions on types E, B and S, while sciences are predominantly associated with the cognitive type S. In conclusion, the capacity of creating distinct categories is better in relation to gender than to academic degree, which once again requires a more detailed study of the relationship between the cognitive type of the brain and career option. The draw conclusions of such an approach can be very useful in career counselling and vocational guidance.

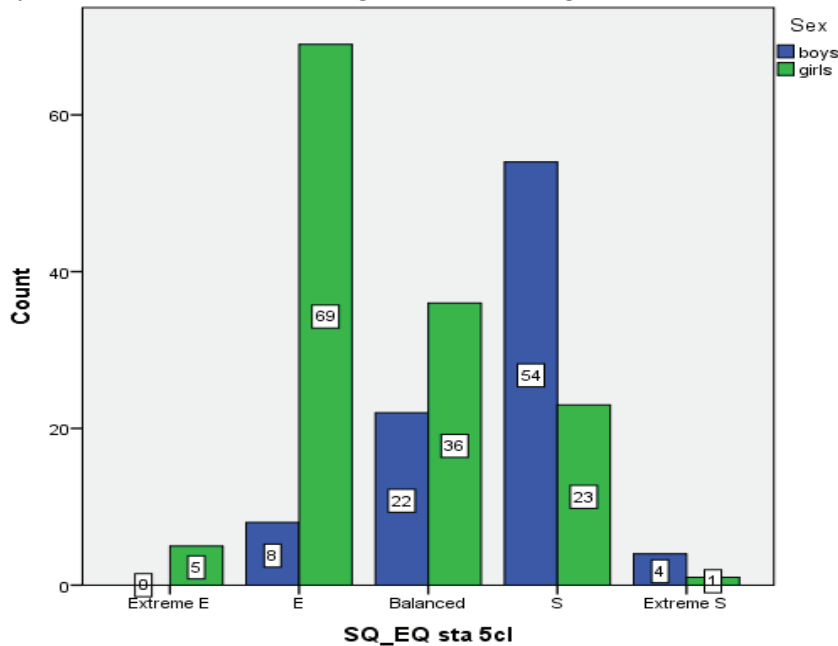


Figure 1. Repartition of boys and girls in function of cognitive “brain type”

#### 4. Conclusions

The four questionnaires that were used in this study produce normally distributed scores, with values of mean and standard deviation that are closed to the one reported by their authors. But, though the correlations between variables are as Baron-Cohen et al. emphasised, in the present survey the intensity of these relationships is lower, which does not allow generating a powerfully regressive model in anticipating the level of autism starting from the scores of empathizing and systemizing. The explanation of this fact can reside in the peculiarities of investigated sample, which makes the survey replication to be necessary on other samples.

Differences connected to gender regarding empathizing and systemizing which the author of empathizing-systemizing theory reported are fully found out in the present survey as well. A growing body of data suggests that, as groups, females are better than males at empathizing, while males are better than females at systemizing. The discrepancy between these two domains leads to useful distinctions in understanding different types of mind. Our data are in accord with those reported by Goldenfeld, Baron-Cohen and Weelwright (2005)

who show that these two abilities – empathizing and systemizing – compete, so that, despite sex difference in cognitive style, there is no overall such differences in cognitive ability, and the sum of EQ and SQ does not produce significant differences between males and females. It means that females’ relatively high empathizing ability compensates for their less developed systemizing ability, while males’ high systemizing ability compensates for their less well-developed empathizing skills. Another valuable result of this survey is the one that finds differences of the empathizing-systemizing report at the level of sciences academic studies domain (more systemizing) versus humanities (more empathizing). This thing constitutes not only a supplement validation of the empathizing-systemizing theory, but it also suggests its possible extension towards the area of career counselling and vocational guidance.

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