Brazilian-Portuguese Empathy Quotient: Evidences of its Construct Validity and Reliability

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Empathy is the ability to read other's mind and understand their intentions. This paper examines the psychometric properties of the Brazilian-Portuguese version of a short form of the empathy quotient (EQ, 15 items). The EQ-15 was administered to 237 participants from the general population from João Pessoa, Brazil. Confirmatory factor analyses supported the tripartite model with cognitive, emotional and social empathy factors. In line with other studies, gender differences were only observed for the first two factors, with female participants scoring higher on both, which suggests that the social factor might not constitute a truly dimension of empathy. Strong evidence for convergent and discriminant validity was only observed for the cognitive factor. The poor psychometric parameters of the emotional and social factors are argued to reflect the complexity and contrasting ideas of their items. The possibility of elaborating specific items for the emotional and social factors is also discussed.
Keywords: empathy, cognition, affect, emotion, empathy quotient, gender.

La empatía es la capacidad de leer en la mente del otro y comprender sus intenciones. Este artículo analiza las propiedades psicométricas de la versión brasileña-portuguesa del formulario corto del cociente de empatía (EQ, de 15 ítems). El EQ-15 se aplicó a 237 participantes de la población general de João Pessoa, Brasil. Los análisis factoriales confirmatorios apoyaron el modelo tripartito con factores cognitivo, emocional y social de la empatía. En consonancia con otros estudios, las diferencias de género sólo se observaron en los dos primeros factores, con las mujeres participando puntuando más en ambos, lo que sugiere que el factor social podría no constituir una verdadera dimensión de la empatía. Sólo en el factor cognitivo se observó una fuerte evidencia de validez convergente y discriminante. Se considera que los pobres parámetros psicométricos de los factores emocional y social reflejan la complejidad de sus ítems. También se discute la posibilidad de elaborar ítems específicos para los factores emocionales y sociales.
Palabras clave: empatía, cognición, afecto, emoción cociente de empatía, género.

Empathy can be understood as the ability to read others' mind and understand their intentions. Empathizing with others may assure individuals to fit to their social context, and is thus an important human cognition attribute (Smith, 2006; Wakabayashi et al., 2006; Wheelwright et al., 2006). The concept of empathy goes beyond the theory of mind by including also an emotional dimension. This emotional empathy dimension is clear in Wakabayashi et al.'s (2006) definition of empathizing as "the drive to identify emotions and thoughts in others and to respond to these with an appropriate emotion" (p. 930). A social empathy dimension has also been identified more recently (Falcone et al., 2008). This social dimension refers to individuals' difficulties in explaining things to others, maintaining relationships, and judging if someone is rude or polite (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Muncer & Ling, 2006).

Contrarily to this tripartite structure of cognitive, emotional, and social dimensions, empathy has traditionally been considered as having only two factors: cognitive empathy (mental perspective taking) and emotional empathy (the vicarious sharing of emotion) (Baron-Cohen & Wheelwright, 2004; Smith, 2006). Supporting this view, it has been argued that the social dimension is not empathy, but a dimension of social skill (Muncer & Ling, 2006) which is tapped in other measures (Davis, 1994). Thus, there is no consensus about the number of factors underlying empathy, even when a single instrument is taken into account (e.g., Empathy Quotient; Baron-Cohen & Wheelwright, 2004; Muncer & Ling, 2006). Despite this lack of consensus, most studies tend to support the idea that empathy comprises only cognitive and emotional dimensions.

Support for this two-factor model of empathy also comes from research testing the role of gender in predicting empathy. Baron-Cohen's (2003) Empathizing-Systemizing Theory indicates gender differences in brain types or cognitive styles: Empathizing is stronger in females, while systemizing is stronger in males. In line with this, Baron-Cohen and Wheelwright (2004) observed that, as predicted, males scored significantly lower than females in their empathy measure (discussed below). These gender differences in empathy have also been identified in other studies. For instance, gender differences have been evident with respect to the cognitive and emotional dimensions of empathy (i.e., females scoring higher in both cognitive and emotional empathy than males), but with no clear gender differences for the social dimension (Lawrence et al., 2004; Muncer & Ling, 2006). These results support the two-factor model of cognitive and emotional dimensions, and the lack of gender differences regarding the social dimension also indicates that social empathy might not constitute a truly dimension of empathy.

The Empathy Quotient (EQ)

There are several available instruments to measure empathy (for a review, see Baron-Cohen & Wheelwright,

2004; Falcone et al., 2008). However, most of these instruments have detectable weaknesses (Lawrence et al., 2004). For instance, some of them do not tap emotional empathy, while others are not specific empathy instruments, measuring social skills or other constructs. Taking into account these limitations, Baron-Cohen (2003; Baron-Cohen & Wheelwright, 2004) developed the Empathy Quotient (EQ).

There are at least three versions of the EQ available (Muncer & Ling, 2006). The original version comprises 40 items that is supposed to assess a single empathy dimension (Baron-Cohen, 2003). This 40-item version presents high test-retest (.97) and Cronbach's alpha (.92) reliability (Baron-Cohen & Wheelwright, 2004). Acceptable Cronbach's alphas have also been found in other studies, varying from .85 (Muncer & Ling, 2006) to .88 (Wakabayashi et al., 2006). Muncer and Ling (2006) performed a confirmatory factor analysis to test the hypothesis of a single one-dimension structure for the EQ, but the fit indices [e.g., *GFI (Goodness of Fit Index)* = .71, *CFI (Comparative Fit Index)* = .57, *RMSEA (Root Mean Square Error of Approximation)* = .07] were below the recommended cut-off scores (Byrne, 2001).

Two short-form versions of the EQ were recently developed. The first version was developed by Lawrence et al. (2004), who administered the EQ to two distinct groups according to their mental states: psychologically healthy ($n = 110$; 50 males) and unhealthy ($n = 62$; 32 males) participants. They correlated all EQ items to each other and removed those with inter-item correlations lower than .20. The selected set of 29 items was then submitted to principal components analysis. This procedure allowed the extraction of three components of empathy (cognitive, emotional, and social), accounting for 41.4% of the total variance. One item was later removed, as it did not load onto any component, but no information was provided about the components' reliability. However, in another study with 362 undergraduate students (156 males), Muncer and Ling (2006), reported the following Cronbach's alpha for each of these components: .84 (cognitive; 11 items), .76 (emotional; 11 items), and .57 (social; 6 items). They also tested the factor structure using confirmatory factor analysis, and found acceptable fit indices (e.g., *GFI* = .87, *CFI* = .82, *RMSEA* = .06) for the three-factor model. Taking into account the modification indices from their confirmatory factor analysis, Muncer and Ling (2006) then proposed the second short-version of EQ. This 15-item version has items equally distributed into the three factors. The fit indices were very good (e.g., *GFI* = .95, *CFI* = .92, *RMSEA* = .05), and the Cronbach's alpha for each scale was .74 (cognitive), .63 (emotional), and .57 (social).

Brief measures are important in psychological research, especially when the purpose is to include several instruments to assess psychological correlates of specific behaviors (Gosling, Rentfrow, & Swann Jr., 2003). And short versions of the EQ have been preferred to the original 40-items

version due to their parsimonious nature in measuring empathy. However, apart from the original studies developing the short-form versions of the EQ, no further studies were found testing the validity and reliability of the measures. The present study tests the factor structure of the shortest form of the EQ: the 15-item (Muncer & Ling, 2006). It admits a three-factor solution for empathy, comprising the cognitive, emotional, and social dimensions. As reviewed above, however, only the cognitive and emotional dimensions seem to truly underlie empathy. We thus tested and compared two models: one-factor model (general empathy) and three-factor model (including the social empathy). Two criteria were used to select the best empathy model: (a) fit indices, and (b) the model ability to detect gender differences following Baron-Cohen's (2003) Empathizing-Systemizing Theory.

Method

Participants

A total of 237 participants (103 males, 134 females) from the general population took part in the study. Their mean age was 31 years (SD = 14.09, ranging from 18 to 76), and most of the participants (52.3%) were undertaking undergraduate studies at the time of the research. Participants from this convenient sample were recruited in public places (e.g., shopping malls, streets, university facilities) from João Pessoa, Paraíba (Brazil). Only individuals who filled all items were included in the analyses. Male and female participants did not differ in terms of age [t(235) = 1.65, p = .10] or schooling [χ^2(3) = 1.29, p = .73].

Instrument

The Empathy Quotient (EQ) is a self-administered pencil-and-paper instrument, comprising a total of 60 items, 40 assessing empathizing and 20 filler items (Baron-Cohen, 2003). In the current study the 15-item version was used (Muncer & Ling, 2006). These items were randomly and equally distributed to assess the three theoretically proposed empathy dimensions: *cognitive* (e.g., I am good at predicting how someone will feel; I am quick to spot when someone in a group is feeling awkward or uncomfortable), *emotional* (e.g., I really enjoy caring for other people; If I say something that else is offended by, I think that is their problem, not mine), and *social* (e.g., I find it difficult to explain to others things that I understand easily, when they do not understand it first time). Participants were asked to rate the items on a 4-point scale, ranging from 1 (*It does not describe me at all*) to 4 (*It strongly describes me*). Participants also answered three demographic questions (age, gender, and educational level).

The EQ-15 was translated and adapted using a bilingual committee approach (van de Vijver & Leung, 1997). The English version of the EQ-15 was first translated into Brazilian-Portuguese by two independent translators, and resulting versions were compared by the first author. This first version was then evaluated by the second author, who is a bilingual Brazilian resident in New Zealand. After modifications, a revised Portuguese version was administered in Brazil to ten undergraduate students for their comments. Checks on translation accuracy were completed by the authors with subsequent corrections when necessary.

Procedure

This study was carried out according to ethical principles, following an informed consent process. All participants completed the EQ individually. They were contacted and asked to take part in the study. By accepting to voluntarily take part in the study, they were instructed to read each statement carefully and indicate how much each item describe them by selecting the appropriate scale option.

Statistical Analysis

Confirmatory factor analyses (*CFA*) were performed to test the adequacy of the competing one-factor and three-factor models. The degree to which the data fit the confirmatory models were assessed using the ratio of the chi-square statistic to the degrees of freedom (χ^2/df), the comparative fit index (*CFI*), the adjusted goodness of fit index (*AGFI*), and the root mean square error of approximation (*RMSEA*). Models with a χ^2/df ratio in the range of 2 to 3, *CFI* and *AGFI* close to .95, and *RMSEA* with values close to .05 or better indicate acceptable fit (Carmines & McIver, 1981; Hu & Bentler, 1999). The expected cross-validation index (*ECVI*) and the differences between chi-squares and its corresponding degree of freedom ($\Delta\chi^2$) were used to compare the models. The better fitting model should have lower *ECVI* value and statistically lower chi-square value (Byrne, 2001).

Results

Descriptive statistics and reliability for the empathy dimensions

Multivariate analysis of variance (MANOVA) with a repeated measures design was used to examine differences in participants' scores for each empathy dimension, revealing a significant main effect [Wilks' Lambda = .45, F(2, 235) = 141.41, p < .001; η^2 = .55]. Participants scored highest for cognitive empathy (M = 13.8, SD = 2.99), followed by

emotional ($M = 10.5$, $SD = 2.35$) and social empathy ($M = 9.8$, $SD = 2.06$). These dimensions were moderately correlated to each other: cognitive with emotional ($r = .29$, $p < .001$) and social ($r = −.25$, $p < .001$), and emotional with social ($r = .20$, $p < .01$). The reliabilities (Cronbach's alpha) were .45 (emotional), .50 (social), and .72 (cognitive). These values are lower than those found by Muncer and Ling (2006): .63 (emotional), .57 (social), and .74 (cognitive).

Testing different models

Two competing models were tested. The fit indices for the one-factor model (all 15 items loading on a single factor) were not satisfactory: $\chi^2(90) = 229.56$, $p < .001$, $\chi^2/df = 2.55$, $AGFI = .85$, $CFI = .73$, and $RMSEA = .08$ ($CI90\% = .064 - .088$). The three-factor model (cognition, emotion, and social factors with 5 items each) had somewhat better fit indices: $\chi^2(87) = 193.37$, $p < .001$, $\chi^2/df = 2.26$, $AGFI = .86$, $CFI = .79$, and $RMSEA = .07$ ($CI90\% = .056 - .081$). The $ECVI$ of these models (1.07 and 0.97, respectively) and the difference between its chi-squares [$\Delta\chi^2(3) = 36.19$, $p < .001$] support the three-factor model as the most adequate. All item loadings were statistically different of zero ($z > 1.96$, $p < .05$), except for one emotional empathy item ('I usually stay emotionally detached when watching a film') (see Table 1).

Based on the poor findings from the CFA discussed above and displayed in Table 1, complementary evidences of construct validity of the EQ-15 were assessed by composite reliability and average variance extracted (Fornell & Larcker, 1981). The composite reliability (CR) assesses the item reliability coefficients, with values of .60 or greater considered acceptable (Škerlavaj & Dimovski, 2009), while the average variance extracted (AVE) measures the variance captured by the indicators relative to their measurement error, and it should be greater than .50 to justify using a construct (convergent validity) (Hair, Anderson, Tatham, & Black, 2005). When the square root of the AVE of a construct is higher than its correlation (Φ) with any other construct, this is evidence of its appropriateness (discriminant validity). Results are presented in Table 2. According to this table, two dimensions showed marginally acceptable CR: cognitive (.68) and social (.66), but only the cognitive dimension showed evidences of convergent (AVE = .58) and discriminant ($\sqrt{AVE} = .76 > \Phi = |0.65|$) validity.

Demographic correlates of empathy dimensions

The correlations of the three empathy dimensions with sex (0 = Male, 1 = Female) were assessed. In line with the literature (e.g., Baron-Cohen & Wheelwright, 2004) and our own predictions, being female was positively correlated

Table 1

Estimate and standard regression weights from the confirmatory factoranalysis

Factor / Item	Regression Weights		
	Estimate	Standard	p
Cognitive			
06 I am good at predicting how someone will feel 1.000	0.598	.001	
07 I am quick to spot when someone in a group is feeling awkward or uncomfortable	0.750	0.544	.001
11 I can sense if I am intruding, even if the other person does not tell me	0.675	0.467	.001
13 I can tune into how someone else feels rapidly and intuitively	0.983	0.639	.001
14 I can easily work out what another person might want to talk about	1.032	0.654	.001
Social skills			
01 I find it difficult to explain to others things that I understand easily, when they do not understand it first time	1.000	0.311	.001
03 I find it hard to know what to do in a social	1.458	0.451	.001
04 Friendships and relationships are just too difficult, so I tend not to bother with	1.075	0.380	.002
05 I often find it difficult to judge if something is rude or polite	1.152	0.353	.002
10 I do not tend to find social situations confusing	1.378	−0.434	.001
Emotional reactivity			
02 I really enjoy caring for other	1.000	0.656	.001
05 If I say something that someone else is offended by, I think that is their problem, not mine	−0.269	−0.184	.017
09 Seeing people cry does not really upset me	−0.320	−0.211	.007
12 I usually stay emotionally detached when watching a film	−0.014	−0.009	.906
15 I tend to get emotionally involved with a friend's problems	0.909	0.570	.001

Table 2
Reliability, convergent and discriminant validity coefficients

	CR	AVE	**1**	**2**	**3**
1. Cognitive	.68	.58	**0.76**		
2. Social	.66	.39	−0.65	**0.62**	
3. Emotional	.43	.33	0.65	−0.57	**0.57**

Notes. CR = Composite Reliability; AVE = Average Variance Extracted. Diagonal values are the square root of the shared variance between the construct and their measurement (AVE), and off diagonal values are the correlations among constructs.

with both the cognitive ($r = .14$, $p < .05$) and emotional ($r = .21$, $p < .01$) dimensions of empathy, but the correlation between gender and the social dimension was not significant ($r = .09$, $p > .05$) (e.g., Muncer & Ling, 2006). The results are in line with previous studies and confirm our predictions. The empathy dimensions were also correlated to age and education. Age was negatively correlated with emotional ($r = −.16$, $p < .05$) and social ($r = −.25$, $p < .01$) empathy dimensions. Education level was positively correlated with all empathy dimensions: social ($r = .16$, $p < .05$), emotional ($r = .19$, $p < .01$), and cognitive ($r = .28$, $p < .05$).

Discussion

The aim of this study was to test the psychometric properties of a short-form version of the Empathy Quotient (EQ, 15-item) (Muncer & Ling, 2006) in a Brazilian milieu, and to test competing factorial solutions. Overall, our findings support previous studies suggesting that it is better to conceptualize empathy as a multidimensional construct, and that the EQ presents three factors (Lawrence et al., 2004; Muncer & Ling, 2006). These factors seem to represent cognitive, emotional and social empathy. However, it is still not clear whether the social factor is an unambiguous empathy dimension. The social factor had a weak and non-significant correlation with gender, which is an important marker variable of empathy (Baron-Cohen, 2003; Baron-Cohen & Wheelwright, 2004), and it did not show evidences of convergent and discriminant validity.

We used confirmatory factor analyses to access the adequacy of two competing models, one-factor model and three-factor model. Overall, the fit indices for both models were worse than those reported by Muncer and Ling (2006), but were nevertheless acceptable (Byrne, 2001; Hu & Bentler, 1999). For instance, both AGFI and RMSEA are lower than .10, and the χ^2/df ratio is also in the 2-to-3 range. However, the same is not true for the reliability values. The cognitive dimension had Cronbach's alpha similar to that reported by Muncer and Ling (2006), but the other two dimensions had much lower values and below the recommended cut-off of .70 in both studies (Clark & Watson, 1995). In fact, only the cognitive dimension showed reasonable evidences of construct validity (convergent,

discriminant, and composite reliability) (Hair et al., 2005; Škerlavaj & Dimovski, 2009). Although the emotional dimension was related to gender in the expected way, both the emotional and social dimensions had overall poor psychometric parameters. This could be a result of the small number of items (Muncer & Ling, 2006, p. 1114), but perhaps there are other explanations. Items for the social dimension seem to tap two distinct ideas, contrasting individualistic (personal skill) and collectivistic (interpersonal skill) orientations. Examples of items tapping these orientations are, respectively: 'I often find it difficult to judge if something is rude or polite', and 'Friendships and relationships are just too difficult, so I tend not to bother with them'. These contrasting ideas may explain the low internal consistency of the social empathy dimension. On the other hand, arguably not all emotional items do cover empathy. Some of its items ('Seeing people cry does not really upset me' and 'I usually stay emotionally detached when watching a film') seem to better tap the related, but distinct, construct of emotional contagion (Gouveia, Gouveia, Guerra, Santos, & Medeiros, 2007).

The expected gender differences in the empathy dimensions were supported. In line with the literature, female participants scored higher on emotional and cognitive empathy than their male counterparts; but gender differences were not observed for the social dimension (Baron-Cohen & Wheelwright, 2004; Lawrence et al., 2004; Muncer & Ling, 2006). These findings support the claim that the social dimension, although correlated with cognitive and emotional empathy, reflects more social skills and as such is not a proper empathy dimension. Social skills could be more appropriately understood as part of a personality dimension (i.e., assertiveness), which has also been found to correlate with age (negatively) and education (positively) (Onyeizugbo, 2003) as in the present study. Despite the fact that the correlations between the empathy dimensions and the demographic variables were weak, the correlations were in line with the expected magnitude for psychological constructs (Hemphill, 2003).

In conclusion, our findings partially corroborate those reported by Muncer and Ling (2006). In terms of factorial structure, the three-factor model was more adequate than the one-factor model, and the emotional and social factors had low reliabilities which is also similar to their findings. Although they argue that the low reliability may be a result

of the small number of items, we argue instead that it might reflect the complexity and contrasting ideas of the items. Considering that gender differences were observed only for emotional and cognitive empathy, future studies should focus on these dimensions and thus improve the emotional empathy items. By addressing the psychometric issues found in the present sample, future studies will be able to provide further evidences of the validity and reliability of the EQ-15 for the Brazilian context.

References

Baron-Cohen¸ S. (2003). *Essential difference: The truth about the male and female brain*. New York, NY: Perseus Books Group.

Baron-Cohen¸ S., & Wheelwright, S. (2004). The Empathy Quotient (EQ): An investigation of adults with Asperger Syndrome and high-functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders, 34,* 163–175. http://dx.doi.org/10.1023/B:JADD.0000022607.19833.00

Byrne, B. (2001). *Structural equation modeling with AMOS. Basic concepts, applications and programming*. Mahwah, NJ: Lawrence Erlbaum Associates.

Carmines, E. G., & McIver, J. D. (1981). Analyzing models with unobserved variables: Analysis of covariance structures. In G. W. Bohinstedt & E. F. Borgatta (Eds.), *Social measurement: Current issues* (pp. 65-115). Beverly Hills, CA: Sage.

Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment, 7*, 309–319. http://dx.doi.org/10.1037//1040-3590.7.3.309

Davis, M. H. (1994). *Empathy: A social psychological approach*. Dubuque, IA: Brown & Benchmark.

Falcone, E. M. O., Ferreira, M. C., Luz, R. C. M., Fernandes, C. S., Faria, C. A., D'Augustin, J. F., ... Pinho, V. D. (2008). Inventário de Empatia (IE): Desenvolvimento e validação de uma medida brasileira [Construction of a Brazilia measure to evaluate empathy: The Empathy Inventory (EI)]. *Avaliação Psicológica, 7,* 321–334.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*, 39–50. http://dx.doi.org/10.2307/3151312

Gosling, S. D., Rentfrow, P. J., & Swann Jr., W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality, 37,* 504–528. http://dx.doi.org/10.1016/S0092-6566(03)00046-1

Gouveia, V. V., Gouveia, R. S. V., Guerra, V. M., Santos, W. S., & Medeiros, D. E. (2007). Midiendo contagio emocional: Adaptación de la escala de Doherty [Measuring emotional contagion: Adaptation of the Doherty scale]. *Revista de Psicología Social, 22*, 99–111. http://dx.doi.org/10.1174/021347407780705401

Hair, J., Jr., Anderson, R., Tatham, R., & Black, W. (2005). *Multivariate data analysis*. (5th Ed.) Upper Saddel River, NJ: Prentice Hall.

Hemphill, J. F. (2003). Interpreting the magnitudes of correlation coefficients. *American Psychologist, 58*, 78–79. http://dx.doi.org/10.1037/0003-066X.58.1.78

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1–55. http://dx.doi.org/10.1080/10705519909540118

Lawrence, E. J., Shaw, P., Baker, D., Baron-Cohen, S., & David, A. S. (2004). Measuring empathy: Reliability and validity of the Empathy Quotient. *Psychological Medicine, 34*, 911–924. http://dx.doi.org/10.1017/S0033291703001624

Muncer, S. J., & Ling, J. (2006). Psychometric analysis of the Empathy Quotient (EQ) Scale. *Personality and Individual Differences*, *40*, 1111–1119. http://dx.doi.org/10.1016/j.paid.2005.09.020

Onyeizugbo, E. U. (2003). Effects of gender, age, and education on assertiveness in a Nigerian sample. *Psychology of Women Quarterly, 27*, 12–16. http://dx.doi.org/10.1111/1471-6402.t01-2-00002

Škerlavaj, M., & Dimovski, V. (2009). Organizational learning and performance in two national cultures: A multi-group structural equation modeling approach. In W. R. King (Ed.), *Knowledge management and organizational learning* (Vol. 4, pp. 321-366). New York, NY: Springer.

Smith, A. (2006). Cognitive empathy and emotional empathy in human behavior and evolution. *The Psychological Record, 56,* 3–21.

van de Vijver, F., & Leung, K. (1997). *Methods and data analysis for cross-cultural research*. Thousand Oaks, CA: Sage.

Wakabayashi, A., Baron-Cohen, S., Wheelwright, S., Goldenfeld, N., Delaney, J., Fine, D. ... Weil, L. (2006). Development of short forms of the Empathy Quotient (EQ-Short) and the Systemizing Quotient (SQ-Short). *Personality and Individual Differences, 41,* 929–940. http://dx.doi.org/10.1016/j.paid.2006.03.017

Wheelwright, S., Baron-Cohen, S., Goldenfeld, N., Delaney, J., Fine, D., Smith, R. ... Wakabayashi, A. (2006). Predicting Autism Spectrum Quotient (AQ) from Systemizing Quotient-Revised (SQ-R) and Empathy Quotient (EQ). *Brain Research, 1079,* 47–56. http://dx.doi.org/10.1016/j.brainres.2006.01.012