



# Development and Validation of a New Autism Questionnaire: AUT-EZ-ME

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## Abstract

**Objectives** This study reports the development of the AUT-EZ-ME, a new diagnostic instrument in order to quickly, reliably, and valid identify and differentiate children with autism aged 4–18 years.

**Methods** A total of 216 parents of children age 4 to 18 years participated in this study and were divided into three groups: children with autism, children without any diagnosis, and children with other diagnosis. The participants were asked to complete the AUT-EZ-ME which could be administered online. The AUT-EZ-ME is a 36-item parent report questionnaire based on the empathizing-systemizing theory. The questionnaire consists of a series of descriptive statements designed to assess three main features of autism and the eleven associated areas as shown in previous research: social skills, attention switching, attention to detail, communication, imagination, recognition of emotions, sharing of emotional states, perspective taking, narrow interests, repetitive behavior, and resistance to change or need for sameness.

**Results** A very clear differentiation was found between children with autism and the typical group and the other diagnosis groups using the AUT-EZ-ME. Furthermore, we found a good internal consistency of the AUT-EZ-ME and its belonging subscales.

**Conclusions** The AUT-EZ-ME is found to be a reliable and valid diagnostic tool for the identification of children with autism. The AUT-EZ-ME showed satisfactory internal consistency and high sensitivity together with low specificity when a cut-off score is set at 26.

**Keyword** Autism · Questionnaire · Empathizing-systemizing theory · Differentiating autism

Ever since Kanner (1943) and Asperger (1944) wrote about children with atypical behavior, later on referred to as autism, theories are developed to interpret and frame this behavior in order to provide features of autism and to perhaps find underlying causes of the disorder. However, the extreme diversity of the features of autism is hampering researchers in providing a general and specific framework or a comprehensive theory of autism. First, researchers concentrated on environmental aspects, then on psychological aspects and later on biological aspects became part of the research in this area. Nevertheless, the causes of autism still remain unclear, and classifying autism in clinical practice

is highly complex due to the extreme diversity of features. The core impairments of individuals with autism though are mostly seen in one's social behavior (e.g., persistent deficits in social communication and social interaction across multiple contexts). Therefore, autism has been described as an empathy disorder (Decety & Meyer, 2008; Gillberg, 1992). Children with autism do not pay the same attention to other people as typical developing children do. As a consequence, important social information and social cues are missed in order to require empathy skills (Van der Zee & Derksen, 2019). However, individuals with autism also show nonsocial features such as stereotyped or repetitive motor movements, use of objects, or speech; insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior; highly restricted, fixated interests that are abnormal in intensity or focus; and hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment (American Psychiatric Association, 2013). Researchers have tried to categorize the social

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and nonsocial features into one or two underlying processes in a primary psychological/cognitive theory (Baron-Cohen, 2009). At first, researchers focused on the theory of mind (ToM) which assumes that individuals with autism fail to solve even quite simple problems that require empathy (Ellis & Gunter, 1999). Later on, ToM was extended by the concept of empathizing, which includes an emotional response dimension. Empathizing is seen as the drive to identify another person's thoughts or emotions and to respond to their mental state with an appropriate feeling. Previous research indicated that low empathizing skills are responsible for the social difficulties that individuals with autism experience (Baron-Cohen, 1995). However, the concept of empathizing is not able to explain the nonsocial features of autism. Therefore, a model was created suggesting that there are two relevant dimensions to characterize individuals with autism: empathizing and systemizing (Baron-Cohen, 2002). Currently, researchers and clinical practitioners formed a general consensus which states that the core impairments of autism can indeed be categorized in social and nonsocial features (American Psychiatric Association – DSM-5, 2013; Baron-Cohen, 2002; Gillberg, 1992).

Since this general consensus of two core dimensions in which features of autism are distributed, the empathizing-systemizing model created earlier seems to be most successful in interpreting the core impairments and strengths in autism, both social and non-social, compared to other theories of autism. This E-S theory is based on the evidence that individuals with autism tend to have difficulties in empathizing, alongside a strength in analyzing, exploring, categorizing, or constructing systems (Baron-Cohen, 2003). Low empathizing skills are responsible for the social difficulties that individuals with autism experience, and high levels of systemizing abilities are accountable for the presence of restricted, repetitive patterns of behavior, interests, or activities. This is also consistent with the DSM 5 criteria for autism. As a result, autism is found to be specific in low empathizing skills along with a heightened drive to systemize. Based on this hypothesis and the provided evidence, it is clear that these two dimensions are relevant to and successful in differentiating individuals with autism.

Evidence for the E-S theory was also found in a Dutch study (Van der Zee & Derksen, 2019). Results indicated that the presence of low empathizing skills together with high systemizing skills in children is indeed responsible for higher scores on autism traits. Second, the results indicated that due to a lack of agreement among researchers on empathy and autism (there appears to be a lack of agreement in research when defining empathy, as well as in defining the components of empathy and in the components of empathy that are impaired in individuals with autism), the characteristics of empathy in autism needed to be redefined. Results also showed that children and adolescents with autism are

impaired in three main abilities required for empathy: (1) recognition of emotions, (2) sharing of emotional states, and (3) perspective taking. These three abilities cause the reduced attention level in social contact. Regarding the recognition of emotions, evidence was found that children and adolescents are indeed impaired compared to typical developing peers. Children with autism do recognize some emotions, however, not all emotions, and clearly have a deficit in the cognitive empathy dimension as well as in the affective dimension when it comes to emotions with a negative valence. Regarding sharing emotional states, it was found that children and adolescents with autism experience difficulties in empathizing. And, with regard to perspective taking, evidence was found that children with autism are limited in identifying with other people, show less concern for other people (Hobson, Harris, García-Pérez & Hobson 2009), and experience difficulties in inferring the thoughts and feelings of others (Demurie et al., 2011). Furthermore, the results of the Dutch study also showed that empathy ability measures are useful and are capable in distinguishing autism from other disorders. Therefore, in order to identify autism in clinical practice, at least the use of an instrument which is specialized in measuring one's empathy abilities, with regard to recognizing emotions, sharing emotional states, and perspective taking, is necessary.

For the systemizing concept, solid evidence was found indicating that high systemizing abilities are characteristic and specific in individuals with autism. As a result of these higher systemizing abilities, individuals with autism show three nonsocial features: restricted and repetitive behavior, obsessional interests, and savant skills. These features can be seen as core nonsocial features of autism. Obsessional interests are more prevalent in higher functioning individuals with autism, and the excellent level of systemizing is an explanation for the link between autism and talent (Baron-Cohen & Lombardo, 2017). The significance of obsessive and restricted interests in the development of savant talent suggests that it is most closely associated with autism. Furthermore, evidence was found that measuring systemizing abilities using the questionnaire SQ-R is valid, useful, and capable of distinguishing individuals with autism from individuals with other (or without) disorders.

Thus, in previous studies, evidence was found that low empathy skills together with high systemizing skills are specific and unique in autism. In order to measure these skills, three instruments were developed and used: the AQ, the EQ, and the SQ. The autism-spectrum quotient (AQ) was initially developed for measuring the degree to which an adult with normal intelligence has the traits associated with autism (Baron-Cohen et al., 2001). The AQ comprises 50 questions, and items were selected from domains in the "triad" of autism symptoms and from demonstrated areas of cognitive abnormality in autism. Researchers demonstrated

that individuals with autism score significantly higher on the AQ than individuals in the general population. Males score slightly but significantly higher than females on the AQ, both overall, and at intermediate and high levels of autistic traits (Baron-Cohen et al., 2001). Later on, an adolescent (adolescent AQ) and a children's version (AQ-Child) was developed in order to quantify autistic traits in children and adolescents (Auyeung et al., 2007; Baron-Cohen et al., 2006). Both questionnaires are parent-report questionnaires, and the items were kept as close to adult version as possible. In order to measure empathy abilities in adults of normal intelligence and to test the extreme male brain (EMB) theory of autism, the empathizing quotient questionnaire (EQ) was designed. The EMB states that individuals with autism have an extreme male brain in terms of extreme high systemizing abilities and low empathizing abilities (Baron-Cohen & Wheelwright, 2004). The results indicated that adults with autism score significantly lower on the EQ than the matched controls and that women in general score significantly higher than males. Later on, a children's version (EQ-Child) and an adolescent version (adolescent EQ) were developed (Auyeung et al., 2012; Auyeng, Wheelwright, Allison, Atkinson, Samarawickrema & Baron-Cohen, 2009). In order to measure systemizing abilities in adults of normal intelligence and to test the EMB theory, the systemizing quotient questionnaire (SQ) was designed (Baron-Cohen, 2003). To counter this and to improve the SQ as an instrument, new items were added to the SQ to create the SQ-Revised (SQ-R) (Wheelwright, Baron-Cohen, Goldenfeld, Delaney, Fine, Smith, Weil & Wakabayashi, 2006). A Dutch study translated the adult version of the SQ-R and created a Dutch SQ, which appeared to be reliable and valid to assess systemizing abilities in individuals with and without autism (Groen, Fuermaier, Den Heijer, Tucha & Althaus, 2015). Also, a parent-report questionnaire was designed in order to measure systemizing abilities in children (Auyeung et al., 2009). The results indicated that boys score higher than girls on the SQ-Child and that children with autism score significantly higher on the SQ-Child compared to typical children. Other researchers confirmed that children with autism score significantly higher than typical developing children do on SQ Child\_NL (Van der Zee & Derksen, 2017). These three instruments have a valid and reliable foundation; however, the instruments are not developed to use in clinical practice. Also, all three instruments are long questionnaires, and the scoring is time-consuming. A validated and shortened version of all three integrated questionnaires could provide a valid and reliable view on the present autism traits and its severity.

We hypothesize that children and adolescents with autism could best be identified in clinical practice using measures of empathy abilities, with regard to recognition of emotions, sharing emotional states, and perspective taking, together

with measures of systemizing abilities, which should provide a higher score than the score of typical developing peers. Therefore, the aim of the present study is to develop a reliable diagnostic tool suitable for children based on previous findings. This diagnostic tool is needed in order to identify autism more accurate in clinical practice and to screen for autism in schools.

## Method

### Participants

A total of 216 parents of children aged 4 to 18 years ( $M=8,69$ ;  $SD=3,203$ ; 129 male, 84 female, 3 missing) participated in this study. The autism group comprised  $N=61$  parents of children diagnosed with autism, age 5 to 17 years ( $M=9,8$ ;  $SD=2,950$ ; 46 male, 13 female, 2 unknown). The typical group comprised  $N=127$  parents of children without any diagnosis, age 4 to 18 years ( $M=7,96$ ;  $SD=3,125$ ; 62 male, 65 female). The third group comprised  $N=26$  parents of children diagnosed with other disorders, age 5 to 16 years ( $M=9,08$ ;  $SD=2,869$ ; 20 male, 6 female).

### Procedure

The first step in designing the new tool was shortening the three already existing questionnaires. Tables 1, 2, and 3 show the final items of the shortening procedure. Based on previous findings, shortening these questionnaires is necessary in order to create a version that is more easy to administer and more suitable for the use in clinical practice and in schools. Researchers in the UK have already shortened the AQ-Child version and adolescent version into a reliable and valid 10-item short form (Allison et al., 2012). Furthermore, results from a previous study regarding empathy abilities and autism lead to a 10-item version of the EQ-Child (Van der Zee & Derksen, 2019), and results regarding the systemizing abilities lead to a 10-item version of the SQ-child (Van der Zee & Derksen, 2021). For the EQ, 5 items were added based on previous research outcome which emphasizes more on recognition of emotions, sharing of emotional states, and perspective taking than the original EQ. And, for the SQ, one item was added regarding stereotype and repetitive behavior, based on DSM 5 criteria.

The result of integrating and shortening the AQ, EQ, and SQ is a 36-item version parent-report questionnaire: AUT-EZ-ME. The AUT-EZ-ME is suitable for identifying autism in children and adolescents age 4 to 18 years. The items are divided into three main areas, autism traits, empathizing skills, and systemizing skills, and the associated areas, social skills (items 4, 8), attention switching (items 2, 7), attention to detail (items 1, 6), communication (items 5, 9),

imagination (items 3, 10), recognition of emotions (items 12, 15, 17, 18, 22), sharing of emotional states (items 13, 14, 16, 19, 23, 25), perspective taking (items 11, 19, 20, 21, 24), narrow interests (items 27, 29, 30, 32), repetitive behavior (items 34, 35, 36), and resistance to change or need for sameness (items 26, 28, 31, 33). Items have been worded to produce an approximately equal agree(16)/disagree(20) response in order to avoid a response bias. The questionnaire format is maintained, as well as the parent-report form. Comparisons of self- and parent-reports indicated that children with autism reported significantly fewer autistic traits and more empathic features than their parents attributed to them. This finding supports the notion that children and adolescents have limitations in their self-perception of autism-related traits and that a parent-report questionnaire is necessary in order to retrieve valid results (Johnson, Filliter & Murphy, 2009). The response scale is treated as a 4-point Likert scale. Parents rate to what extent they agree or disagree with the statements about their child, with the following answer categories: 0 representing definitely agree; 0 slightly agree; 1 slightly disagree; and 2 definitely disagree. Total AUT-EZ-ME scores were represented by the sum each item score. The minimum score (0) indicates no autistic traits; the maximum score (72) suggests full endorsement on all autistic items.

All participants were asked to administer the AUT-EZ-ME online and reported the diagnosis and the name of the psychiatrists involved in the diagnostic procedure as well as the name of the institution involved in the procedure. The data collection took place from July 2020 to December 2020. All children had been diagnosed by psychiatrists or psychologists associated with appropriate establishments. Unfortunately, we are not fully assured that the diagnosis is accurate. It is plausible that the diagnosis is correct, but there is no certainty about this. We recruited all participants via several (autism) sources, including schools, autism parent-support groups, specialized clinics and announcements in autism newsletters, Facebook, Twitter, and several autism-related web pages. The participants were asked to complete the AUT-EZ-ME which could be administered online. A total of 222 parents were willing to participate. If more than four items were left blank (10% of the total number of items), the AUT-EZ-ME was considered incomplete and the data were discarded in analyses. We therefore excluded 6 questionnaires in the autism group.

## Data analysis

We used SPSS (Statistical Package for Social Science) 23 to analyze the data. The alpha level of significance was set at 0.05, two tailed. We executed descriptive statistics for all variables to check for normality. We did find outliers but the outliers did not distort the means. Sensitivity and

specificity were set using *receiver-operating-characteristic analysis*. We calculated means, and we compared the mean total scores for both sexes and for the three groups, using independent samples *t* test and *one-way ANOVA*. An item analysis was conducted.

## Results

### Item Analysis

An item analysis (percentage of each group scoring on each item) is presented in Table 4. On items 11, 15, 28, 30, 35, and 36 each group scored in the same direction. These items seem to differentiate less between the groups: My child likes to take care of others; My child shows concern when others are upset; My child would not notice if something in the house had been moved or changed; My child likes to collect things; My child spends large amounts of time lining things up in a particular order; My child likes to spend time mastering particular aspects of their favorite activities. These items should be considered.

### Internal Consistency

Cronbach's  $\alpha$  coefficients were calculated and for the measure as a whole, the  $\alpha$  coefficient was high ( $\alpha=0.934$ ). The internal consistency of the three subscales was also satisfactory: AQ  $\alpha$  0.863; EQ  $\alpha$  0.907; SQ  $\alpha$  0.773.

### Cut-Off Score

A mean total AUT-EZ-ME score of 39.34 was found in the autism group ( $SD=10.279$ ; minimum score = 14, maximum score = 47). A mean total AUT-EZ-ME score of 13.10 was found in the typical group ( $SD=7.059$ , minimum score = 1, maximum score = 35). A mean total AUT-EZ-ME score of 22.62 was found in the group of children with other diagnosis ( $SD=11.416$ , minimum score = 8, maximum score = 47). Using *receiver-operating-characteristic analysis*, a cut-off score (Total AUT-EZ-ME) could be set at 26.5 with high sensitivity (0.869) and low specificity (0.098). The ROC analysis showed that with a total AUT-EZ-ME score of 26, less than 6.3% of the children in the typical group and less than 26.9% of the children with other diagnosis scored at or above the AUT-EZ-ME cut-off.

### Gender Differences

Independent *t* tests were carried out in order to investigate whether the scores between boys and girls overall and in the three groups separately are statistically significant different. Overall a statistically significant difference was found

between boys and girls ( $t(211) = 4.023, p = 0.000; p < 0.05$ ). A total of 129 boys scored a mean total AUT-EZ-ME score of 24.56 ( $SD = 14.111$ ), and a total of 84 girls scored a mean total AUT-EZ-ME score of 16.82 ( $SD = 13.083$ ). Also, in the typical group a statistically significant difference was found between boys and girls ( $t(125) = 3.087, p = 0.003; p < 0.05$ ). A total of 62 boys scored a mean total AUT-EZ-ME score of 15.03 ( $SD = 7.918$ ), and a total of 65 girls scored a mean total AUT-EZ-ME score of 11.26 ( $SD = 5.594$ ). In the autism group, however, no statistically significant difference between boys and girls was found ( $t(57) = -0.640, p = 0.525; p > 0.05$ ). A total of 46 boys scored a mean total AUT-EZ-ME score of 38.54 ( $SD = 10.829$ ), and a total of 13 girls scored a mean total AUT-EZ-ME score of 40.62 ( $SD = 8.068$ ). In the group of children with other diagnosis, no gender differences were found either ( $t(24) = -0.494, p = 0.639; p > 0.05$ ). A total of 20 boys scored a mean total AUT-EZ-ME score of 21.75 ( $SD = 9.153$ ), and 6 girls scored a mean total AUT-EZ-ME score of 25.50 ( $SD = 17.897$ ). Therefore it is concluded that when autism or another diagnosis is present, no statistically significant difference in total AUT-EZ-ME scores will be found. Boys and girls with a diagnosis score equally on the AUT-EZ-ME.

### Differentiating Autism

A one-way ANOVA was conducted to compare the mean total AUT-EZ-ME scores in the three groups: typical group, autism group, and group of children with other diagnosis. There was a statistically significant difference between groups as determined by one-way ANOVA ( $F(2,211) = 188.728, p = 0.000$ ). A Tukey post hoc test revealed that the mean total AUT-EZ-ME score of the autism group was statistically significant higher compared to the mean total AUT-EZ-ME scores of the two other groups. The AUT-EZ-ME is therefore able to differentiate between children with and without autism and between children with autism and children with other diagnosis.

### Discussion

Previous studies found evidence that low empathy skills together with high systemizing skills are specific and unique in autism (Van der Zee & Derksen, 2017). Therefore, it is found clear that children and adolescents with autism could best be identified in clinical practice using measures of the empathy abilities, with regard to recognition of emotions, sharing emotional states, and perspective taking, together with measures of systemizing abilities, which should provide a higher score than the score of typical developing peers. Thus, in the present study, a diagnostic tool based on the previous findings was developed and pilot. This diagnostic

tool is needed in order to identify autism more accurate and reliable in clinical practice and to screen for autism in schools. Such diagnostic tool will fill the gap for health care professionals and school teachers in making quick, reliable, and valid decisions in real clinic time about whether a child has autism traits.

The AUT-EZ-ME was developed and showed satisfactory internal consistency and high sensitivity together with low specificity when a cut-off score is set at 26. Evidence was found that the AUT-EZ-ME is able to differentiate between children with and without autism and between children with autism and children with other diagnosis. Therefore, it is concluded that the AUT-EZ-ME is likely able to valid and reliable classify and to differentiate children with autism in a clinical sample. However, despite the strong predictive validity of the AUT-EZ-ME, the statement has to be made that an individual's diagnosis of autism should never just depend on a single measure. Diagnosis is not dependent on a cut-off score. The AUT-EZ-ME cannot solve a difficult diagnostic decision. Experienced clinical judgment is essential for accurate diagnosis. However, research, clinical experts, and schoolteachers can benefit from the AUT-EZ-ME because it quickly provides valuable information about a child's behavior, and a child could then be earlier identified and get the appropriate treatment or help.

### Limitations and Future Research

As stated, caution should be exercised when using the AUT-EZ-ME as a single instrument in the diagnostic decision. Other limitations of the study are the relatively small sample size, the unequal group size, and the fact that the diagnoses of the participants have not been verified or confirmed as part of the study. The participants were diagnosed by psychiatrists or psychologists associated with appropriate establishments; however, we are not fully assured that the diagnoses were accurate. It is unknown what procedures were used or if those assessments represented best practice. To improve this part of the study, the participants should go through a full diagnostic process in order to make accurate statements about the diagnosis. However, the majority of the participants are frequently asked to participate in several Dutch or international studies concerning autism. Therefore, the motivation of the participants could be lower when asked to participate in a full diagnostic process, and, as a consequence, even less participants could be willing to participate. On the other hand, all participants are visiting special education. In order to enter this form of education, children need an official diagnosis. Therefore, this limitation is partly validated. A further limitation is that the intelligence quotient of the children participated in the study remained unknown. The questionnaires were originally designed for children who function at a normal intelligence level. Therefore, the

present findings should be seen as a pilot and future research could focus on testing the AUT-EZ-ME in a larger group. To our knowledge, no studies have validated the measures in people with an intellectual disability using these questionnaires. Future research could focus on this topic. Finally, no test–retest design was used. Therefore, no statements were made about the test retest reliability. Taken together, these elements limit the confidence in the results of the study.

## Appendix

### AUT-EZ-ME

1. S/he often notices small sounds when others do not.
2. In a social group, s/he can easily keep track of several different people's conversations.
3. When s/he is reading a story, s/he finds it difficult to work out the characters' intentions or feelings.
4. S/he finds it hard to make new friends.
5. S/he does not know how to keep a conversation going with his/her peers.
6. S/he usually concentrates more on the whole picture, rather than the small details.
7. S/he finds it easy to go back and forth between different activities.
8. S/he finds it easy to work out what someone is thinking or feeling just by looking at their face.
9. S/he is good at social chit-chat.
10. When s/he was in preschool, she used to enjoy playing games involving pretending.
11. My child likes to take care of others.
12. My child often doesn't understand why some things upset other people so much.
13. My child has trouble forming friendships.
14. My child has one or two close friends, as well as several other friends.
15. My child shows concern when others are upset.
16. My child can easily tell when another person wants to enter into conversation with them.
17. My child would worry about how another child would feel if they weren't invited to a party.
18. My child likes to help new children integrate in class.
19. My child gets upset at seeing others crying or in pain.
20. My child listens to others' opinions, even when different from their own.
21. My child is often rude or impolite without realizing it.
22. My child can adequately react to another child that's crying.
23. My child makes eye contact in a conversation.
24. My child uses a dressing-up box when playing.
25. My child understands what other individuals mean when they are not using words.
26. My child does not mind if things in the house are not in their proper place.
27. My child is interested in the different members of a specific animal category.
28. My child would not notice if something in the house had been moved or changed.
29. My child is interested in different types of vehicles.
30. My child likes to collect things.
31. My child gets annoyed when things aren't done on time.
32. My child remembers large amounts of information about a topic that interests them.
33. My child is not bothered about knowing the exact timings of the day's plans.
34. My child tends to repeat certain remarkable behavior every day.
35. My child does not spend large amounts of time lining things up in a particular order.
36. My child likes to spend time mastering particular aspects of their favorite activities.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s41252-021-00228-4>.

**Author Contribution** JD collaborated in the writing and editing of the final manuscript. EZ designed and executed the study, analyzed the data, and wrote the paper. Both authors read and approved the final manuscript.

**Data Availability** The datasets/literature during and analyzed during the current study available from the corresponding author on reasonable request.

### Declarations

**Ethics Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

**Consent to Participate** Informed consent was obtained from all individual participants in the study.

**Consent for Publication** Not applicable.

**Competing Interests** The authors declare no competing interests.

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