



# Brief Report: An Evaluation of the Social Communication Questionnaire as a Screening Tool for Autism Spectrum Disorder in Young People Referred to Child & Adolescent Mental Health Services

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## Abstract

The SCQ is a widely used screening measure for the assessment of autism spectrum disorder (ASD). However, its sensitivity and specificity when used with older children in the context of community Child & Adolescent Mental Health services is unclear. Seventy-seven (Mean age = 12.8 years) young people with suspected ASD were screened using parent- and teacher-reported SCQ's before completing a comprehensive diagnostic assessment. Of the 77 young people included, 44 (57%) met criteria for an ASD diagnosis. Our results indicated that regardless of informant, SCQ scores did not significantly predict the outcome of the diagnostic assessment. Based on the published cut-off score for the SCQ, Receiver Operating Characteristic curve analyses revealed a lower than expected sensitivity and specificity. This suggests that the SCQ is not an effective screening tool when used in the context of community Child & Adolescent Mental Health services.

**Keywords** Adolescent · Autism spectrum disorder · Assessment · Mental health services · Questionnaires · Sensitivity

The Social Communication Questionnaire (SCQ; Rutter et al. 2003) is one of the most widely used measures for the purposes of screening for autism spectrum disorder (ASD). The SCQ is designed for use with children aged 4 years and above and maps onto the items of the Autism Diagnostic Interview—Revised (ADI-R; Lord et al. 1994). In the initial validation study the predictive ability of the SCQ was evaluated in 200 children and adults (age range 4–40) with a range of diagnoses including ASD, conduct disorder and a number of other neurodevelopmental difficulties (e.g., language delay, learning disability etc; Berument et al. 1999). With the published cut-off score of 15, the SCQ reported a sensitivity of 0.96, a specificity of 0.80 and an area under the

curve (AUC) of 0.95, indicating good predictive accuracy (Hanley and McNeil 1982). The AUC is considered a useful metric when considering screening measures (and diagnostic tests more broadly) as it provides a summary measure of test accuracy, accounting for both the tests sensitivity and specificity. Whilst other studies since this time have raised some questions about the accuracy of the SCQ as a screening tool (Corsello et al. 2007; Snow et al. 2008), a recent meta-analysis has suggested that overall the SCQ is an acceptable screening instrument for ASD but that its accuracy varies greatly depending on factors such as age at assessment, the version used and sampling strategy (Chesnut et al. 2016).

Most of the studies since the original validation study compare children with ASD with children with a range of other developmental or behavioural difficulties. Older children, and those who present with mental health difficulties, are only rarely included (Allen et al. 2007; Charman et al. 2007; Corsello et al. 2007). The emphasis on younger children is perhaps unsurprising given the focus on the early detection of ASD and the emergence of symptoms in the pre-school or primary school years (Lord et al. 2006).

However, a substantial proportion of children with ASD are not assessed until they reach late primary or secondary school age (Mandell et al. 2005). This leads to several challenges in services to whom people may present for an

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ASD assessment in late childhood or adolescence; not least because these young people are more likely to be verbally fluent and may initially present to services due to other mental health difficulties, such as attention deficit hyperactivity disorder (ADHD) or anxiety, which are known to co-occur at high frequencies with ASD (Simonoff et al. 2008). This may mean that studies investigating the psychometric properties of the SCQ in younger children with ASD, comparing them primarily to those with specific learning difficulties/intellectual disability, may not be generalisable to these common clinical settings. Indeed, the original validation study did not include people with significant difficulties with anxiety or low mood (Berument et al. 1999), which are amongst the primary reasons for young people to access mental health services. In addition, like many studies investigating screening measures for young people with ASD this study was conducted in a research setting, which raises questions about the ecological validity of the results and their generalisability to clinical settings.

The aim of this study was to evaluate the sensitivity and specificity of the SCQ in a non-selected clinical sample of young people referred for an ASD assessment clinic in two community child and adolescent mental health (CAMH) teams based in one county of the United Kingdom. We also investigated the level of agreement between parent and teachers SCQ scores.

## Methods

This study included 77 verbally able young people (mean age 12.8 years; range 6–19 years) referred to CAMH services for an ASD assessment across Cambridgeshire, United Kingdom. This is a publicly funded community mental health team that provides support to young people and their families who are registered with a general practitioner within the geographical area defined above. As we included all young people presenting to the clinic who met the inclusion criteria, the sample can be considered highly representative of the clinical population (see “Results” section). Participants must have had at least one of either the parent or teacher reported SCQ questionnaires completed to be included in the current evaluation. The ASD assessment clinic receives referrals for school aged children, including internal referrals from other parts of the service which young people have accessed to due to other neurodevelopmental conditions (e.g., ADHD) or mental health difficulties such as anxiety or depression. Referrals are also received from general practitioners, schools or from other health professionals in the community. Parents and teachers of all young people referred to the clinic are asked to complete their respective SCQ questionnaires. If scores on the SCQ are indicative of a possible ASD then young people are assessed

via the Autism Diagnostic Observational Schedule (ADOS; Lord et al. 2000), a thorough developmental history, a school observation, and if additional information is required the Autism Developmental Interview-Revised.

The current project was reviewed and approved as a service related project by both the local mental health trust’s Research and Development department and the Faculty of Medicine and Health Sciences Research Ethics Committee at the University of East Anglia (reference no. 2015/2016-105 SE). As this was considered a service evaluation of existing clinical data and there was no change to standard clinical practice, informed consent was not sought from individual service users.

## Measures

The *SCQ—Lifetime form*, is a 40-item screening questionnaire with questions focusing on the child’s entire developmental history in the domains of social communication and language development. The SCQ can be interpreted with suggested cut-off score of 15, which may indicate the need for further assessment (Rutter et al. 2003). For the purposes of this study the SCQ-lifetime form was completed by the young person’s parent/carer.

The *SCQ—Current form*, is similarly a 40-item screening questionnaire, but does not assess developmental history. Instead this form focuses on the child’s behaviour over the most recent three-month period (Rutter et al. 2003). For the purposes of this study the SCQ—current form was completed by the young person’s school teacher or classroom assistant.

The *Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2)*, is a semi-structured, observational tool used as a part of the diagnostic assessment of ASD (Hus and Lord 2014). Due to the nature of the clinical population, only modules three and four were selected; these are designed for verbally fluent children and adolescents/young adults, respectively.

## Statistical Analysis

The statistical analysis compared the ratios of those who met the published SCQ cut-off score ( $\geq 15$ ) with the ASD diagnostic outcome to provide a descriptive account of the usefulness of the teacher scale compared to the parent-reported score. This difference was quantified using a  $\chi^2$  test. The primary analysis consisted of two separate logistic regression analyses with parent or teacher rated SCQ score (treated continuously) predicting group status (ASD/No ASD). Age was included as a covariate to investigate any significant association with diagnostic outcome. Receiver Operator Characteristic (ROC) curve analyses determined the *AUC*, and the sensitivity and specificity of the SCQ. Hanley and

McNeal (1982) outlined how an *AUC* score corresponds to the validity of a screening measure, with a score between 0.5 and 0.6 being a *failure*, between 0.6 and 0.7 being *poor*, between 0.7 and 0.8 being *fair*, between 0.8 and 0.9 being *acceptable*, and between 0.9 and 1.0 being *perfect*.

## Results

### Descriptive Statistics

The final sample consisted of 77 young people aged between 6 and 19 years of age (Mean age = 12.8, S.D. = 3.6) and included 58 males and 19 females. Sixty-five of the participants were referred to the ADOS-clinic from within the child adolescent mental health service and the remaining were referred from community paediatrics ( $n = 2$ ), general practitioners ( $n = 6$ ), social care ( $n = 1$ ) or from their school ( $n = 1$ ). Referral information was not available for two young people. Of the 77 young people included, 44 (57%) were considered to meet criteria for a diagnosis of ASD. There was no significant difference between those who did or did not receive a diagnosis of ASD on age, gender or scores on the either version of the SCQ. For those who met criteria for an ASD diagnosis the following comorbidities were also recorded by diagnosing clinicians: ADHD ( $n = 12$ ), anxiety ( $n = 11$ ), dyslexia ( $n = 2$ ), learning disability ( $n = 1$ ), low mood ( $n = 1$ ), OCD ( $n = 1$ ) and oppositional defiant disorder ( $n = 1$ ).

For the 33 participants who did not meet criteria for a diagnosis of ASD, the most common alternative diagnosis was ADHD (13/33), followed by anxiety (9/33). Other diagnoses in the group that was not found to have an ASD were; fetal alcohol spectrum disorder (2/33), post-traumatic stress disorder (1/33), tic disorder (1/33), low mood/depression (1/33), specific learning difficulty (1/33) and not specific/no diagnosis (5/33). Please see Table 1 for full descriptive statistics. Missing data was recorded for both the parent ( $n = 2$ ) and teacher ( $n = 9$ ) reported SCQ's and these cases were excluded from their respective statistical analysis, described below. There are several disadvantages of the casewise deletion of missing data including the loss of useful data and an increasing in type II error which mean our results should be interpreted with caution.

**Table 1** Characteristics of young people included in the study

	Whole group (n=77)	ASD (n=44)	Non-ASD (n=33)	Difference test
Age (mean, SD)	12.8 (3.2)	12.9 (3.3)	12.5 (2.9)	$t = 0.63, p = 0.53$
Gender (M:F)	58:19	35:9	23:10	$\chi^2 (1) = 0.98, p = 0.32$
SCQ—parent	22.2 (6.9)	22.4 (6.6)	21.8 (7.2)	$t = 0.39, p = 0.69$
SCQ—teacher	16.8 (6.2)	17.6 (5.8)	15.9 (6.7)	$t = 1.23, p = 0.23$

### Ratio of Participants Who Screened Positive for ASD Versus Diagnostic Outcome

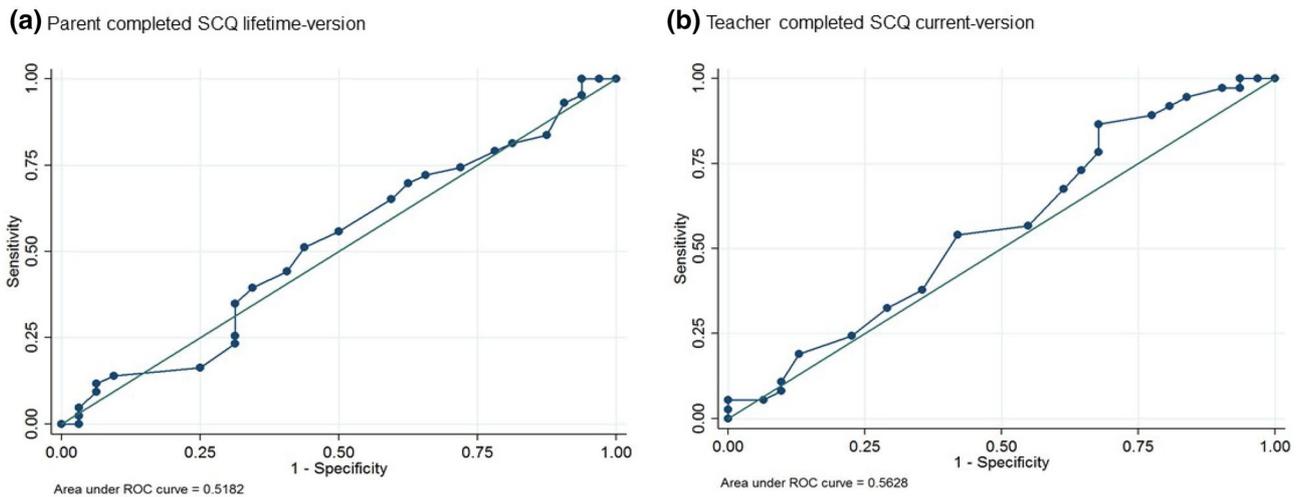
The mean score on parent completed SCQ scale was 22.2 (S.D. = 6.8, range = 6–37), with 64/75 (85%) meeting the suggested clinical cut-off. For the teacher completed SCQ the mean score was 16.8 (S.D. = 6.2, range = 0–34), with 47/68 (69%) meeting the clinical cut-off. Based on assessment using ADOS-2, 44/77 of the participants were considered to meet criteria for a diagnosis of ASD. A Pearson's  $\chi^2$  test indicated that neither the parent [ $\chi^2 (1) = 2.32, p = 0.13$ ], nor the teacher reported SCQ cut-off scores [ $\chi^2 (1) = 0.02, p = 0.89$ ], were significantly related to the diagnostic outcome.

### Sensitivity and Specificity of Parent/Caregiver Completed Lifetime-version of the SCQ

A logistic regression with the continuous parent SCQ regressed onto the dichotomous variable of ASD diagnosis revealed no significant association between SCQ score and ASD diagnosis ( $\beta = 0.02, p = 0.61$ ), with no significant effect of age ( $\beta = 0.05, p = 0.51$ ). ROC analysis revealed an AUC of 0.52 (95% C.I. 0.38–0.65) correctly classifying 53% of participants (see Fig. 1). Based on the validated cut-off score of 15, the SCQ when completed by parents/caregivers had a sensitivity of 83.7% and specificity of 12.5%. Alternative cut-off scores and their respective sensitivities and specificities are presented in Table 2.

### Sensitive and Specificity of Teacher Completed Current-version of the SCQ

A logistic regression with the continuous teacher SCQ score regressed onto the dichotomous variable of ASD diagnosis revealed no significant association between SCQ score and ASD diagnosis ( $\beta = 0.05, p = 0.24$ ), with no significant effect of age ( $\beta = 0.03, p = 0.74$ ). ROC analysis revealed an AUC of 0.56 (95% C.I. 0.42–0.70) correctly classifying 56% of participants (see Fig. 1). Based on the validated cut-off score of 15, the SCQ when completed by parents/caregivers had a sensitivity of 72.9%, and a sensitivity of 35.5%. Alternative cut-off scores and their respective sensitivities and specificities are presented in Table 2.



**Fig. 1** Receiver operating characteristic curves plotting sensitivity against 1-specificity for the SCQ lifetime- and current-version

**Table 2** Alternative SCQ cut-off scores for the SCQ lifetime- and current versions

SCQ-lifetime	Sensitivity (%)	Specificity (%)	Correctly classified (%)	SCQ-current	Sensitivity (%)	Specificity (%)	Correctly classified (%)
13	–	–	–	13	86.5	32.3	61.7
14	93	9.4	57.3	14	78.4	32.3	57.3
15	83.7	12.5	53.4	15	72.97	35.5	55.8
16	81.4	18.8	54.7	16	67.6	38.7	54.4
17	79.1	21.9	54.7	17	56.8	45.2	51.7
18	74.4	28.1	54.7	18	54.1	58.1	55.9
19	72.1	34.4	56.0	19	37.8	64.5	50.0
20	69.7	37.5	56.0	20	32.4	71.0	50.0

## Parent and Teacher Agreement When Rating Symptoms of ASD

To test the degree to which parent and teacher reported SCQ scores corresponded to each, these were correlated with each other using a Pearson correlation coefficient. This revealed a non-significant relationship between parent and teacher reported ASD symptoms ( $r = -0.07$ ,  $p = 0.58$ ).

## Discussion

The results of this study suggest that, regardless of the informant selected, scores on the SCQ are not significantly related to the outcome of the diagnostic process. ROC analysis indicated that the published SCQ cut-off score performed at little better than chance level when used in this clinical setting. Furthermore, there was no significant relationship between ratings made by parents and teachers, potentially

indicating a lack of agreement between informants. While you may not always expect parents and teacher report to agree, in the context of a diagnostic assessment, it is desirable to have a good convergence of test scores. It is also important to note that the SCQ is not originally designed for use by teachers in an educational setting. Indeed, one study that has specifically looked at the use of the SCQ by teacher has reported a sub-optimal level of sensitivity and specificity (Schanding et al. 2012). Overall these results suggest that, in the setting of this community CAMH services, the SCQ may not be a suitable screening tool.

The SCQ is one of the most commonly used screening tools to assess ASD. The current results indicate that the SCQ sensitivity and specificity is lower than would be expected given the results presented in both its initial validation (Berument et al. 1999), and a recent meta-analysis which indicated a pooled *AUC* of 0.87 (Chesnut et al. 2016). It is worth noting that the results of the meta-analysis by Chesnut and colleagues indicated a

lower *AUC* of 0.71 for studies which used the SCQ current version. However, the results of this study indicate scores substantially lower for both the current- and lifetime- versions. One reason for this apparent discrepancy may be that studies included in the above meta-analysis rely on studies which compare those with ASD to young people with other specific learning difficulties/intellectual disability (Allen et al. 2007; Charman et al. 2007; Corsello et al. 2007). In contrast, this project focused on a clinical sample for whom the comparison population are those that often present with considerable mental health difficulties, either with or without ASD. While it is the clinical reality that most young people with ASD have multiple mental health comorbidities (Salazar et al. 2015; Simonoff et al. 2008), this is often not considered when validating screening tools.

However, it is important to consider that the SCQ is designed as a screening tool, not a diagnostic test. Given that the diagnostic test in this case is non-invasive, it is sensible to select a screening measure with a high sensitivity, over good specificity, as the implications for false positives are relatively minor (Boyko 1994). However, the lower than expected sensitivity of the SCQ in this service makes it difficult to reliably rule out the possibility of ASD even in those who score below threshold. In this context, it means that even when people score below the published cut-off of “15”, there is still a higher than acceptable chance that after further investigation they will meet criteria for ASD.

The low specificity of the SCQ in this service means that the measure lacks the ability to accurately identify those young people who do not have ASD, and therefore their current difficulties are better explained by something else, such as anxiety, depression or another neurodevelopmental difficulty. This means that there is a substantial proportion of young people who score above the SCQ cut-off but, based on the ADOS or wider clinical assessment, do not meet criteria for an ASD. This high rate of false positives has the potential to place an unnecessary burden on the diagnostic clinic in terms of assessment waiting times, and on the young person by exposing them to an unnecessary assessment. However, it is important to note that in many cases the ASD assessment process itself provides an opportunity for a detailed assessment and if considered in this way may contribute to the understanding of the young person regardless of the diagnostic outcome. It is also important to highlight that this sample included a high frequency of mental health comorbidities and it is likely that the SCQ may be better at predicting ASD when only one diagnosis is present. Therefore, the use of the SCQ and the selection of an optimal cut-off score should be guided by the clinical context.

## Recommendations for Clinical Practice

The results of this project indicate that the SCQ is not an effective screening tool for use in the context of this CAMH service. There are a number of alternative screening tools, such as the Social Responsiveness Scale-second edition (SRS-2) (Constantino and Gruber 2012) or the Children’s Communication Checklist (CCC) (Bishop 1998). However, the available literature suggests that the SCQ performs better than these measures when used in clinical contexts (Charman et al. 2007). Furthermore, these measures focus on a narrower range of difficulties, such as social ability and communication development, which may help to increase specificity, but it is likely to be at the detriment of good sensitivity, which is important in this context.

An alternative approach may be to develop and validate a novel measure that is specifically designed to account for the complexity of presentations in a CAMH service setting and with children who tend to be referred for an ADOS assessment at a slightly older age. While in the longer term the development of a new measure may be the ideal solution at the current time perhaps the most feasible approach to this problem is to take a multiple testing approach to screening. This could include the use of the SCQ, perhaps adopting the higher cut-off (optimising sensitivity; see Table 2), in combination with a second “narrower measure” of ASD such as either the SRS-2 or CCC. Another consideration would be to ask parents to complete a measure of childhood mental health such as the Strengths and Difficulties Questionnaire (SDQ; Goodman 1997), which can provide a broader picture of mental health difficulties and allow an earlier clinical discussion about the most likely cause of the young persons current difficulties.

## Limitations

It is important to raise some caveats when interpreting the findings of this study. As this was a service related project, we only included young people from a single service covering a well-defined geographical region. It is therefore important to consider that the results obtained may not be generalisable beyond this service. Nevertheless, the sample was highly representative of young people seen in clinical practice and it is likely that similar challenges are faced by other services due to the complexity of the clinical population. Again, due to the nature of the project we are limited to the data collected as a part of routine clinical practice and as such cannot look at covariates of possible interest such as intellectual ability or other domains of functioning.

## Conclusion

In conclusion, in the context of a CAMH service the SCQ is not an effective screening tool regardless of whether it is completed by parents or teachers. This can be improved to a limited degree by using a stricter “cut-off score” than is typically suggested. In the longer-term efforts need to be made to develop screening tools/approaches for ASD that can be used in older children who present to CAMHS with complex presentations and high levels of co-occurring mental health difficulties. However, in the short-term one recommendation is to use multiple measures and sources of information at the screening stage to reduce the number of unnecessary ADOS assessments.

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**Author Contributions** MJH conceived of the study, participated in its design and coordination, performed the statistical analysis and drafted the manuscript; RC participated in the design of the study and interpretation of the data; CW participated in the design of the study and interpretation of the data; JD participated in the coordination of the study and data collection; PB participated in the interpretation of the data and manuscript preparation; AH participated in the coordination of the study and interpretation of the data. All authors read and approved the final manuscript.

## Compliance with Ethical Standards

**Conflict of interest** All authors declared that they have no conflicts of interest.

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