

1 **An Evaluation of the Social Communication Questionnaire as a Screening Tool for**
2 **Autism Spectrum Disorder in Young People Referred to Child & Adolescent Mental**
3 **Health Services**

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11 RUNNING HEAD: An Evaluation of the SCQ in Child Mental Health

12

1 Abstract

2 The SCQ is a widely used screening measure for the assessment of autism spectrum disorder
3 (ASD). However, its sensitivity and specificity when used with older children in the context of
4 community Child & Adolescent Mental Health services is unclear. Seventy-seven (Mean age
5 = 12.8 years) young people with suspected ASD were screened using parent- and teacher-
6 reported SCQ's before completing a comprehensive diagnostic assessment. Of the 77 young
7 people included, 44 (57%) met criteria for an ASD diagnosis. Our results indicated that
8 regardless of informant, SCQ scores did not significantly predict the outcome of the diagnostic
9 assessment. Based on the published cut-off score for the SCQ, Receiver Operating
10 Characteristic (ROC) curve analyses revealed a lower than expected sensitivity and
11 specificity. This suggests that the SCQ is not an effective screening tool when used in the
12 context of community Child & Adolescent Mental Health services.

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1 The Social Communication Questionnaire (SCQ; Rutter et al, 2003) is one of the most
2 widely used measures for the purposes of screening for autism spectrum disorder (ASD). The
3 SCQ is designed for use with children aged 4 years and above and maps onto the items of
4 the Autism Diagnostic Interview – Revised (ADI-R; Lord et al, 1994). In the initial validation
5 study the predictive ability of the SCQ was evaluated in 200 children with a range of diagnoses
6 including ASD, conduct disorder and a number of other neurodevelopmental difficulties
7 (Berument, Rutter, Lord, Pickles, & Bailey, 1999). With the published cut-off score of 15, the
8 SCQ reported a sensitivity of 0.96, a specificity of 0.80 and an area under the curve (AUC) of
9 0.95, indicating good predictive accuracy (Hanley & McNeil, 1982). The AUC is considered a
10 useful metric when considering screening measures (and diagnostic tests more broadly) as it
11 provides a summary measure of test accuracy, taking into account both test sensitivity and
12 specificity. Whilst other studies since this time have raised some questions about the accuracy
13 of the SCQ as a screening tool (Corsello et al., 2007; Snow et al., 2008), a recent meta-
14 analysis has suggested that overall the SCQ is an acceptable screening instrument for ASD
15 but that its accuracy varies greatly depending on factors such as age at assessment, the
16 version used and sampling strategy (Chesnut, Wei, Barnard-Brak, & Richman, 2016).

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

23 However, a substantial proportion of children with ASD are not assessed until they
24 reach late primary or secondary school age (Mandell, Novak, & Zubritsky, 2005). This leads
25 to several challenges in services to whom people may present for an ASD assessment in late
26 childhood or adolescence; not least because these young people are more likely to be verbally
27 fluent and may initially present to services due to other mental health difficulties, such as

1 attention deficit hyperactivity disorder (ADHD) or anxiety, which are known to co-occur at high
2 frequencies with ASD (Simonoff et al., 2008). This may mean that studies investigating the
3 psychometric properties of the SCQ in younger children with ASD, comparing them primarily
4 to those with specific learning difficulties/intellectual disability, may not be generalisable to
5 these common clinical settings.

6 The aim of this study was to evaluate the sensitivity and specificity of the SCQ in a
7 non-selected clinical sample of young people referred for an ASD assessment clinic in two
8 community child and adolescent mental health teams based in one county of the United
9 Kingdom. We also investigated if there was an effect of age on the relationships between
10 parent and teacher reported SCQ scores and the outcome of the ASD diagnostic assessment
11 and the level of agreement between parent and teacher report.

12 **Methods**

13 This study includes 77 young people referred to child and adolescent mental health
14 (CAMH) services for an ASD assessment across Cambridgeshire, United Kingdom. As we
15 included all young people presenting to the clinic who met the inclusion criteria, the sample
16 can be considered highly representative of the clinical population (see results section).
17 Participants must have had at least one of either the parent or teacher reported SCQ
18 questionnaires completed to be included in the current evaluation. The ASD assessment clinic
19 receives referrals for school aged children, including internal referrals from other parts of the
20 service which young people have accessed to due to other neurodevelopmental conditions
21 (e.g., ADHD) or mental health difficulties such as anxiety or depression. Referrals can also be
22 received from general practitioners, schools or from other health professionals in the
23 community. Parents and teachers of all young people referred to the clinic are asked to
24 complete their respective SCQ questionnaires. If scores on the SCQ are indicative of a
25 possible ASD then young people are assessed via the Autism Diagnostic Observational

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

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

9 *Measures*

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

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

19 The *Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2)*, is a semi-
20 *structured*, observational tool used as a part of the diagnostic assessment of ASD (Hus &
21 Lord, 2014). Due to the nature of the clinical population, only modules 3 and 4 were selected;
22 these are designed for verbally fluent children and adolescents/young adults, respectively.

23 **Statistical analysis.** The statistical analysis compared the ratios of those who met the
24 published SCQ cut-off score (≥ 15) with the ASD diagnostic outcome to provide a descriptive
25 account of the usefulness of the teacher scale compared to the parent-reported score. This

1 difference was quantified using a chi-squared test. The primary analysis consisted of two
2 separate logistic regression analyses with parent or teacher rated SCQ score (treated
3 continuously) predicting group status (ASD/No ASD). Age will be included as a covariate to
4 investigate any significant association with diagnostic outcome. Receiver Operator
5 Characteristic (ROC) curve analyses determined the *AUC*, and the sensitivity and specificity
6 of the SCQ. Hanley and McNeal (1982) outlined how an *AUC* score corresponds to the validity
7 of a screening measure, with a score between 0.5 and 0.6 being a *failure*, between 0.6 and
8 0.7 being *poor*, between 0.7 and 0.8 being *fair*, between 0.8 and 0.9 being *acceptable*, and
9 between 0.9 and 1.0 being *perfect*.

10 **Results**

11 **Descriptive statistics.** The final sample consisted of 77 young people aged between 6
12 and 19 years of age (Mean age = 12.8, S.D. = 3.6) and included 58 males and 19 females.
13 Sixty-five of the participants were referred to the ADOS-clinic from within the child adolescent
14 mental health service and the remaining were referred from community paediatrics ($n = 2$),
15 general practitioners ($n = 6$), social care ($n = 1$) or from their school ($n = 1$). Referral information
16 was not available for two young people. Of the 77-young people included, 44 (57%) were
17 considered to meet criteria for a diagnosis of ASD. There was no significant difference
18 between those who did or did not receive a diagnosis of ASD on age, gender or scores on the
19 either version of the SCQ.

20 For the 33 participants who did not meet criteria for a diagnosis of ASD, the most
21 common alternative diagnosis was ADHD (13/33), followed by anxiety (9/33). Other diagnoses
22 in the group that was not found to have an ASD were; fetal alcohol spectrum disorder (2/33),
23 post-traumatic stress disorder (1/33), tic disorder (1/33), low mood/depression (1/33), specific
24 learning difficulty (1/33) and not specific/ no diagnosis (5/33). Please see Table 1 for full
25 descriptive statistics. Missing data was recorded for both the parent ($n=2$) and teacher ($n=9$)
26 reported SCQ's and these cases were excluded from their respective statistical analysis,
27 described below.

1 [INSERT TABLE 1 ABOUT HERE]

2 **Ratio of participants who screened positive for ASD versus diagnostic outcome.** The
3 mean score on parent completed SCQ scale was 22.2 (S.D. = 6.8, range = 6 - 37), with 64/75
4 (85%) meeting the suggested clinical cut-off. For the teacher completed SCQ the mean score
5 was 16.8 (S.D. = 6.2, range = 0 - 34), with 47/68 (69%) meeting the clinical cut-off. Based on
6 assessment using ADOS-2, 44/77 of the participants were considered to meet criteria for a
7 diagnosis of ASD. A Pearson's chi-squared test indicated that the distribution of neither the
8 parent ($\chi^2 (1) = 2.32, p = 0.13$), nor the teacher reported SCQ cut-off scores ($\chi^2 (1) = 0.02, p$
9 $= 0.89$), were significantly related to the diagnostic outcome.

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

18 [INSERT FIGURE 1 ABOUT HERE]

19 [INSERT TABLE 2 ABOUT HERE]

20 **Sensitive and specificity of teacher completed current-version of the SCQ.** A logistic
21 regression with the continuous teacher SCQ score regressed onto the dichotomous variable
22 of ASD diagnosis revealed no significant association between SCQ score and ASD diagnosis
23 ($\beta = 0.05, p = 0.24$), with no significant effect of age ($\beta = 0.03, p = 0.74$). ROC analysis revealed
24 an AUC of 0.56 (95% C.I. 0.42 – 0.70) correctly classifying 56% of participants (see Figure 1).
25 Based on the validated cut-off score of 15, the SCQ when completed by parents/caregivers

1 had a sensitivity of 72.9%, and a sensitivity of 35.5%. Alternative cut-off scores and their
2 respective sensitivities and specificities are presented in Table 2.

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

7 **Discussion**

8 The results of this study suggest that, regardless of the informant selected, scores on
9 the SCQ are not significantly related to the outcome of the diagnostic process. ROC analysis
10 indicated that the published SCQ cut-off score performed at little better than chance level
11 when used in this clinical setting. Furthermore, there was no significant relationship between
12 ratings made by parents and teachers, potentially indicating a lack of agreement between
13 informants. While you may not always expect parents and teacher report to agree, in the
14 context of a diagnostic assessment, it is desirable to have a good convergence of test scores.
15 Overall these results suggest that, in the setting of this community CAMH services, the SCQ
16 may not be a suitable screening tool.

17 The SCQ is one of the most commonly used screening tools to assess ASD. The
18 current results indicate that the SCQ sensitivity and specificity is lower than would be expected
19 given the results presented in both its initial validation (Berument et al., 1999), and a recent
20 meta-analysis which indicated a pooled *AUC* of 0.87 (Chesnut et al., 2016). It is worth noting
21 that the results of the meta-analysis by Chesnut and colleagues indicated a lower *AUC* of 0.71
22 for studies which used the SCQ current version. However, the results of this study indicate
23 scores substantially lower for both the current- and lifetime- versions. One reason for this
24 apparent discrepancy may be that studies included in the above meta-analysis rely on studies
25 which compare those with ASD to young people with other specific learning
26 difficulties/intellectual disability (Allen et al., 2007; Charman et al., 2007; Corsello et al., 2007).

1 In contrast, this project focused on a clinical sample for whom the comparison population are
2 those who often present with considerable mental health difficulties, either with or without
3 ASD. While it is the clinical reality that most young people with ASD have multiple mental
4 health comorbidities (Salazar et al., 2015; Simonoff et al., 2008), this is often not considered
5 when validating screening tools.

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

14 The low specificity of the SCQ in this service means that the measure lacks the ability
15 to accurately identify those young people who do not have ASD, and therefore their current
16 difficulties are better explained by something else, such as anxiety, depression or another
17 neurodevelopmental difficulty. This means that there is a substantial proportion of young
18 people who score above the SCQ cut-off but, based on the ADOS assessment, who do not
19 meet criteria for an ASD. This high rate of false positives has the potential to place an
20 unnecessary burden on the diagnostic clinic in terms of assessment waiting times, and on the
21 young person by exposing them to an unnecessary assessment. However, it is important to
22 note that in many cases the ASD assessment process itself provides an opportunity for a
23 detailed assessment and if considered in this way may contribute to the understanding of the
24 young person regardless of the diagnostic outcome. Therefore, the use of the SCQ and the
25 selection of an optimal cut-off score should be guided by the clinical context.

26 **Recommendations for clinical practice.** The results of this project indicate that the SCQ
27 is not an effective screening tool for use in the context of this CAMH service. There are a

1 number of alternative screening tool, such as the Social Responsiveness Scale (SRS)
2 (Constantino et al., 2003) or the Children's Communication Checklist (CCC) (Bishop, 1998).
3 However, the available literature suggests that the SCQ performs better than these measures
4 when used in clinical contexts (Charman et al., 2007). Furthermore, these measures focus on
5 a narrower range of difficulties, such as social ability and communication development, which
6 may help to increase specificity, but it is likely to be at the detriment of good sensitivity, which
7 is important in this context.

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

20 **Limitations.** It is important to raise some caveats when interpreting the findings of this
21 report. As this was a service related project, we only included young people from a single
22 service covering a well-defined geographical region. It is therefore important to consider that
23 the results obtained may not be generalisable beyond this service. Nevertheless, the sample
24 was highly representative of young people seen in clinical practice and it is likely that similar
25 challenges are faced by other services due to the complexity of the clinical population. Again,
26 due to the nature of the project we are limited to the data collected as a part of routine clinical

1 practice and as such cannot look at covariates of possible interest such as intellectual ability
2 or other domains of functioning.

3 *Conclusion*

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

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3 **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)	$t = 1.23, p = 0.23$

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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%

Figure 1. Receiver Operating Characteristic curves plotting sensitivity against 1-specificity for the SCQ lifetime- and current-version

