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An Evaluation of the AQ-10 as a Brief Screening Instrument for ASD in Adults

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Abstract

There is a need for brief screening instruments for autistic spectrum disorders (ASD) that can be used by frontline healthcare professionals to aid in the decision as to whether an individual should be referred for a full diagnostic assessment. In this study we evaluated the ability of a short form of the Autism Spectrum Quotient (AQ) questionnaire, the 10 item AQ-10, to correctly classify individuals as having or not having ASD. In a sample of 149 individuals with ASD and 134 controls without an ASD diagnosis, we found that the full AQ (AQ-50) abridged AQ (AQ-S) and AQ-10 all performed well as a screen for ASD. ROC analysis indicated that sensitivity, specificity and area under the curve were very similar at suggested cut-off's for ASD across measures, with little difference in performance between the AQ-10 and full AQ-50. Results indicate the potential usefulness of the AQ-10 as a brief screen for ASD.

Introduction

In a recent study, Allison, Auyeung and Baron-Cohen (2012) argued for the importance of the availability of a brief screen for autism spectrum disorders (ASD) that can be used by frontline health professionals as a means to identify individuals who should be referred for full diagnostic assessment. The Adult Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelright, Skinner, Martin & Clubley, 2001) was developed for the assessment of autistic traits in adults with normal intellectual functioning. It comprises 5 subscales measuring key traits thought to be important dimensions of ASD: social interaction, communication, attention to detail, attention switching and imagination. These dimensions were clinically derived based on the triad of impairment (Baron-Cohen et al., 2001). It has undergone extensive psychometric development and evaluation, with the majority of studies supporting its validity in both individuals with and without a clinical diagnosis of ASD (e.g. see Wheelright, Auyeung, Allison & Baron-Cohen, 2010).

An abbreviated version of the AQ, the AQ-10, has been developed in an attempt to meet the need for a brief screen for ASD (Allison et al.2012). Allison et al.(2012), in a sample of 449 adults with an ASD diagnosis and 838 controls randomly split into calibration (ASD=224; Control=419) and validation (ASD=225; Control=419) samples, selected the 2 items from each of the five subscales of the full AQ with the greatest discriminatory power (calibration sample). Table 1 shows the items included in the AQ-10 and the original item numbers from the AQ-50.

(Insert Table 1 about here)

The authors then used ROC analyses to test the discriminative power of the 10 selected items in the validation sample. They found that using a cut-point of 6, the 10 selected items yielded a sensitivity of 0.88, specificity of 0.91 and a positive predictive value of 0.85. This supported the utility of the 10 item form of the AQ as a "rapid screener" (p.208) for ASD to serve as a guide for further referral and evaluation. However, the authors pointed out that replications, particularly in samples in which participants' diagnoses of ASD could be independently confirmed, would be important to assess the generalisability of this result.

Therefore, the aim of the present study was to assess the ability of the AQ-10 to discriminate

between individuals with and without a confirmed diagnosis of ASD. For comparison, we also evaluate the full AQ (AQ-50) and the AQ short form (AQ-S; Hoekstra et al., 2011) to assess the extent to which important information is lost in the briefer measures.

Method

Ethics

Ethical approval for the study was obtained, as applicable, from the local National Health Service ethics committee and Caldicott Guardians, and the research ethics committee at the first and sixth author's home institutions.

Participants and Measures

All participants completed the 50 item AQ (Baron-Cohen et al., 2001). In line with Allison et al. (2012) and the majority of applications of the instrument, we scored the AQ dichotomously. For the current analysis, we included only those participants who had complete data on the AQ.

ASD Sample

We used archival data that have been analysed and described in detail in previous publications (Burnett & Jellema, 2012; Kuenssberg, Murray, Booth & McKenzie, 2012). The original data were collected from three sources: A Regional ASD Consultancy Service (RASDCS), a clinical psychology service in Scotland and disability services at universities in the North East of England where a prior diagnosis of AS or high-functioning autism was available. We note that there is debate about the diagnosis of 'high- functioning autism' (see Blacher Kraemer, & Schalow, 2006), but retained this term as this was the diagnostic term used by the independently diagnosing clinicians. In all instances, diagnosis was made with reference to the Diagnostic and Statistical Manual of Mental Disorders 4th Edition (American Psychiatric Association: DSM-IV-TR, 2000) by trained clinicians. In the case of RASDCS and the clinical psychology service, the diagnostic process included a clinical interview, informant interview (where possible) to obtain additional a developmental history and history of neuropsychological testing. The Adult Asperger Assessment

(Baron-Cohen et al., 2005) was administered routinely, but was not part of clinical diagnosis.

The ASD sample for the current study was drawn from 3 independent sources (n=173). In the current study, we include only those individuals who had complete data for the AQ-50 in order to allow for comparisons across the full AQ-50, AQ-S and AQ-10. Data were anonymised prior to receipt and so the specific demographic characteristics of the sample are unknown. However, sample demographics from the larger samples from which the current complete cases were collated is available (see also Burnett & Jellema, 2012; Kuenssberg et al., 2012). The RASDCS sample comprised 140 individuals (102 males, 38 females) with a mean age at diagnosis of 33 (Range=17 to 75); the clinical psychology sample comprised 13 individuals (10 male, 3 female) with a mean age at diagnosis of 34 (Range=19 to 47); finally the university sample comprised 20 individuals (15 male, 5 female) with a mean age of 21 (SD=6.1). The final ASD sample used in the current analyses consisted of 149 individuals.

Non-ASD Sample

Non-ASD participants were recruited online and from a large university community and online social media. Participants completed an electronic version of the full AQ and also a number of basic demographic questions. Of the total number who began the online questionnaire (n=170), a final sample of 134 individuals (34 males, 100 females; mean age=29.6, range = 17 to 65) who had complete AQ data were used in the current study. All participants were free from clinical diagnosis of ASD.

Statistical Method

We used ROC analysis to evaluate the discriminative power of the AQ-10 (Allison et al., 2012). For comparison, we also evaluated the full AQ (AQ-50; Baron-Cohen et al., 2001), and the AQ short form based on item selections by Hoekstra et al. (2011) (AQ-S). The suggested optimal cutpoint for the AQ-10 and AQ-50 based on previous ROC analyses are 6 for the AQ-10 and 26 or 32 for the AQ-50. Optimal cut-points for the AQ-S dichotomously scored have yet to be established but Hoekstra et al. (2011) suggest cut-points of above 65 or 70 or greater when the instrument is scored

on a four-point scale.

We evaluated the discriminative power of each measure based on sensitivity, specificity and area under the curve (AUC). AUC provides global measure of the predictive validity of the measure. Values above 0.90 are generally considered to indicate excellent validity. Sensitivity and specificity were computed for all whole number thresholds within each inventory using the 'pROC' package (Robin et al., 2011) in R 2.13.0. Confidence intervals were computed using the default 2000 stratified bootstrap replicates.

Results

Table 2 displays the AUC for the AQ, AQ-S and AQ-10, and the sensitivity and specificity of the suggested cut-points. The AUC for all three measures is >90%, suggesting that the shortened versions of the AQ retain the predictive validity of the full 50 item inventory.

(Insert Table 2 about here)

In the case of both the AQ and AQ-10, the suggested cut-points from previous studies performed reasonably well. For the AQ, the cut point of 26 would be preferred to a cut point of 32 within the current sample. For the AQ-S, no cut-points have been published for the binary scoring. Here we present results from all cut-points where the median values from the bootstrapped analysis were greater than 70%. Based on both medians and confidence intervals, a cut-point of 16 appears to provide the best balance of sensitivity and specificity.

Discussion

We found that the AQ-50, and AQ-10 performed well at discriminating between individuals with and without a clinical diagnosis of ASD at the cut-points suggested by the test developers. In addition, based on our analyses we tentatively suggest a cut-point of 16, based on a dichotomous scoring method, if the AQ-S is to be used as a screening instrument for ASD. There was little loss of discriminative power in AQ-10 compared with the AQ-S and AQ-50. This suggests that, for frontline

professionals for whom the longer measures would be too time consuming to administer, the much briefer AQ-10 would be an appropriate alternative. A score above the 6 on the AQ-10 would be indicative to the clinician of the need to undertake a full diagnostic assessment with the individual, which incorporated all of the recommended components (National Institute for Health and Clinical Excellence, 2012)

It is important to point out the potential limitations of our study. Our sample was restricted to adults of average intelligence as the AQ is designed for use in this group only. Conclusions on its discriminative power are, therefore, not necessarily applicable to the large number of individuals with ASD and low intellectual functioning (Matson & Shoemaker, 2009).

The non-ASD sample for the present study was a mix of participants recruited online and through the University community; therefore, it may not be representative of the general population as a whole. More importantly, however, non-ASD sample was comprised of individuals who had not previously been referred for clinical assessment and, therefore, we could not evaluate how well the screening instrument performed in a clinical or referred setting. It is likely that the discriminative power observed when applied to a diagnosed versus a general clinical sample or a sample at risk of ASD would be lower than that observed in the present study.

The discriminative power of the instrument will also depend on other characteristics of the ASD and comparison sample. For example, in the present study we had a high male:female ratio in the ASD group and the opposite in the non-ASD group. Given that it is thought that ASD traits tend to manifest more often and to a greater extent in males than in females (e.g. see Mandy et al., 2012), it is likely that the discriminative power of the instrument would be lower if a more heavily male non-ASD sample were used. Thus, future studies should aim to assess the discriminative power of the instrument across other relevant comparison and ASD sample compositions with respect to sex and other characteristics.

It also is possible that sex differences in ASD could result in the AQ being sex biased, meaning that it does not have equivalent measurement properties in both sexes. A possible consequence of this could be a systematic over-estimation of the scores of one sex relative to the other sex. Here, measurement invariance was not assessed due to insufficient sample size and neither has it

been assessed in previous studies. Measurement invariance procedures provide formal tests of the equivalence of a given instrument across groups (Wicherts & Dolan, 2010) and the results of the current study should, therefore, be considered in light of the lack of studies assessing measurement invariance of the AQ instruments. Such studies remain practically difficult given the generally large samples required to conduct invariance analyses and the comparative scarcity of females with an ASD diagnosis. However, future research should seek to test whether the AQ instruments display measurement invariance.

Finally, did not examine the child and adolescent versions of the AQ and their briefer counterparts in the present study. It, therefore, remains an important future direction for these two measures to be evaluated in a sample independent of the initial calibration and validation samples of Allison et al.(2012).

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Table 1:

Items of the AQ-10 and Original AQ-50 item numbers

Scale	Item	Original Item Number from AQ-50
Attention to Detail	I often notice small sounds when others do not.	5
	I usually concentrate more on the whole picture, rather than the small details.	28
Attention Switching	I find it easy to do more than once thing at once.	32
	If there is an interruption, I can switch back to what I was doing very quickly.	37
Communication	I find it easy to 'read between the lines' when someone is talking to me.	27
	I know how to tell if someone listening to me is getting bored.	31
Imagination	When I'm reading a story I find it difficult to work out the characters intentions.	20
	I like to cllect information about categoris of things (e.g. types of car, types of bird, types of train, types of plant, etc)	41
Social	I find it easy to work out what someone is thinking or feeling just by looking at their face.	36
	I find it difficult to work out people's intentions.	45

Adapted from Allison, et al. (2012, Table 2, page 207).

Table 2:

Area Under the Curve (AUC), Sensitivity, Specificity for the AQ, AQ-10 and AQ-S and suggested cut points.

	AUC	Sensitivity	95% CI	Specificity	95% CI
AQ-50	91.38%				
Cut-point 26		87.92%	75.17% to 96.64%	79.85%	68.66% to 89.55%
Cut-point 32		69.80%	56.38% to 83.22%	91.04%	82.09% to 98.51%
AQ-10	90.27%				
Cut-point 6		79.87%	69.13% to 90.60%	87.31%	76.87% to 95.52%
AQ-S	91.06%				
Cut-point 14		91.95%	83.89% to 98.66%	73.13%	56.72% to 84.33%
Cut-point 15		89.26%	81.21% to 97.99%	76.87%	60.45% to 88.81%
Cut-point 16		84.56%	74.50% to 93.96%	82.84%	68.66% to 93.28%
Cut-point 17		79.19%	65.77% to 89.86%	85.08%	72.39% to 94.78%
Cut-point 18		71.14%	59.06% to 82.55%	88.81%	79.10% to 97.02%