

Eagle-eyed Visual Acuity in Autism

To the Editor:

We thank Michael Bach and Steven Dakin and David Crewther and Alexandra Sutherland for their interesting commentaries with regard to the technical issues associated with use of the Freiburg Visual Acuity and Contrast Test (FrACT) (version 1.3) (1) in our study (2). We chose the FrACT for use in our study, because it is both quick and easy to implement and provides us with a quantitative measure of visual acuity (VA) that can be readily interpreted. As outlined in the commentaries, there are a number of settings within the FrACT that can be changed from their default values. We agree that any potential influences that changes to these settings might have on the results should be investigated further.

In the following, we summarize what these changes from default were, why they were selected, and the extent to which these call our results into question.

- 1) Viewing Distance. We selected this to be 60 cm, because this is commonly used in psychological research studies and thus was chosen for reasons of comparability. A shorter viewing distance was also chosen to deter participants from leaning toward the screen during more difficult trials.
- 2) Threshold Definition. We set this to “psychometric” because we wanted to report results in terms appropriate for publication in a psychological journal. The FrACT manual does not indicate that this would reduce acuity estimates by 10%, but even so, such a decrease does not explain the results we obtained.
- 3) Number of Trials. The number of trials for the task was in fact 150 (not 200 as stated in their commentary). We acknowledge that this is a substantial increase from the default value of 30 trials. We chose this number to maximize the potential for variability between the groups (allowing a maximum of 3 sec/trial), without making the task too laborious.
- 4) Time-Out Value. We set 3 sec as our participant response time, to “force” participants to respond as quickly and accurately as possible. Although it was not possible to obtain time-out error values for the participants, we did note down whenever a response was not made within the time allowed. Analysis of this qualitative measure showed that there was no difference in the number of time-outs recorded for either the control or the autism spectrum conditions (ASC) group.
- 5) The “post hoc max. likelihood analysis”. This option was set to “on” precisely because of its estimation of the slope of the psychometric function: the chosen output for our results. As noted by Bach and Dakin, this would not normally result in changes to estimates of VA, and it is unfortunate if our choice of viewing distance affected this. However, it is not clear the extent to which this would change the estimation of VA values.

Although we acknowledge that this chain of unrelated events might have affected the absolute magnitude of the VA measures obtained in our study, we do not believe that they can be dismissed out of hand. As Bach and Dakin and Crewther and Sutherland point out, the difference in VA observed between the group with ASC and the control group still exists. In our minds, this is the single most important point. Both groups were tested under exactly the same test settings (as outlined in the preceding

text) and took part in the study over the same test period in a randomized order (i.e., we did not test all of one group before starting with the other). Furthermore, the diagnosis of a “case” (ASC) is obviously a factor to which the FrACT itself is blind. Thus, although the magnitude of group averages might be called into question, the extent of the difference between the groups is not.

Considering the magnitude of average group results, however, we would like to make a further point. According to the commentaries, the settings of the FrACT as we used them would severely overestimate VA values. This would have been true for both the ASC and control groups. It is interesting that typical reports of VA in the general population are similar to that reported for the control group in our study, as we would expect (3). However, if the FrACT had overestimated the results of the control group to the extent suggested, we would have to assume that our control group actually had extremely poor vision indeed! This is certainly not true: control participants were recruited from various sources, to include a representative sample of ages and social backgrounds, and all were screened specifically for optical problems or abnormalities and excluded from testing in any cases where these occurred. Furthermore, given the evidence for decreasing VA with age and the fact that the ASC group was significantly older than the control group, if anything, we should not have expected to see such a large group difference in VA scores. We therefore surmise that the group difference in VA might prove even more significant if the groups are closely matched on age.

Bach and Dakin argue, contrary to our conclusions of truly enhanced VA in ASC, that the ASC group in our study achieved such results simply through increased perseveration on the task (especially when the stimuli were presented at increasingly smaller sizes and the task became more difficult). Although we agree with the evidence presented for such a hypothesis, we do not believe that the nature of the task necessarily lends itself to observing such an effect. Our reasoning for this is that we made careful note of any participant who showed any sign of difficulty or frustration at any point during the task. These qualitative records provide us with some measure of perseveration effects, and the incidence of difficulties within each group did not differ significantly. In fact, the ASC group showed slightly higher rates of task difficulty as compared with control subjects, which might suggest that their ability to persevere was lower than that of the control subjects. However, because the task was typically completed very quickly (an indication that participants were responding within the 3-sec cut-off time), very few participants in either group actually demonstrated any difficulty on the task at any time. This is consistent with early research by Clark and Rutter (4), which showed that the performance by children with autism on a cognitive task was best explained by the intrinsic difficulty of each item rather than by the individual levels of interest or motivation. However, we agree that there is a need to investigate this further, with quantitative measures (e.g., computer recorded errors and response times).

Our report presents both anecdotal (5–7) and empiric evidence (8–11) for increased VA in individuals with ASC. All participants in our study completed further tasks during the test period that examined threshold and discrimination abilities within olfactory, auditory, and tactile sensory modalities. Importantly, findings from all of these tasks indicate significantly enhanced sensory abilities within the ASC group (12–14), which we consider to be complementary evidence to our results on the

FrACT. These additional findings together suggest amodal sensory hypersensitivity in ASC.

We accept that the technical issues outlined in the commentary need to be resolved. We are therefore pleased to be working in collaboration with Michael Bach and Steven Dakin to replicate the study with both the most recent version of the FrACT (which now usefully includes warnings when any parameters have been changed in ways that can affect measures of VA) (15) and with other stringent measures of VA. We hope that this will resolve these technical issues and predict the results will confirm the existence of superior VA in ASC.

Emma Ashwin

Autism Research Centre
University of Cambridge
Department of Psychiatry
Douglas House
18b Trumpington Road
Cambridge CB2 8AH UK
elc36@cam.ac.uk

*Chris Ashwin
Teresa Tavassoli
Bismadev Chakrabarti
Simon Baron-Cohen*

Autism Research Centre
Douglas House
Cambridge, United Kingdom

We were supported by the Medical Research Council (UK) during the period of this work. We are grateful to Danielle Rhydderch and Jess Howells for their invaluable contributions to this study.

The authors of this paper report no biomedical financial interests or potential conflicts of interest.

1. Bach M (1996): The Freiburg Visual Acuity Test—Automatic measurement of visual acuity. *Optom Vis Sci* 73:49–53.
2. Ashwin E, Ashwin C, Rhydderch D, Howells J, Baron-Cohen S (2008): Eagle-eyed visual acuity: An experimental investigation of enhanced perception in autism. *Biol Psychiatry* 65:17–21.
3. Rassow B, Cavazos H, Wesemann W (1990): Normgerechte Sehschärfenbestimmung mit Buchstaben. *Augenärztliche Fortbildung* 13:105–114.
4. Clark P, Rutter M (1979): Task difficulty and task performance in autistic children. *J Child Psychol Psychiatry* 20:271–285.
5. Kanner L (1943): Autistic disturbance of affective contact. *Nervous Child* 2:217–250.
6. Grandin T (2008): *The Way I See It: A Personal Look at Autism and Asperger's*. Arlington, TX: Future Horizons.
7. Grandin T (2006): *Thinking in Pictures*. New York: Vintage Books.
8. Leekam SR, McGeer V (in press): Sensory-perceptual dysfunction and the development of autism. *Trends Cogn Sci*.
9. Plaisted K, O'Riordan M, Baron-Cohen S (1998): Enhanced visual search for a conjunctive target in autism: A research note. *J Child Psychol Psychiatry* 39:765–775.
10. Bertone A, Mottron L, Jelenic P, Faubert J (2005): Enhanced and diminished visuo-spatial information processing in autism depends on stimulus complexity. *Brain* 128:2430–2441.
11. Jolliffe T, Baron-Cohen S (1997): Are people with autism or Asperger's syndrome faster than normal on the embedded figures task? *J Child Psychol Psychiatry* 38:527–534.
12. Baron-Cohen S, Ashwin E, Ashwin C, Tavassoli T, Chakrabarti B (2009): Talent in autism: Hyper-systemizing, hyper-attention to detail and sensory hypersensitivity. *Philosophical Transactions of the Proceedings of the Royal Society, Series B, Biological Sciences*, 364:1377–1383.
13. Ashwin C, Ashwin E, Tavassoli T, Howells J, Rhydderch D, Baron-Cohen S (submitted): Olfactory hypersensitivity in autism spectrum conditions.
14. Tavassoli T, Ashwin E, Ashwin C, Chakrabarti B, Baron-Cohen S (submitted): Tactile and Auditory hypersensitivity in autism spectrum conditions.
15. Bach M (2008): Homepage of the Freiburg Visual Acuity and contrast test ("FrACT"). Available at: <http://www.michaelbach.de/fract/index.html>.

doi:10.1016/j.biopsych.2009.05.015