Alternative Bayesian accounts of autistic perception:

comment on Pellicano and Burr

Jon Brock $^{1,2}$

1. Department of Cognitive Science, Macquarie University

2. ARC Centre of Excellence in Cognition and its Disorders

Contact details:

Dr Jon Brock, Department of Cognitive Science, Macquarie University, Sydney 2109, Australia. Phone: +61 (2) 9850 6869. Email jon.brock@mq.edu.au
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Atypical sensory-perceptual experiences are a widely acknowledged but poorly understood feature of autism. An enduring and still unresolved question is whether autistic perception should best be characterised in terms of reduced top-down influences on perception or, alternatively, enhanced bottom-up sensory-perceptual processes [1,2]. In their recent Opinion article, Pellicano and Burr [3] argue for the former. Their “hypo-priors” account of autistic perception is essentially a Bayesian formalization of Mitchell and Ropar’s earlier suggestion of “attenuated influence by prior knowledge” [4]. However, bottom-up accounts of enhanced autistic perception can also be formalized in Bayesian terms [5] and this leads to similar predictions.

Figure 1 illustrates this point. The Bayesian approach to perception begins with a noisy sensory “observation”, represented here by a red Gaussian. This is multiplied by the prior (yellow Gaussian) to produce a posterior distribution (orange). The optimal estimate, represented by the centre of the posterior distribution, is shifted towards the prior, as indicated by the arrow in Figure 1a. Figure 1b illustrates the hypo-priors account. In this example, the prior is weakened by doubling its variance and hence the optimal estimate is much closer to the mean of the sensory observation. Figure 1c represents the alternative bottom-up account. Here, the strength of the prior is unaltered from the original example, but there is reduced sensory noise, indicated by a halving of the variance of the observation. The optimal estimate is identical to that in the “hypo-priors” example – the symmetry arising because the relative influence of the prior is a function of the ratio of the variance of the prior to the variance of the observation [6].
So which account of autistic perception is correct? The above analysis suggests that top down and bottom-up accounts may be difficult (although not impossible) to disentangle. One way forward might be to consider underlying neural mechanisms: hypo priors could plausibly be attributed to reduced connectivity between different cortical regions [7], whereas reduced sensory noise might originate from increased lateral inhibition within cortical regions [8]. However, given the heterogeneity within the autism population, it is probably unwise to speak of “autistic perception” as if there were only one mechanism. The Bayesian account allows for the possibility that similar atypicalities of perception may arise for different reasons in different autistic individuals.

None of this, however, answers the big question – why do (some) autistic people have atypical perception? If the mechanisms of atypical perception really were independent of those responsible for the diagnostic characteristics of autism [1], then there should not be the association we see between autism diagnosis and atypical perception. At some level there must be a connection. Pellicano and Burr side-step this issue, suggesting that their Bayesian account is relevant only to non-social features of autism (although see their Box 2). Yet the effective and flexible use of prior knowledge is at the heart of everyday social interactions [9,10]. Perhaps more than any other aspect of autism, social impairment is in need of the Bayesian treatment.
Figure 1: Individual differences in Bayesian perception

A - Typical

B - Hypo-prior

C - Reduced sensory noise
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References


