Title: Some Clarifications on Neural Noise and Sensory Sensitivities in Autism

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Abstract:

Ward (2018) has provided an elegant synthesis of the literature on the neural basis of individual differences in sensory sensitivity, and a useful proposed framework to guide future research. In this commentary clarify some of the issues raised by Ward (2018) surrounding neural noise and sensory sensitivities in autism.

Keywords:

Autism, Autism Spectrum Disorder, Perception, Sensory Sensitivity

Some Clarifications on Neural Noise and Sensory Sensitivities in Autism

Ward (2018) has provided an elegant synthesis of the literature on the neural basis of individual differences in sensory sensitivity and a useful proposed framework to guide future research. However, in this commentary I should like to clarify some of the issues surrounding neural noise and sensory sensitivities in autism.

First, and most importantly, the significance of sensory issues for the autism community cannot be underestimated. A recent consultation exercise by the UK charity *Autistica* put "How can sensory processing in autism be better understood" (Cusack & Sterry, 2016) into the top 10 of research priorities for this group. Our own research, and that of others, has highlighted that sensory hyper-sensitivities can often cause pain, distress, discomfort and, in some cases endanger the personal safety of autistic individuals (e.g. Robertson, 2012; Robertson & Simmons, 2015; Smith & Sharp, 2013; Ismail et al, 2018). However, unlike what is implied in Ward (2018), hypo-sensitivities can also be highly problematic. We have recorded accounts of individuals suffering immensely due to hypo-sensitivity in the rectal area, an example of a profoundly autistic adult chasing a desired sensory stimulus (a snack packet) across a busy street and another with an obsession for touching dangerously hot objects like toasters and cooker tops (Simmons et al, 2017). There are also the well known issues with temperature sensitivity and "pica" (i.e. eating non-food objects: see https://www.autism.org.uk/about/behaviour/challenging-behaviour/pica.aspx). It has also been argued that a preponderance of hypo-sensitivities in younger children suggest a poorer prognosis in terms of life outcomes (Jones et al, 2018).

My second point concerns the precise nature of the neural noise hypothesis as originally published in Simmons et al. (2009). Ward (2018) has characterized this idea as solely about additive noise, although does qualify this statement somewhat in Table 2. Whilst the idea of increased levels of spontaneous neural activity was certainly in our minds, thinking in particular of approaches like Equivalent-noise analysis as promising avenues for further research, we did not specify. Indeed, more recently, we have been persuaded by the data of Dinstein et al (2012) that multiplicative noise might be a more likely candidate. The important issue, and one that we did not make perfectly clear in the Simmons et al (2009) account, is that there must be some sort of stochastic process which underlies the variability in sensory phenotypes in autism. The most likely explanation given current thinking in both the neuroscience and genetics of autism is unreliable synaptic transmission which, in turn, will lead to aberrant brain connectivity (Hebb, 1949).

My final point is that Ward (2018) has arguably not done justice to the empirical literature on neural noise in autism. Whilst Davis & Plaisted-Grant's (2015) "low noise" account does get a mention, it is important to acknowledge Manning et al.'s (2015) equivalent noise study and Butler et al's (2017) EEG investigation of neural noise in the visual systems of autistic and control children. Neither of these studies provided empirical evidence for increased levels of neural noise in autism. However, using the rigorous double-pass method, Vilidaite et al (2017) did find evidence for indices of neural noise increasing with increasing autistic trait levels.

The sensory aspects of autism were highlighted in the earliest descriptions of the condition by Kanner (1943). Since that time interest in them has waxed and waned, with a high point being the inclusion of "sensory reactivity" in the DSM-5 diagnostic criteria for Autism Spectrum Disorder (APA, 2013), although not the most recently published draft ICD-11 criteria (WHO, 2018). Ironically this may be due to work of ourselves and others that indicates that the sensory issues similar to those reported by autistics seem to be common in the general population, and are therefore not necessarily unique to Autism Spectrum Disorder (e.g. Robertson & Simmons, 2013, 2018; Takayama et al, 2014; Ward et al, 2017; Grapel et al, 2015). Ward (2018) has usefully pointed out the commonalities across a number of clinical and other conditions in terms of the sensory phenomenology and it makes sense that we should begin to think in a more cross-disciplinary way about these issues. Arguably the focus for further research should be on more precise descriptions of both the phenomenology and the direct measurement of sensory performance to tease apart the relationships between subjective, neural and behavioural sensory sensitivity that define these conditions and which have been so eloquently articulated by Ward (2018).

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