

Autism spectrum conditions: the pathophysiological basis for inattention and the new Diagnostic and Statistical Manual of Mental Disorders

W Lawson*

Abstract

Introduction

The pathophysiological basis for repetitive and stereotyped interests in autism spectrum conditions (ASC) has been related to difficulties with shifting attention. For example, to engage socially depends upon being able to attend (note) the physical, cognitive, emotional and sensory aspects of 'self' and of 'other'. Exchanging information from divided attention (broader interests), depends upon GAMMA connectivity. GAMMA connectivity is powered down in ASC, but this can be remediated artificially or by using individual 'interest'.

The aim of this critical review is to discuss the pathophysiological basis for inattention and the new Diagnostic and Statistical Manual of Mental Disorders related to ASC.

Conclusion

Repetitive, single and focused 'interests and behaviour' in ASC are more to do with how attention is processed and less to do with lacking in 'theory of mind'.

Introduction

Some research shows that GAMMA synchrony is more prolific in a typical population than in autism spectrum conditions (ASC) (see Table 1). At the same time, there appears to be excess GAMMA in general, in ASC (red areas in Figure 1a).

* Corresponding author
Email: lawson_wendy@hotmail.com

Autism Centre for Education and Research,
Edgbaston Campus, University of Birmingham,
England, B15 2TU

This in turn will impact negatively on joint attending in ASC. Joint attending relies upon a distributed cortical network connecting aspects of attention within and across neuronal networks. In ASC, the lack of joint attention may be the first thing, a care giver notices in a child. However, joint attention can develop naturally using an individual's 'interest' (passion), sparking attention and subsequent connection.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-V) describes the phenomena in ASC associated with attention and interest, which apply to the whole spectrum of autism. Increasing GAMMA synchrony may be one of the variables that aide synaptic communication and may lead to enable social understanding, which in turn, is the precursor to build social skill.

The aim of this critical review is to discuss the pathophysiological basis for single attention and the new Diagnostic and Statistical Manual of Mental Disorders (DSM-V) related to ASC.

Diagnostic and Statistical Manual of Mental Disorders

The latest DSM-V 2013¹ has all updates of the American diagnostic criteria for ASC. The International Classification of Diseases,² is expected to be followed. In DSM-V, new criteria take us away from the much followed 'triad of impairments', i.e., difficulties with social understanding, difficulties with communication and difficulties with social imagination; hence, the three domains will become two domains. The two domains are, 'the social and communication domain' and 'a restricted repetitive interest

and behaviour domain'¹. The latter category could also be considered as 'being single-minded' using single attention or being singly focussed.

To gain a diagnosis of ASC, difficulties must exist in both domains. There may also be sensory problems, either hyper or hypo, causing environmental reactivity. However, such characteristics may not manifest, until the environmental demands out way the ability to cope. Other issues accompanying the above problems are known as 'specifiers' and may be peculiar to the individual. There may also be additional difficulties with coordination, language and intellectual capacity¹.

Attention

The definition of 'attention' is widely and controversially debated. For the purposes of this critical review, 'attention' and 'interest' will be viewed as two sides of the same coin. The interest system is an array of neuronal activity sparked by any factor or variable allowing the brain to connect it to awareness^{3-5,22}. Therefore, consideration of sensory-motor processing and interest is necessary for typical and ASC individuals^{3,22}. The concept that ASC individuals are 'wired' to work with a single attention/interest field was first postulated by Murray⁶ and was called 'monotropism'. The monotropism idea was further developed by Murray, Lesser and Lawson⁷; Dern⁸ and Lawson^{4,5,9-15}.

Generally, the published literature states that individuals with an ASC find it difficult to shift and/or share attention^{3,6,10-14,16-21,46}. Others suggest that ASC attention appears to be equally available as it is in neurotypical (NT) development; but

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Table 1. Gamma power in four frontal and four posterior sensors²⁹.

		Neurotypicals	ASD
		M (SD)	M (SD)
Frontal-induced		1.36 (0.53)	0.97 (0.33)
Posterior-evoked		4.55 (1.35)	3.64 (1.53)
Frontal-induced	(Congruent)	1.73 (0.75)	1.12 (0.37)
Frontal-induced	(Incongruent)	1.56 (0.72)	1.44 (0.47)
Frontal-induced	Congruency effect	-0.17 (0.99)	0.32 (0.72)

M, mean; SD, standard deviation.

shifts in attention may depend upon complexity²²⁻²⁴.

For example, Goldstein et al.¹⁹ concluded the following:

Thus, this comprehensive analysis of attention in individuals with high-functioning autism only found differences on measures in which the task placed demands on cognitive flexibility or psychomotor speed. Thus, purported attention deficits in autism may actually be primary deficits in complex decision making or psychomotor abilities'. (2001:438)

Some suggest that attention shifts are possible in ASC, when the individual's interest is triggered to spark motivation^{6,15,20,25,26,56}.

GAMMA

GAMMA (brain wave activity between 30–90 Hz) synchrony in ASC²⁷ and in schizophrenia⁵⁷, appear to work differently than in typical development^{10,20,21,57}.

Table 1 provides an illustration of this point in ASC, but only with regard to post-hoc analyses of the in between group on Frontal induced gamma power in the congruent condition, as shown by an independent t-test which approached significance ($p < 0.1$) with neurologically typical individuals showing higher gamma power than those with ASD (ASC). Paired sample t -tests comparing frontal induced gamma power in the congruent and incon-

gruent conditions within each group were not significantly different from each other²⁹.

Richards concluded the following from the study:

The results of this study support the hypothesis that ASC show lower induced gamma power in frontal regions than neurotypicals during a gaze-cueing task. Though the between group difference in gamma power calculated using four sensors did not reach significance, post-hoc analysis using all sensors in the frontal region revealed significantly higher gamma power in neurotypicals than ASC²⁹.

Kleinhans et al. argued that enhanced GAMMA synchrony may enable broader social understanding and connection in ASC^{10,29,30}. If observed, then modelling others as in typical behaviour, is less likely to happen in ASC (unless simply parroting without due understanding) due to narrowed attention; instead opening up attentional capacity via enhancing GAMMA synchrony activity, could allow access to more typical social understanding.

In ASC, there is mounting evidence that GAMMA activity can be either artificially or naturally activated. During times of repetitive transcranial magnetic stimulation (rTMS)²⁸ and during motivation (interest), an increase in GAMMA synchrony was observed, which meant an increase

in cross- and intra-modal neuronal networking¹⁰. This potentially enables an ASC individual to connect to social understanding in a deeper way.

Some research shows that *'dysfunctional excitatory and inhibitory synaptic activities underlie several of the characteristics of autism'*³³. This appears to be the main excitatory and inhibitory neurotransmitters in the human brain due to glutamate and gamma-aminobutyric acid (GABA), working 'differently' in ASC than in the NT populations³³.

However, it is suggested that activity-dependent plasticity, via means of an individual's 'passion' (interest), is a viable means to enhance and enable glutamate and GABA receptors to 'fire'.

Implications

Some researchers and professionals are open and welcome the changes to the DSM^{2,29,34}, whilst others are very sceptical and state that the changes will cause all sort of problems, and are not well thought out³⁵⁻³⁷.

It is of interest that one of the two domains that has been transferred to the DSM-V¹ refers to 'a restricted repetitive interest and behaviour domain'. This implies that the use of attention and interest are being utilised differently in ASC than in the generic population. Restricted interests will mean attention is narrowed, harnessed and deeply seated.

Discussion

In this review, the author has referenced some of her own studies. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees associated to the institutions in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in the studies.

The autism spectrum

Although there are those who debate that deep-seated interests are not a

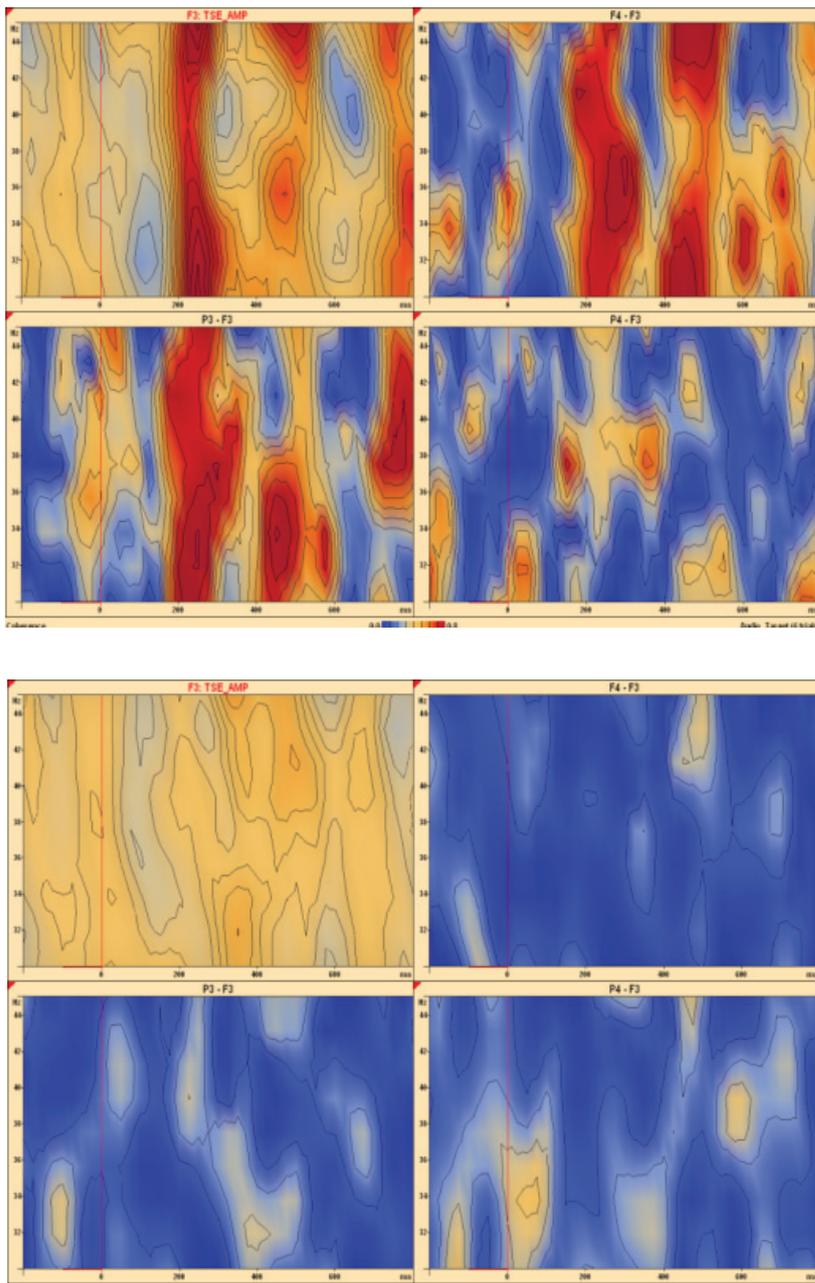


Figure 1: (a) GAMMA in ASC; (b) GAMMA in typical development (slides were obtained upon personal communication with Ryan Kiser, 2013. Also see: Kiser RMB. Audio-visual sensory processing in autism spectrum disorders. Master's Thesis, University of Louisville, 2013).

factor in some with high functioning autism (HFA), the author argues that single focus is a trait that all those with an ASC will share, wherever they are on the spectrum of autism^{11,12}. Whether an individual with ASC is a Professor or an expert in their own field^{38,39} and is cognitively challenged with an intelligent quotient (IQ) of 70

or below² or is at some other point between these two values⁴⁰, they will do better at one task at any one time, unless it is a related task within their field of interest⁴¹.

In ASC multitasking, outside of areas of attention and interest, are practically impossible^{18,24,31}, unless routine, mundane, automatic and/or

not requiring the extra effort of 'extra' attention. If individuals with ASC do manage to do this, it takes over their life and causes their brain to explode (metaphorically speaking)⁴².

Individual experiences

Many authors living with ASC have said that they are not good at shifting attention, but can focus better on one thing at any one time^{2,6,21,35,36,38,41,43}. The stories of individuals living with ASC tell us so much about why they do the things they do and what they actually do.

*It is a lurch for us as individuals with ASC to be precipitated into a new attention tunnel from the one we are engaged in. It makes us feel bad. Therefore, engaging with us on the basis of our own interests makes it much more comfortable for us than bringing other pressing interests to bear*²¹.

However, being single-minded does not necessarily have to be a bad thing. At times, this ability can lead to a person becoming an expert in their field.

Research work, originally stated that fusiform gyrus (FG), which is the part of the brain that is implicated in face recognition, synaesthesia and expertise, was 'faulty' in autism; it did not 'light up' when children with ASC were shown photographs of faces. This was called face blindness or prosopagnosia^{26,44}.

Further research, however, found that the FG in ASC is normally active when children with ASC are shown their own mother's face⁹ or objects that they are particularly familiar with (e.g. cars)¹⁹. The 'expert object recognition pathway' as it is often now thought of, enables individuals, especially when focused and practiced, to become chess experts, mathematicians and so on. This knowledge is very useful and helps us to understand the potential for using the passion or interest of an individual with ASC to unlock connections to social understanding.

Many individuals with ASC say:

'I believe my autism gives me the added ability to focus in depth and this gives me the edge I need in my work'^{11,12,34,38,40,43}. Others have stated that they blame their autistic disposition for their *'failure to make it in a world where being socially minded is the only normal'*³. As human beings we have a lot to answer for if this is the attitude, we populate. Being human means being valuable, it should come as part of the territory.

Conclusion

Repetitive, single and focused 'interests and behaviours' in ASC are more to do with how attention is processed and less to do with lacking in 'theory of mind'.

Some may argue that not being able to put oneself into someone else's shoes (metaphorically), denotes selfishness and egocentricity. Indeed, the term 'autism' suggests 'self', but what if this was because attention is grouped in one place at any one time, rather than divided between 'self' and 'other'. What if this difficulty was more to do with issues in shifting attention and what if we could mediate this through building connections via 'interest'? If the research points to ASC, being a matter of 'attention', we should explore ways to assist individuals to enhance attention; this is what dictates to the patterns and characteristics observed in ASC.

Abbreviations list

ASC, autism spectrum condition; DSM-V, Diagnostic and Statistical Manual of Mental Disorders; FG, fusiform gyrus; GABA, gamma-aminobutyric acid; NT, neurotypical.

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