



Systemizing in autism: The case for an emotional mechanism



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ABSTRACT

More often than others, people with autism engage in systemizing – attempts to understand and build rule-based systems. The mechanism behind the increased frequency of such behavior in autism is unknown, however. The assumption has long existed that emotions exist to motivate behavior, and there is now much evidence that people with autism tend to have stronger, more easily elicited emotions than the average person. This appears to be the cause of increased systemizing in autism – through a negative and a positive emotional pathway: There is evidence that autistic people want control more strongly than do others. This is often so, says the hypothesis, because strong negative emotions, other things equal, make lack of control feel more aversive than it does for most people. Systemizing can increase the feeling of control and hence reduce the negative emotion. Positive emotion can also motivate systemizing in autism – fascination and attraction more strongly felt and more easily elicited than in other people.

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1. Introduction

Some seventy years ago, [Asperger \(1944\)](#) claimed that autism is an extreme variant of the male intelligence and character. This remained a hypothesis based on a limited number of clinical observations until [Baron-Cohen \(2002; Baron-Cohen et al., 2011\)](#) launched his extreme male brain theory, arguing that autism can be understood as an exaggerated variant of the male brain. Not all psychological sex differences will be exaggerated in autism, says the theory, but there will be less of everything having to do with empathy, and more of all that has to do with systemizing ([Baron-Cohen et al., 2011](#)).

Systems can be numerical, mechanical, natural, social, or belong to several other categories – and systemizing, says [Baron-Cohen \(2012\)](#), is the drive to understand or build systems, which are by definition rule-based. A machine is a system, so is mathematics – and dance, too, can be a rule-based system.

The drive to systemize is assumed to explain central aspects of autistic behavior ([Baron-Cohen, 2003, 2010](#)). Though still controversial, Baron-Cohen's theory has generated a considerable amount of research, which in general appears supportive ([Baron-Cohen et al., 2011; Nettle, 2007; Wei, Jennifer, Shattuck, McCracken, & Blackorby, 2013](#)), though not without exception ([Pellicano et al., 2011](#)).

There are several possible causes behind the increased tendency to systemize: Androgens are known to affect brain structure and function ([Genazzani, Pluchino, Freschi, Ninni, & Luisi, 2007](#)), and positive correlations have been found between autistic behavior and the level of

testosterone as well as other sex steroids ([Baron-Cohen, 2010; Baron-Cohen et al., 2015](#)). There are also other hypotheses, not necessarily incompatible with the androgen theory, that may help explain why aspects of the autistic brain and behavior appear hypermasculinized – an interesting example being the possible role of gene variants on the X chromosome ([Nava et al., 2012](#)).

A central question is still unanswered, however. If we assume that the drive called systemizing is indeed unusually strong in people with autism, how can that be? It is well and good that causative processes may have to do with an unusually masculinized brain – but systemizing is described as a drive, and a “drive,” says an uncontroversial definition, is an “internal source of motivation that impels an organism to pursue a goal or to satisfy a need” ([Colman, 2014](#)). What is lacking is an account of why structures and functions thought to characterize an autistic brain give rise to the specific drive to systemize, and what the nature of this drive might be. The present hypothesis attempts to remedy this by describing an emotional mechanism that brings us nearer to several missing answers in a parsimonious fashion.

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2. Presentation of the hypothesis

Most people prefer order (or system) to chaos – and much human progress has been based on the construction of social, legal, and political systems. We are often curious, and may wonder how systems such as locomotives or organisms work. We want to know and control – and as do other organisms, we like most things to be predictable, so we go far to reduce uncertainty (Anselme, 2010). Still people differ, and some are more strongly motivated than others by the chance to understand, construct, and predict the behavior of systems – by systemizing, in other words.

There is little disagreement that feelings exist because they motivate behavior (Damasio & Carvalho, 2013; Overskeid, 2000). We feel good when we eat, rest, and have sex because these activities increase our power to survive and spread our genes. From the first published accounts of autism, however, there have been indications that people with autism have stronger feelings, and therefore stronger motivation, than the rest of us. Let's have a look at the evidence.

The existence of status quo bias is well documented in typical subjects (Samuelson & Zeckhauser, 1988). People don't like change. But autistic people take this further. Everything that changes the external or internal environment "represents a dreaded intrusion," said Kanner in 1943 (p. 244). He went on (p. 245) to describe his autistic patients' responses to everyday events with words such as "horror," "major panic," "grave emotional crisis," and "despair." Not surprisingly, a review (Dawson & Lewy, 1989) concluded (p. 163) that "autism is associated with aversive responses to novelty."

There is general agreement that people with autism often have stronger emotions than others. Negative emotion has received the most attention, and studies show that autistics are frequently anxious and depressed (Mayes, Calhoun, Murray, Ahuja, & Smith, 2011; Vasa et al., 2013), and also often angry, stubborn, and easily frustrated (Lecavalier, 2006; Singh, Lancioni, Winton, & Singh, 2011).

The fact that people with autism have higher scores on the trait of neuroticism than do most people (Austin, 2005) points, of course, in the same direction. It is simply another way of saying that autistic persons experience more negative feelings and have a lower threshold for doing so. Markram and Markram (2010) reviewed a large number of studies and concluded that those who have autism tend to be hyper-emotional, among other things (cf. Yizhar et al., 2011). Smith (2009) also reviewed the literature, focusing on emotional empathy, and concluded that people with autism often have unusually strong feelings, positive as well as negative. Such findings fit well with many autobiographical statements from autistic people, such as O'Neill (1999, p. 24) who describes herself as having "extremely intense emotions." A recent review of the literature supports the assumption that she is not untypical, and concludes that "autism ... is associated with amplified emotional responses" (Mazefsky et al., 2013, p. 679).

Baron-Cohen (e.g., 2003) has pointed out that autistic people tend to systemize so much because systemizing can help them control their environment. The thesis of the present article is that the strong need for control, and hence the increased systemizing often found in autistic people, is motivated by stronger than average emotional responses, which, other things equal, are more easily elicited than in typical individuals. The motivation in question may take the form of positive reinforcement, as when arranging toys by height or solving math problems gives rise to positive feelings. It may also take the form of negative reinforcement, as when ritualized behavior reduces anxiety. Let us look at the pertinent evidence.

Lack of order, system, and predictability can at times make most of us uneasy. It follows from the hypothesis that this unease will be

stronger and more easily elicited in people with autism, and it is relevant that autistics have been shown to react more strongly when a rule is broken (Bolling et al., 2011). The hypothesis further assumes that negative emotions elicited when order, system, or predictability is felt to be lacking will motivate attempts to increase the world's degree of order, system, and predictability – in other words, systemizing.

At other times, however (as when lining up objects or doing science), the motivation to systemize may come from positive emotion – fascination and enchantment that is also more strongly felt and more easily elicited than in other people. Even though bad is stronger than good, in the sense that negative experiences (of which autistics have many) tend to affect people more strongly than do happy events (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001) – the intense joy of which autistics are capable has been noted from the earliest days of autism research, by Asperger (1944) as well as Kanner (1943).

Asperger (1944) described the extraordinary enthusiasm of Harro L., and referred to this as one of his "characteristic depictions" (p. 85) of the autistic personality. Kanner (1943, p. 228) recounted how an autistic person could focus on a circumscribed interest in an "ecstatic-like fashion" while shouting "delightedly." And autistic people do in fact seem enthusiastic about many different things (e.g., Gal et al., 2005; Schoen & Bullard, 2002). A boy describing his autistic childhood emphasized "the excitement." "When I was little," he said, "pretty often I was the happiest a person could be. It was the ultimate joy, this rush in your entire body, and you can't contain it" (see Padawer, 2014). Matt (2013), another person with autism, describes how he and others like him "love" their special interests to the point of becoming "enthralled."

Indeed, the consuming interests which are so typical of autism, and which almost always involve systemizing, appear to be driven by intense positive emotion (Cascio et al., 2014; Mercier, Mottron, & Belleville, 2000). Klin, Danovitch, Merz, and Volkmar (2007, p. 97) conclude: "'obsessions' in individuals with ASD [autism spectrum disorder] are beloved activities apparently associated with great positive valence. ... in individuals with ASD 'obsessions' take the form of passionate pursuit of knowledge or routines ..."

In the words of Jackson (2002, p. 43–44), who has Asperger syndrome (AS): "... it seems that the difference between someone with AS who has a fascination and someone without AS is the level of intensity ... If I am focused on my fascination ... I feel an overwhelming excitement ..." Such subjective reports are also consistent with the findings of Dichter et al. (2012), whose subjects could either win money or the opportunity to see pictures of objects often involved in the circumscribed interests of autistic people (like trains and electronics). Relative to money, autistic participants responded to the object pictures with hyperactivation in reward-related brain areas. In other contexts, too, stronger than usual positive feelings have been found in people with autism (Capps, Kasari, Yirmiya, & Sigman, 1993).

Our relationship with others is important to how we feel, and people with autism often engage in bossy behavior, trying to gain control in their social relations (Baron-Cohen, 2008). When high-functioning autistic people are asked about their circumscribed interests, they do not only mention mechanics and machines – but also fields related to social systems, such as politics, history, social sciences, the U.S. Congress, and U.S. presidents (Klin et al., 2007; Lorenz & Heinitz, 2014; South, Ozonoff, & McMahon, 2005). Politics, history, and social sciences are about understanding and influencing social relations through systemizing – and circumscribed interests in autistic people tend, as we have seen, to be driven by strong positive emotion. This can occasionally be useful. For instance, Klinger and Williams (2009, p. 349) explain how, in an autistic student "obsessed with presidents," being allowed to

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