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Are special abilities in autism spectrum disorder associated with a distinct clinical presentation?

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ABSTRACT

Special abilities may be common in autism spectrum disorders (ASD). The aim of this study was to investigate the clinical presentation of ASD with special abilities. Special abilities were defined based on the Autism Diagnostic Interview-Revised (ADI-R). Based on a sample of 398 children, ages 2–7 years old with ASD, 112 with special skills were compared to an age- and gender-matched group without special abilities ($n = 79$). The examined measures included autism symptoms severity, adaptive behaviors and head circumference percentile. Children with ASD and special abilities seemed to exhibit significantly less impaired ASD symptoms in the social, communication and stereotyped behaviors and significantly better adaptive skills than individuals with ASD without special skills. Children with ASD and special abilities had a larger head circumference percentile than children without special abilities. Special abilities occurred in 28% of the study participants. Memory skills were the most frequently reported special ability, followed by musical, visuospatial and reading skills. The authors conclude that individuals with ASD and special abilities might represent a distinct ASD subgroup with milder clinical ASD presentation. Larger head circumference in ASD was previously associated with enhanced "local" connectivity which provides detailed information processing and therefore might be related to the appearance of special abilities.

1. Review of literature

Autism spectrum disorders (ASD) has been characterized by impairments in social-communication abilities, repetitive and restrictive behaviors. However, the existence of unusual special skills, called "islets of ability", "savant skills", "splinter skills" or "talent" has been described in the ASD literature (Bennett & Heaton, 2012; Howlin, Good, Hutton, & Rutter, 2009). In the past, the term "savant skills" was used to describe individuals with intellectual impairment who demonstrated one or more outstanding skills in various areas that were above what was expected from their cognitive ability (Heaton & Wallace, 2004; Young & Nettelbeck, 1995). Special skills were reported in specific genetic syndromes. For example, memory and visual spatial skills were described in Prader-Willi syndrome (Milner et al., 2005) or exceptional music and memory abilities in Williams syndrome (Levitin et al., 2004). However, special skills have been most identified and described in connection to those with ASD. In his first reports on autism, Kanner (1943) described the presence of excellent memory and musical, mechanical and calculation skills. In later reports, numerous areas of special abilities were described in individuals with ASD.

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Among the described talents were mathematical calculation (Heavey, Pring, & Hermelin, 1999), music (Heaton, Pring, & Hermelin, 1999), drawing (Pring, Hermelin, & Heavey, 1995), memory (Mottron, Belleville, Strip, & Morasse, 1998) and mechanical and spatial abilities (Joseph, Tager-Flusberg, & Lord, 2002). In a postal survey of 5400 parents of children with autism, Rimland (1978) found that 531 (9.8%) were reported to have savant skills. Of this group, 53% reported special ability in music, 40% in memory, 25% in mathematical calculations, and 19% in art. Among 254 subjects with ASD, Bolte and Poustka (2004) reported that 13% had at least one special skill and 11% had special skills in several domains as assessed on the Autism Diagnostic Interview-Revised (ADI-R). In this study, the most frequently described special skill was exceptional memory. Previous reports assessed the association between special abilities and cognitive levels in ASD. Researchers reported that the mean IQ of "savants" with autism was considerably higher than that of those with ASD without special skills (Miller, 1999). Howlin et al. (2009) studied high cognitive ability in 137 individuals with ASD. Of these, 28.5% had either a savant skill (11.6%) or exceptional cognitive skills (16.9%), above population norms or above their own overall level of cognitive functioning. In this cohort, none of those with savant skills had a non-verbal IQ on the Wechsler test below 50 and, overall, the means of the savant group were consistently higher than those without special skills. Bolte and Poustka (2004) did not find differences in IQ between groups with ASD with and without special skills.

Researches have reported sex differences in the frequency of special skills in ASD. Savant skills occur more frequently in males than in females (Bennett & Heaton, 2012; Hill, 1977; Howlin et al., 2009).

In several studies researches have suggested in a link between the severity of the restrictive and repetitive behaviors (RRB) domain and having savant skills. O'Connor and Hermelin (1991) found that individuals with autism and savant skills showed a particular interest in one specific topic (i.e. names, birthdays) and in repetitive ordering of their belongings. Howlin et al. (2009) assessed the relationship between savant skills and stereotyped repetitive behaviors based on ADI-R scores on the RRB domain, including the entire severity range of 0–3 code for each item. Their study found that individuals with exceptional cognitive or parent-rated skills did not have higher rates of RRB than those who did not. They concluded that the severity of RRB domain was not related to savant skills. A recent study (Bennett & Heaton, 2012) supported this finding as the researchers, using their own newly-developed questionnaire that included items on social, communication, RRB and savant skills did not find increased repetitive behavior or increased obsessionality in the savant group.

The findings from several studies suggested a local information bias in certain domains in individuals with savant skills. This has led researchers to suggest that special skills might be related to weak central coherence (Happe & Frith, 2006), one of the core theories to explain autism. In their hyper-systemizing theory, Baron-Cohen, Ashwin, Ashwin, Tavassoli, and Chakrabarti (2009) suggested that an autism-specific ability to identify repeated patterns in stimuli may help to explain the high prevalence of savant skills in ASD.

In a few studies, the neurological basis of "savant skills" has been investigated using neurobiological and neuroimaging techniques. It has been assumed that these savant skills are commonly associated with the right cerebral hemisphere function. The underlying cause could then be left hemispheric maldevelopment with right hemispheric compensation, possible right hemispheric disinhibition, or utilization of alternate memory circuits. Most imaging studies were based on case reports with special skills and suggested abnormal brain organization. For example, in a MRI study on a 54-year old with numerous savant skills, Treffert and Christensen (2006) found complete absence of corpus callosum and altered white matter tracts connecting the two hemispheres. Bor, Billington, and Baron-Cohen (2007) reported abnormal brain activation patterns in a fMRI study on a young man with Asperger syndrome and unusual numerical visual digit span memory skills. The researchers described abnormal activation patterns in the prefrontal cortex in the savant as compared with typical controls during the performance of a task of memorizing sequences of digits. In a study where a PET scan was used on a young person with autism and unusual ability in calendar calculation, researchers reported an activated fronto-temporal network that included the hippocampus (Boddaert et al., 2005). Recently, Corrigan, Richards, Treffert, and Dager (2012) reported in a DTI study performed on a 63-year old with savant skills that the amygdala and caudate nucleus were highly asymmetric with enlargement on the right side, suggesting differences in white matter integrity of the cerebral circuits involving these structures.

Although there have been several studies that investigated the phenomenon of special skills in ASD, many are single case or small group studies of individuals and only a few have been systematic and large-scale investigations (Corrigan et al., 2012). Heterogeneity in diagnosis procedures, criteria for diagnosis of ASD, and ages of the participants add to the inconsistency in the results regarding special abilities in ASD. For now, there is little valid information on rates of savant skills in ASD and whether the existence of such abilities indicates a more-or-less severe presentation of clinical symptoms. No published research has examined whether having special abilities is associated with functioning of individuals with ASD.

In addition, the phenomenon of special skills in ASD may have important theoretical implications. Evidence regarding a relation between having special skills and the repetitive and restricted behaviors domain and/or sensory abnormalities may support the hypothesis that systemizing or 'enhanced perceptual functioning theory' (Mottron, Dawson, & Soulieres, 2009) contribute to the occurrence of special skills in ASD.

The main aim of the current study was to compare behavioral functioning and head circumference as a biological marker in children with ASD and special skills to an age- and gender-matched ASD group without special abilities. The current study addresses two main assumptions regarding 'special abilities' in ASD. Firstly, 'special abilities' in ASD might represent either a separate subtype with a unique clinical presentation, or a distinct feature within ASD. Alternatively, having special abilities in ASD might be related to the restricted and repetitive behaviors (RRB) domain. Secondly, the study examined the frequency and characteristics of 'special abilities' in a large, well-characterized population with ASD in early childhood.