

# Sensory Features as Diagnostic Criteria for Autism: Sensory Features in Autism

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In this study, we examined the frequency of sensory-related issues as reported by parents in a large sample of school-age adolescents and adults with autism/autism spectrum disorder (ASD†) [1] as compared to a group of individuals receiving similar clinical evaluations for developmental/behavioral difficulties but whose final diagnoses were not on the autism spectrum. In no comparison were the features examined predictive of autism or autism spectrum in comparison to the non-ASD sample. Only failure to respond to noises had sensitivity above .75 in the comparison of the broader autism spectrum group, but specificity was poor. While sensory issues are relatively common in autism/ASD, they are also frequent in other disorders. These results question the rationale for including sensory items as a diagnostic criterion for autism.

Since Kanner's [2] original description, sensory features have been noted in many individuals with autism. In their recent comprehensive review, Baranek et al. [3] note some of the complexities in interpreting the available literature, including variations in terminology and lack of information on age-related changes in such features. Although hypo/hypersensitivity was a proposed feature of the National Society for Autistic Children definition [4], it was not regarded as an essential feature in the Rutter [5] definition that proved highly influential in the third Diagnostic and Statistical Manual for Mental Disorders (DSM-III) [6]. As part of the DSM-IV field trial, a potential criterion of hypo- or hypersensitivity to sensory stimuli was examined but not included in the final definition, since it was a less powerful diagnostic feature than other potential criteria [7]. In contrast, the new DSM-V definition of autism [1] does include sensory issues as one of the four restricted/repetitive behavior features defined as "hyper or hypo reactivity to sensory input or unusual interest in sensory aspects of the environment."

Reactivity to sensory input has been related to autism even as far back as when Kanner first began studying the disorder [2]. Dating back to the 1940s, Kanner would observe children with autism who expressed hyposensitivity to stimuli (such as not hearing fire alarms when they were set off) or hypersensitivity (such as throwing tantrums when made to wear certain clothing because the child could not

tolerate the texture of the fabric). Children with autism also have been reported to be fixated on certain sensory stimulants, such as staring at a flashing light for hours and refusing to be interrupted from it. Although small studies have reported a prevalence of more than 90 percent of children with autism possessing some sort of hypo- or hypersensitivity to sensory stimuli, there have been no epidemiological studies to prove this. Furthermore, although such a high percentage of children with autism have been reported to have some hypo- or hypersensitivity to sensory stimuli, there is no data that differentiates the nature of these reactivities with reactivity seen in other mental disorders.

Sensory issues and problems are clearly not unique to autism. Although not officially recognized as a diagnosis, the term sensory processing disorder (SPD) has been used to describe individuals with a range of difficulties, not just those with autism. Individuals with intellectual impairments or attention deficit disorder (ADD) may also exhibit sensory over/under-responsiveness. Although potentially important as targets for intervention, the significance of sensory issues as a diagnostic criterion/feature for identifying autism remains to be clearly established.

## METHODS

Data from a sample of 776 people who participated in a comprehensive, trans-disciplinary diagnostic assessment

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†Abbreviations: ASD, autism spectrum disorder; DSM, Diagnostic and Statistical Manual for Mental Disorders; TR, text revision; SPD, sensory processing disorder; ADD, attention deficit disorder; PDD, pervasive developmental disorder; AS, Asperger's syndrome; PDD-NOS, PDD-not otherwise specified; ADOS, Autism Diagnostic Observation Schedule.

**Table 1. Parent reports of sensory features in autism: sensitivity and specificity.**

Item	Autism (DSM-IV TR) vs. NON-PDD							Autism Spectrum (DSM-IV TR) vs. NON-PDD						
	Total N	Se	Sp	PPV	NPV	Overall Accuracy	$\phi$	Total N	Se	Sp	PPV	NPV	Overall Accuracy	$\phi$
Overly preoccupied with sounds/auditory stimuli	491	.50	.51	.50	.49	.50	.00	776	.56	.33	.23	.68	.39	0.10
Not aware of painful bumps/falls	490	.53	.51	.21	.82	.51	.03	775	.71	.32	.20	.82	.40	.03
Doesn't notice noises others would	491	.70	.55	.24	.89	.56	.17	776	.79	.34	.19	.90	.41	.11
Upset by bright lights	491	.44	.49	.46	.79	.48	-.06	776	.64	.31	.17	.79	.37	.05
Upset by loud sounds	491	.48	.49	.44	.53	.49	-.02	776	.69	.33	.49	.53	.50	.02
At least one sensory feature reported	491	.52	.44	.69	.37	.57	.07	776	.54	.36	.54	.37	.47	.08

Se=Sensitivity, Sp=Specificity, PPV=Positive Predictive Value, NPV=Negative Predictive Value,  $\phi$  =Phi Coefficient/Measure of the strength of association

and were tested and diagnosed using DSM-IV text revision (TR) were used for this study. Of these 776, 244 were diagnosed with autism according to the DSM-IV criteria. Another 285 were diagnosed with a pervasive developmental disorder (PDD) that is not autism but is on the autism spectrum, such as Asperger's syndrome (AS) or PDD-not otherwise specified (PDD-NOS). The rest of the people in the study were diagnosed with another non-ASD, such as intellectual deficiency, language disorder, learning disabilities, or other issues. In all instances, individuals received comprehensive intellectual and adaptive skills assessment; administration of at least one diagnostic instrument, typically the Autism Diagnostic Observation Schedule (ADOS); and their parents provided reports of past testing as well as behavioral history. Cases ranged in age from 7 to 61 years of age, with a mean of 19.06 years and a standard deviation of 6.32 years. The comparison group's mean age was 20.16 years with a standard deviation of 5.81. This study collected data from 128 females and 648 males. In each case, diagnosis was established by DSM-IV TR (2001) criteria following a comprehensive multidisciplinary evaluation, which included parent-completed developmental/behavioral questionnaires. From the large set of information available, five questions routinely were asked of parents regarding current sensory features (see Table 1). Parents, typically mothers, responded on a Likert scale of 0 to 5, with responses of "rarely" and "never" regarded as negative and responses of "common" to "highly frequently" as positive. These dichotomized items were then compared using both more strictly diagnosed autistic disorder as defined in

DSM-IV TR and the broader autism spectrum category (ASD+AS+PDD-NOS). Diagnoses were established by consensus of the interdisciplinary team. Sample size for each comparison varies slightly given the potential for parents to indicate that they couldn't accurately answer the question or they just left it blank. We specifically chose not to include preschool cases as there is a consensus that the diagnosis becomes more stable by school age [8].

## RESULTS

Table 1 presents the various sensory items and comparison of DSM-IV TR diagnosis for autistic disorder and the broader PDD/autism spectrum group, including cases with diagnoses of AS and PDD-NOS. Analyses are presented for both autistic disorder (DSM-IV TR) versus non-PDD and PDD/ASD (autistic disorder, AS, and PDD-NOS) versus non-PDD. In other words, the data compares autism specifically to non-PDD, and it compares all PDD disorders collectively to non-PDD disorders. As noted in Table 1, only failure to respond to noises that others would notice had a sensitivity above .75, although specificity was poor (.34). This means that a failure to respond to noises that others respond to is the only measure in which there was a significant difference between patients diagnosed with autism or another PDD disorder and patients diagnosed with a non-PDD disorder. Table 1 also presents the phi statistic, a measure of strength of association similar to a correlation co-efficient [9]. In all cases, the strength of the association

was modest at best. The final comparison in the table (at least one sensory feature endorsed) is probably the closest approximation to the current DSM-V sensory criterion. As noted in the table, the power of such an item to discriminate ASD versus non-ASD or autism (more strictly defined in DSM-IV TR terms) is poor.

## DISCUSSION

In the field trial [7], hypo- and hypersensitivity to sensory stimuli as a diagnostic criterion for autism was examined for possible inclusion in the DSM-IV definition and, in the end, was not included given its relatively poor power to discriminate autism and non-PDD cases. The current results are consistent with that view. While sensory issues and problems are frequent in autism/ASD, they are also relatively common in other disorders and do not discriminate autism nearly as strongly as the core social dysfunction does [10]. The comparison group here — a large group of cases seen in the same developmental disabilities clinic using the same protocol — is quite relevant, since it is just this group in which issues of diagnostic discrimination are most important.

As noted in Baranek et al.'s recent review [3], a wide range of terms and concepts have been used in the description and conceptualization of sensory issues in autism. The topic is a broad one; for example, it includes under- and over-responsiveness, sensory avoidance or sensory seeking, enhanced sensory perception, deficits in sensory integration, and over-preoccupation with sensory aspects of the environment. In part, this broad range in terms and concepts reflect the underlying and dramatically different experiences of individual with autism. As Baranek et al. [3] note, much of the literature on the topic is rather age specific, with little information on sensory issues in young children or adolescents and adults. Furthermore, sensory issues vary by modality. For example, in some cases, it may be an auditory issue, while in others, tactile perception or visual stimulation may be the issue. In some cases, the issue may have to do with enhanced sensory perception. These complexities may contribute to the difficulties of including sensory features as a defining feature of autism. In addition, sensory features are frequent in a range of other developmental problems. It is also quite possible that in many cases the severity of social and communication problems mask, at least to some extent, the sensory difficulties in autism. Anecdotal reports further highlight this issue [3]. As noted in the Baranek review [3], it may be very difficult to disaggregate restricted and repetitive behaviors with sensory features; that is, the two symptom areas in the DSM-5 definition may be largely overlapping. The inclusion of hyper- and hypo-reactivity to sensory stimuli in the DSM-5 definition may have reflected several factors, including an awareness, at least in school-age children in whom most of the data arise, of the frequency of sensory issues. Another consideration may have been an awareness of the importance of sensory features in intervention. It does, however, remain unclear that this addition is helpful

across the entire span of age and developmental level. Put another way, the results basically indicate that sensory problems are relatively common in a range of developmental/learning disorders and not unique to autism/ASD.

Our sample did not include children younger than 5 years, and it is possible that differential sensory responses are observed only in those groups. The one item that did have modest power in the broader autism spectrum versus other comparison (failure to respond to sounds) might also be related to failure to respond to the voice of the caregiver, a frequently reported feature in younger children [3]. Unfortunately, we did not have a question focused on just that issue, and it will be important to clarify with future research. If the response to the question asked is colored by a lack of social interest, this item might just as well be considered a more social one — and such items have historically proven more robust in diagnosing autism [10].

The data presented here are based on parental reporting. As with any single measure (parent, teacher, or self-report), such data should be treated with some caution. Clinical observation may have yielded different results, as professionals may have noticed things the parents did not pick up on. That being said, for purposes of the present study, parents are almost certainly the most well-informed individuals on behavioral sensitivities of their own children. Clinical observation may be useful in future studies.

Sensory issues may be a source of concern and disability and may well need to be addressed as part of a comprehensive treatment program [4]. These results strongly question the utility of including such features in the DSM-V definition of autism in school-age, adolescent, and adult samples.

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