

SENSORY – PERCEPTUAL DEFICIENCIES AND POSSIBLE CONSEQUENCES IN AUTISM

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Difficulties and peculiarities of sensory and perceptual experiences in autism have been acknowledged since long, autism research, however, has greatly focused on problems of cognitive processing, such as difficulties in using mind reading skills. Research generated by major theories of autism has concentrated on the cognitive side, but it has become clear that gaps in explanations for autism spectrum disorder still exist. A line of new research calls for a better understanding of the so far neglected role of sensory – perceptual difficulties in autism (Bogdashina, 2003; Robinson & Johnson, 2010). In this paper we briefly review theories of autism, emphasizing the role of sensory – perceptual processes in understanding autism spectrum disorder. Then, we present findings of an exploratory study in which we compared the way typically developing children and children with autism perceive the world and select information. We used Bogdashina's Sensory Profile Checklist Revised (SPCR) in a sample of 30 healthy children (age 2-7) and 17 children diagnosed with autism (age 2-7.5). The questionnaires surveying the current and retrospective sensory profiles of children were filled out by the parents. Results suggest that autistic individuals' sensory – perceptual patterns are different from the control group in several respects. We suggest that perceptual differences in autism need to be studied further so we can provide efficient therapies and also because understanding sensory-perceptual processes in autism will contribute to theoretical development in the field.

Keywords: autism spectrum disorder, sensory deficiencies, sensory and perceptual processing, sensory integration deficiency, embodied cognition

Autism and its theories

Autism (Autistic Spectrum Disorder, ASD) is a highly variable, perplexing phenomenon and a great number of research projects aim at finding out the roots of the various deficiencies typically present in autism. After many years of intense research in the field researchers tend to emphasize the multitude of factors that may reside behind the disorder (e.g. Ratajczak, 2011). The "final common pathway" model of Baron-Cohen and Bolton (2000) suggests that genetic factors, viral infections, circumstances of pregnancy, birth complications and other factors

together can result in brain damage. Evidently, autism can result from multiple causes and can have different manifestations in different individuals. In spite of the assumed multitude of factors, theoretically inspired research in the past decades has greatly focused on cognitive deficiencies present in autism. There have been three major theories trying to account for the “triad of impairments” characteristic of autism, as first described by Wing and Gould (1979): 1. Impairment in communication (delayed speech development, echolalia, lack of reciprocity in verbal and nonverbal communication), 2. Impairment of social interaction (poor understanding of and little participation in social interactions), and 3. Impairment of imagination (poor quality of pretend play, repetitive and ritualised behaviours).

The most popular theory, first introduced by Baron-Cohen, Leslie and Frith (1985), points out the weakness of mentalizing ability in autism. Difficulties in inferring other people’s mental states (thoughts, beliefs, intentions) is explained by not being able to construct a model (theory of mind, ToM) of others’ mental states. Research along this line has widely demonstrated ToM deficits by failure on false belief tasks, however, methodology and interpretation of these results have been reviewed with criticism recently. Boucher (2012), for example, points out that whereas false belief tasks create a triadic interaction situation (the subject has to observe a dyadic interaction from a third person point of view and theorize about the thoughts of the actor involved in the interaction), real social interactions involve dyadic situations in which first and second person perspectives are involved. Research should focus on dyadic interaction, as that may be of critical importance in the development of mentalizing abilities. Gallagher (2004) claims that ToM approaches offer an inadequate account of the non-autistic understanding of others, in the first place. In line with Boucher he argues for the importance of dyadic relations and primary intersubjective understanding present from birth in typically developing children. Primary intersubjectivity (a term originally introduced by Treverthen, 1979) refers to the early developing capacity to focus on key aspects in dyadic interaction that regulate mutual control, such as eye contact and sensomotor coordination (Gallegher, 2004). The typically developing infant is naturally geared toward eye contact, bodily movements, facial gestures, eye direction - all revealing emotional, sensory-motor, perceptual information about the other person’s intentions and feelings. In case this capacity is not in place in early development, as in autism, the entire pathway of social development is negatively effected.

Executive function theory, the second major theoretical approach to cognitive deficiencies in autism, focuses on problems with the conscious control of thought and action, suggesting that problems in planning, flexibility, cognitive organization and self-monitoring are the core problems (Hughes & Russell, 1993; Ozonoff & McEvoy, 1994). The theory has been used to account for a variety of cognitive disorders and has been extended to explain rigid, repetitive behaviors (Turner, 1997). Executive function theory points out frontal lobe dysfunction in the background of stereotyped and repetitive behaviors, such as spinning and rocking, and insistence on sameness. Executive function is an umbrella term for a variety of higher-order mental operations, the exact nature of which is not yet fully understood. Nor is impairment of executive function specific to people with autism, since a variety of other developmental disorders (e.g. attention deficit hyperactivity disorder,

Tourette syndrome, conduct disorder) also shows these signs (Happé & Frith, 1996).

Both ToM theory and executive function theory explain certain deficits, but neither of them provides any clue for reserved or superior functions sometimes present in autism (Happé & Frith, 1996). The theory of central coherence, the third major theory of cognition in autism, focuses on the normal capacity to process incoming stimuli globally and in context. People with autism make less use of context and pay preferential attention to parts rather than wholes. The idea is that in autism information input is weakly integrated and thus people with autism can not interpret fragmented pieces of information coherently (Happé and Frith, 1996). Local and piecemeal information processing may explain not just deficiencies but also intact and superior abilities in autism (such as outstanding memory of details or numbers).

The above theories generated much research by the mid-1990's, however, leading researchers of autism concluded that attempts to reduce mindreading deficits to problems in executive function or central coherence alone appeared to be unfruitful (Happé & Frith, 1996). Neuropsychological theorizing has come to the forefront since the 1990's, and recently a novel theory has been developed by extending findings related to mirror neurons discovered in that decade. At present we understand that the mirror neuron system (MNS) is a neurophysiological mechanism that has essential role in understanding other's actions and intentions (Gallese, 2003). MNS-based social understanding is assumed to be an implicit, automatic process, and since it is assumed to involve sensory-motor based simulation of observed actions and emotions, it is called an "embodied" process (Gallese, 2003), referring to the importance of bodily-based sensory and perceptual processes. Several studies have found that individuals with autism show no or reduced MNS-activation during the observation and imitation of faces expressing four different kinds of basic emotions (Dapretto et al., 2006; Gallese, 2010; Oberman, Winkielman, & Ramachandran, 2010). Evidence is, however, at present inconsistent and inconclusive (Dinstein et. al., 2010). Explanations abound, each having its strengths and weaknesses. Theories highlight a multitude of factors, yet it is highly conspicuous that sensory - perceptual processes are not among the main candidates of causal factors behind autism. Why this is so and why they should be of interest are questions we raise next.

Sensory-perceptual aspects of autism

Although autism is defined by behavioral criteria first and foremost related to the impairment of communication, social skills and imagination (Wing's triad, Wing & Gould, 1979), we have to consider sensory - perceptual aspects as well, in order to understand this disorder. Unusual sensory experiences have been observed in autistic people from the very beginning of the first descriptions of the condition. Autobiographical accounts published in the past decades by high functioning people with ASD (e.g. Grandin, 1992; O'Neill & Jones 1997; Williams, 1992) confirmed early observations and filled them out with subjective details describing the experiences of hyper- and hyposensitivity, sensory overload, visual distortions, fragmented perception, and sensory shutdowns. These accounts, along with subjective reports appearing on the Internet, present graphic descriptions of unusual sensory experiences

and make it easier to understand what it means to live with such disorders:

“What I do realise is that I do not see the world as others do. Most people take the routines of life and day to day connections for granted. The fact that they can see, hear, smell, touch and relate to others is ‘normal’. For me, these things are often painfully overwhelming, non-existent or just confusing” (Daly et al, 2012, 6).

“Sometimes when other kids spoke to me I would scarcely hear, then sometimes they sounded like bullets” (White & White, 1987, 224-225).

“The sharp sounds and bright lights were more than enough to overload my senses. My head would feel tight, my stomach would churn, and my pulse would run my heart ragged until I found a safety zone” (Willey, 1999, 22).

“I did not see whole. I saw hair, I saw eyes, nose, mouth, chin, ... not face” (Williams, 1999, 180).

“My hearing is like having a sound amplifier set on maximum loudness. My ears are like a microphone that picks up and amplifies sound. I have two choices: 1) turn my ears on and get deluged with sound or 2) shut my ears off. Mother told me that sometimes I acted like I was deaf. Hearing tests indicated that my hearing was normal. I can't modulate incoming auditory stimulation” (Grandin, 2000, Sound and Visual Sensitivity, 1. paragrafus).

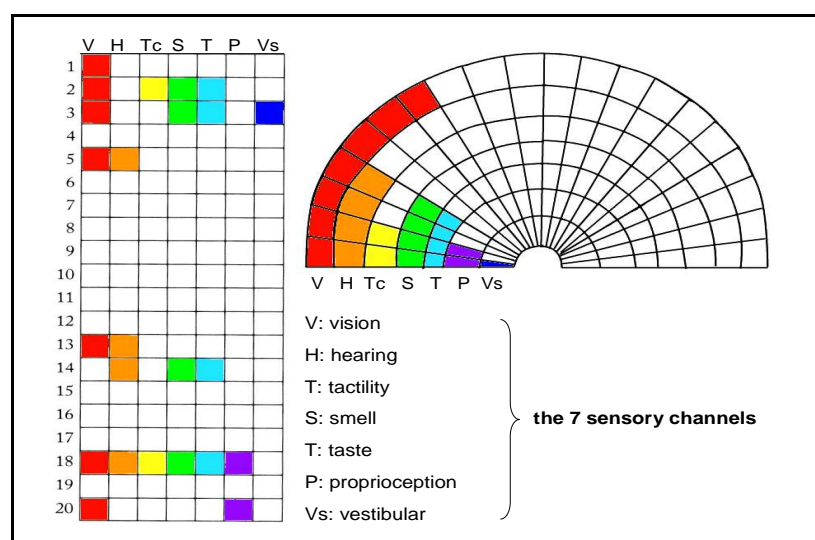
Experiences like the ones described above have major impact on social interaction, communication, and on developmental processes in infancy and childhood. Coping processes involve avoidance, fascination, mono-processing, peripheral vision, and delayed processing, among others (Daly et al, 2012). Unusual experiences call forth unusual behavioral responses, and if these sensory behaviours are not understood, they appear as incomprehensibly strange behaviour.

In spite of accounts on sensory differences, sensory aspects did get moderate attention in theories of autism. The origin of this bias can probably be traced back to Hermelin and O'Connor (1970), who first contrasted autism with other forms of handicap, including blindness and deafness (described in Happe & Frith, 1996). Hermelin and O'Connor made the assumption that there could be specific impairments in autism and they argued that neither general retardation, nor peripheral input problems could explain these. In accordance with information processing models of the time they separated central processing from input and output processes and concluded that, most importantly, central cognitive processes were effected in autism (Happe & Frith, 1996). Sensory processes as „peripheral” were not given much weight, and, instead of core causal factors they were considered as less essential co-morbid phenomena. This approach was certainly due to the then prevalent view of cognition as abstract and “disembodied”. However, with much current emphasis on the role of sensory-motor processes in the context of “embodied cognition” (e.g. Clark, 1999), there is a more favourable Zeitgeist to appreciate the importance of sensory and perceptual processes in autism.

Sensory processing differences are neither universal nor specific to autism, but the prevalence of such problems in autism is unquestionably high. Anecdotal subjective accounts are an important source of information, however, systematic research is needed to explore occurrence and quality of sensory and perceptual abilities and experiences (Dawson & Watling, 2000). Such research has been so far scarce and lacked consistency (Baranek, 2002). Major problem is the scarcity of standardized assessment tools.

One of the assessment tools is the Sensory Profile Checklist Revised by Bogdashina (SPCR; Bogdashina, 2003). The SPCR requires the caretaker to respond to items describing behavioral responses of his/her child to sensory stimuli. The caretaker responds by indicating how characteristic the given behavior is to the child at present, and how characteristic it was in early development. On the basis of the answers the child's sensory strengths and weaknesses can be recognized and visually displayed as an individual „rainbow” (see Figure 1). The measure is suitable to distinguish hypersensitivity, hyposensitivity and other types of sensory and perceptual experiences (including both general modality-specific sensitivity and unusual experiences, for example, sensory overload, visual distortions, fragmented perception, and sensory shutdowns) in different sense modalities.

Figure 1. *Sensory Profile Checklist Revised (SPCR, Bogdashina, 2003), showing markings for 20 items*



The SPCR has proved to be useful in guiding clinical intervention but its internal consistency and validity have been only recently analysed. In their research Robinson and Johnson (2010) used the SPCR questionnaire to explore patterns of sensory and perceptual experiences and to establish measures of validity and reliability. In this study the SPCR was completed by support workers based on their observations of 38 individuals with diagnosis of ASD and 40 individuals from the general population. Internal consistency of SPCR was high. Individuals with autism were found to score significantly higher on the SPCR than healthy controls. The authors concluded that sensory and perceptual processing styles of individuals with ASD are significantly different compared to those of healthy controls. The high correlation between items of the SPCR and AQ scores (autism quotients, Baron-Cohen, Wheelwright,

Skinner, Martin, & Clubley, 2001) suggested that the SPCR is a valid and useful tool for evaluating the sensory and perceptual experiences of individuals with autism spectrum disorder (Robinson & Johnson, 2010).

A comparative study of sensory profiles of typically developing and ASD children

The current research aims to explore the pattern of sensory and perceptual experiences of young children living with autism as compared to typically developing children, using the Sensory Profile Checklist Revised (SPCR) developed by Bogdashina (2003). Our goal is to map out sensory – perceptual differences of children living with autism and thereby delineate developmental pathways characteristic of autism.

Participants

Seventeen mothers with ASD-diagnosed children participated in the experimental group (one having a daughter and sixteen having sons). Children ranged in age from 2 to 7 years ($M = 4.68$; $SD = 1.47$). The criterion of inclusion in the study was previous medical diagnosis. Participants were recruited by professionals working in local day care services for children with autism. In the control group there were mothers of thirty typically developing nursery school children matched on chronological age (age from 2 to 7.5 years, $M = 4.72$; $SD = 1.35$; 11 girls and 13 boys, 6 of the children's gender remained unknown). Ethnic or social background didn't distinguish between the two groups.

Materials

Bogdashina's Sensory Profile Checklist Revised (SPCR, Bogdashina, 2003) contains 232 items pooled into 20 categories based on the seven sensory modalities (vision, hearing, tactile perception, smell, taste, proprioception and vestibular perception), covering the whole array of sensory experiences. The items are based on clinical observations and first-hand accounts by individuals with high-functioning autism and Asperger syndrome. (Examples are: "Avoids direct eye contact", "Covers ears when hears certain sounds", "Enjoys certain patterns (e.g. brickwork, stripes)", "Is frightened by flashes of light"). Caretakers respond to statements by indicating that the given behaviour (1) was true in the past (2) is true now (3) is false (4) doesn't know the answer, or is unsure.

Procedure and scoring

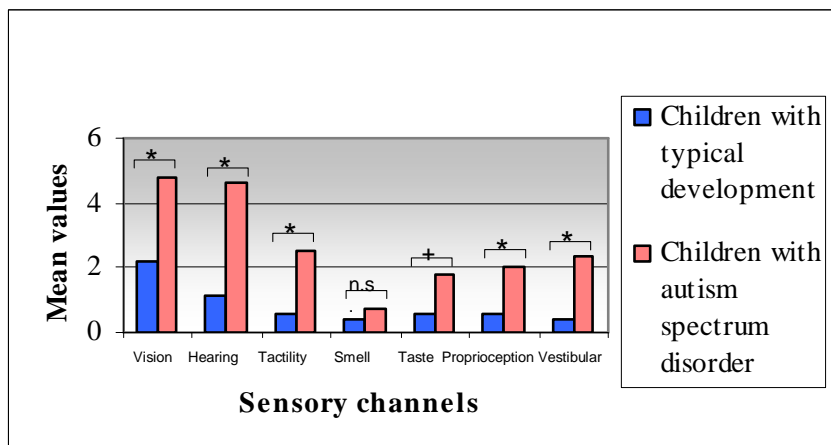
The parents were asked to complete the Sensory Profil Checklist Revised (SPCR) in their homes and return the questionnaires to the researchers. Participating parents were cooperative, although 6 of them did not specify the child's exact age or gender. In scoring we used the guide for SPCR outlayed by Bogdashina (2003) to get the sensory profiles on the seven sensory modalities. Furthermore, we analysed reported behavior regarding hypersensitivity, hyposensitivity and other sensory and perceptual experiences. Following Bogdashina (2003), in our paper hypersensitivity refers to acute, heightened, or excessive sensitivity (examples are: "Dislikes dark and bright lights", "Covers ears at many sounds", "Cannot tolerate new clothes; Avoids wearing shoes"). Hyposensitivity stands for below normal sensitivity (examples are: "Looks intensely at objects and people", "Bangs objects, doors", "Likes pressure, tight clothing", Bogdashina, 2003, 53) and the term „other sensory and perceptual experiences” means characteristic sensory experiences other than hyper- and hyposensitivities, including both general modality-specific sensitivity and unusual experiences, such as sensory overload, visual distortions, fragmented perception, and sensory shutdowns (examples are: "Displays a good visual memory", "May respond differently (pleasure - indifference - distress) to the same visual stimuli (lights, colours, visual patterns, etc.)", "Hears a few words instead of the whole sentence", "Uses songs, commercials, etc. to respond", "Seems to feel pain of others").

Results

Comparison of earlier and current presence of sensory experiences

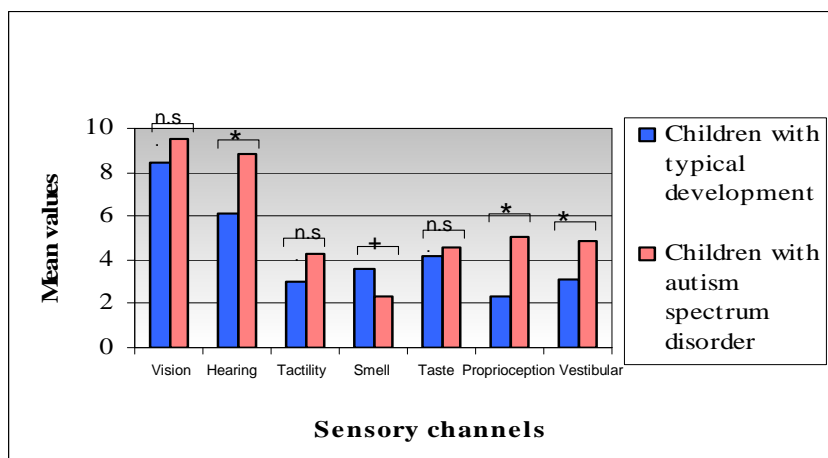
Comparison of the mean values of answers indicating earlier presence (“was true in the past”) of sensory phenomena by Independent-Samples T test showed significant differences between typically developing (TD) children and ASD children in the following five sensory modalities: (1) vision ($t(45)=-2.240$, $p=0.036$); (2) hearing ($t(45)=-2.826$, $p=0.011$); (3) tactility ($t(45)=-2.543$, $p=0.021$); (4) proprioception ($t(45)=-2.162$, $p=0.042$); (5) and vestibular perception ($t(45)=-2.932$, $p=0.009$). Regarding taste there was a statistical tendency for difference between the two groups ($t(45)=-1.930$, $p=0.068$). All of the mean values of the seven sensory modalities were higher in the ASD group compared to the TD group (see Figure 2). Gender differences could not be fully analysed since there was only one girl in the ASD group. In the control group there was no significant difference between boys and girls with regards to the 7 sensory modalities.

Figure 2. Mean values of the earlier sensitivity of the 7 sensory channels, in comparison of typically developing children and children with autism (*: $p < 0.05$; +: $p < 0.1$; n.s.: $p > 0.1$)



Comparison of the mean values of answers indicating current presence (“is true now”) of sensory phenomena by Independent-Samples T test showed significant differences between TD and ASD children in the following three sensory modalities, with scores higher in the ASD group: (1) hearing ($t(45)=-2.864$, $p=0.008$); (2) proprioception ($t(45)=-3.425$, $p=0.002$); (3) and vestibular perception ($t(45)=-2.116$, $p=0.045$). Regarding smell there was a statistical tendency for difference between the two groups ($t(45)=1.749$, $p=0.087$). Interestingly, smell was the only factor which had a mean value higher in the TD group than in the ASD group (see Figure 3). In the control group there was no significant difference between boys and girls with regards to the seven sensory modalities. Comparison of the earlier and current mean values of the seven sensory modalities by Paired Samples test showed significant differences ($p < 0.05$) between the groups in all cases. The mean values for current presence of sensitivities in the seven sense modalities were found higher than mean values for past presence.

Figure 3. The current mean values of the 7 sensory channels, in comparison of typically developing children and children with autism (*: $p < 0.05$; +: $p < 0.1$; n.s.: $p > 0.1$)



To explore age differences in sensitivity of the seven sensory modalities we formed three subgroups within the groups of TD children and ASD children: (1) 2-3.5-year-old children (2) 4-5.5-year-old children, and (3) 6-7.5 year old children. The proportion of TD children and ASD children was nearly the same in all of the subgroups. Oneway ANOVA didn't show any significant differences among the age groups.

Comparison of association patterns

To examine association patterns over the seven sensory modalities we performed Bivariate Correlations within the TD and the ASD groups, separately for past and current presence of sensory experiences. Regarding past presence of sensory phenomena noticeable associations were more numerous and stronger in the ASD group than in the TD group. In the ASD group the strongest correlations were between: (1) vestibular perception and tactile perception ($r(16)=0.873$, $p=0.000$); (2) vision and hearing ($r(16)=0.855$, $p=0.000$); and (3) vision and vestibular perception ($r(16)=0.843$, $p=0.000$). In the control group vision had a strong correlation with hearing ($r(29)=0.773$, $p=0.000$) and taste ($r(29)=0.768$, $p=0.000$), furthermore smell had the third strongest correlation with taste ($r(29)=0.753$, $p=0.000$).

Regarding current presence of sensory phenomena we found more and stronger associations in the TD group than in the ASD group. In the ASD group the strongest correlations were between: (1) tactile perception and proprioception ($r(16)=0.838$, $p=0.000$); (2) smell and taste ($r(16)=0.792$, $p=0.000$); and (3) vestibular perception and proprioception ($r(16)=0.773$, $p=0.000$). In the control group vision had a strong correlation to hearing ($r(29)=0.843$, $p=0.000$), taste ($r(29)=0.703$, $p=0.000$) and proprioception ($r(29)=0.658$, $p=0.000$).

That is, regarding earlier sensory patterns sensory modalities seem to show stronger correlations with each other in the ASD group than in the TD group, while regarding current sensory patterns they seem to show stronger correlations with each other in the TD group. It's remarkable that among all of the senses, smell had the most powerful connections with the other sensory channels. Vision appears to be dominant in both groups. In addition, proprioception and vestibular perception have less close relationships with the other modalities, although compared to TD children these modalities form a separate association pattern with tactility in the ASD group. (Correlations are presented in Figure 4 and Figure 5).

Figure 4. Earlier and current correlations in typical development (red line means correlation is significant at the 0.01 level and black line means correlation is significant at the 0.05 level; straight line means correlation above 0.6, dotted line means correlation above 0.4 and dashed line means correlation above 0.2; figure below the earlier and current correlations shows only the conserved strongest associations)

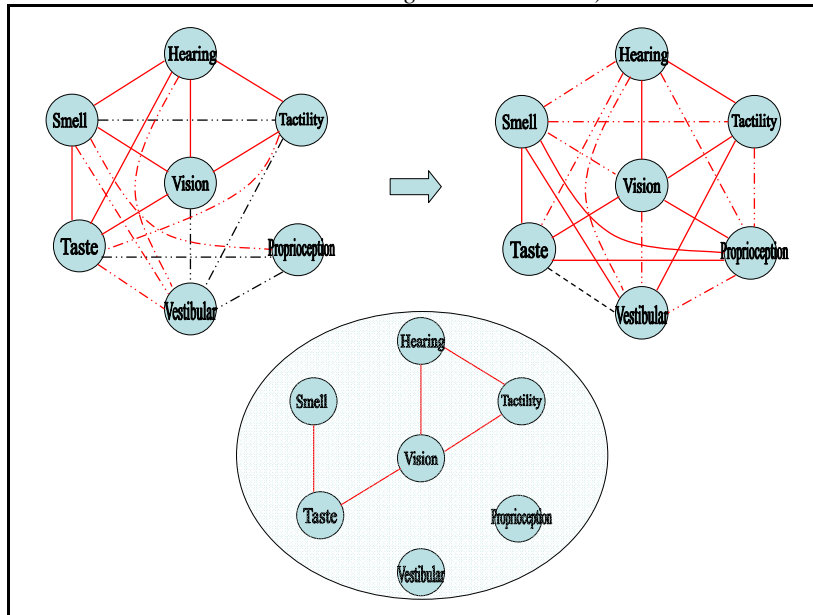
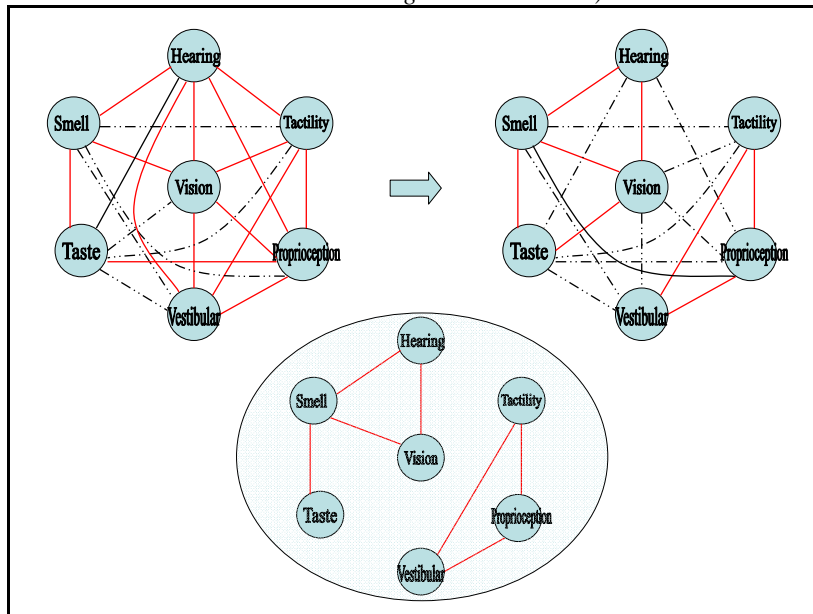


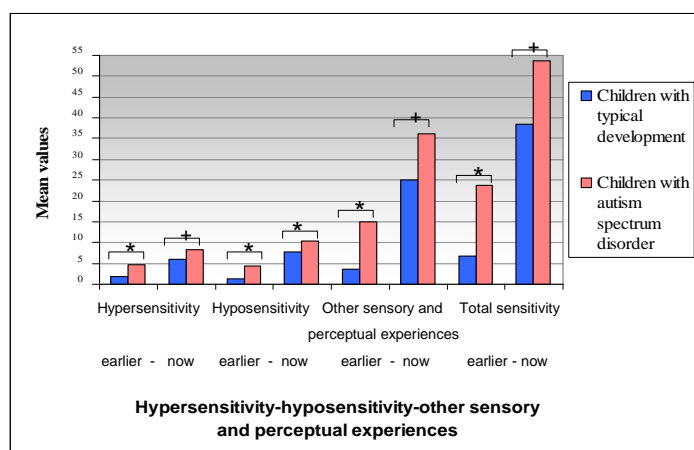
Figure 5. Earlier and current correlations in autism spectrum disorder (red line means correlation is significant at the 0.01 level and black line means correlation is significant at the 0.05 level; straight line means correlation above 0.6, dotted line means correlation above 0.4 and dashed line means correlation above 0.2; figure below the earlier and current correlations shows only the conserved strongest associations)



Presence of hyper- and hyposensitivity

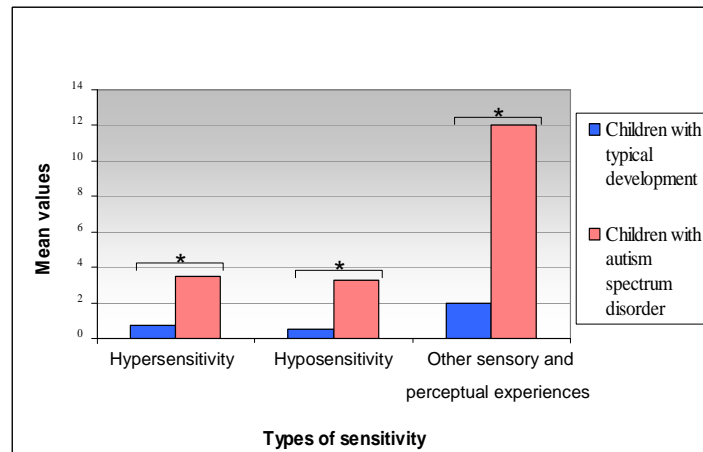
On the examination of hypersensitivity, hyposensitivity and other sensory and perceptual experiences, ASD status had effects on both past and current occurrences. Results by Independent-Samples T test show significant differences between the two groups in: (1) earlier hypersensitivity ($t(45)=-2.240$, $p=0.037$); (2) earlier hyposensitivity ($t(45)=-2.626$, $p=0.016$); (3) current hyposensitivity ($t(45)=-2.098$, $p=0.045$); (4) earlier presence of other sensory and perceptual experiences ($t(45)=-2.616$, $p=0.017$); (5) and earlier presence of total sensitivity ($t(45)=-2.603$, $p=0.018$), in all cases the ASD group scoring higher (see Figure 6).

Figure 6. *Hyper- and hypo- and other sensory and perceptual experiences of the 7 sensory channels (*: $p < 0.05$; +: $p < 0.1$; n.s.: $p > 0.1$)*



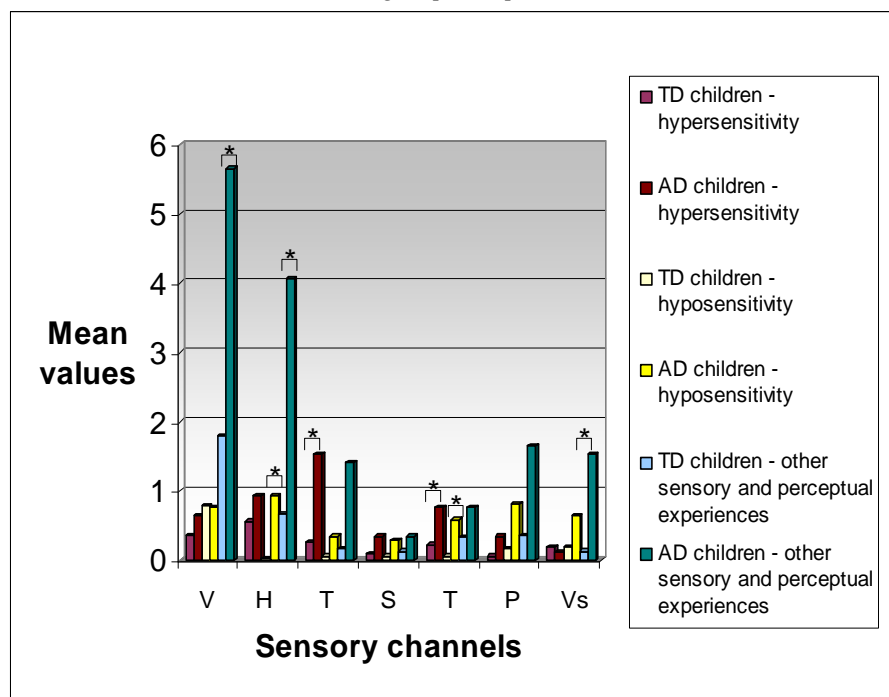
We also investigated conserved sensitivity in the two groups (referring to sensitivity present both in the past and in the present) using Independent-Samples T test. Mean values of all types of sensitivity were significantly higher in autism: (1) hypersensitivity ($t(45)=-2.178$, $p=0.043$); (2) hyposensitivity ($t(45)=-2.427$, $p=0.025$); and (3) other sensory and perceptual experiences ($t(45)=-2.427$, $p=0.026$; see Figure 7).

Figure 7. Conserved hyper- and hypo- and other sensory and perceptual experiences of the 7 sensory channels (*: $p < 0.05$)



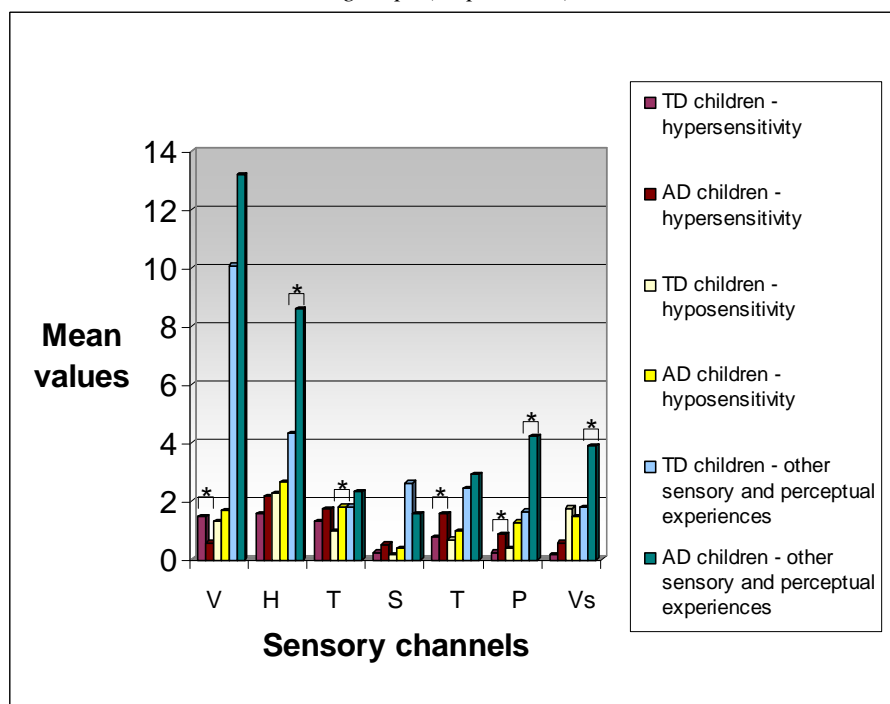
Finally we explored hyper- and hypo- and other sensory and perceptual experiences in all of the seven modalities in the two groups, considering both earlier and current presence. In comparison of the two groups, mean values regarding earlier hypersensitivity were significantly higher in autism in tactile perception ($t(45)=-2.604$, $p=0.018$) and in taste ($t(45)=-2.103$, $p=0.048$). Regarding earlier hyposensitivity mean values were significantly higher in autism in hearing ($t(45)=-2.453$, $p=0.026$) and in taste ($t(45)=-2.916$, $p=0.009$). Mean values in earlier other sensory and perceptual experiences were significantly higher in autism in vision ($t(45)=-2.411$, $p=0.026$), hearing ($t(45)=-2.713$, $p=0.014$) and vestibular perception ($t(45)=-2.753$, $p=0.014$; see Figure 8).

Figure 8. *Earlier hyper- hypo- and other sensory and perceptual experiences in TD and AD groups (*: $p < 0.05$)*



For current hypersensitivity mean values were significantly higher in autism in taste ($t(45)=-2.611$, $p=0.016$) and in proprioception ($t(45)=-2.904$, $p=0.008$). For current hyposensitivity mean values were significantly higher in autism in tactile perception ($t(45)=-2.738$, $p=0.010$). Mean values for current occurrence of other sensory and perceptual experiences were significantly higher in autism in hearing ($t(45)=-3.407$, $p=0.003$), proprioception ($t(45)=-2.874$, $p=0.010$) and vestibular perception ($t(45)=-2.350$, $p=0.029$). Vision is the only sense which shows significantly more current hypersensitivity in typical development ($t(45)=2.922$, $p=0.006$, see Figure 9).

Figure 13. Present occurrence of hyper- hypo- and general sensitivity in TD and AD groups (*: $p < 0.05$)



Discussion and outlook for theory and therapy

In addition to subjective reports, systematic research also demonstrates that sensation and perception in autism differs from typical experiences and therefore there must be distinct pathways of perceptual development in autism. In accordance with Henshall's study (2008) we found that children with ASD displayed increased sensitivity compared to typically developing children in most of the seven sensory modalities. Consistent with Ermer and Dunn (1998), parents of children with ASD indicated a higher frequency of sensory-related unusual behaviour in general, and unusual behaviour specifically linked to hyper- and hyposensitivity, compared to the healthy control group.

Patterns of sensitivity also have distinct profiles in typical and in autistic development. Eventually, sensory patterns in typical development seem to show a higher level of association and therefore suggest a more integrated functioning of the senses. Although past associations among the senses were stronger in the ASD group than in the control group, we found less strong relationships among the seven senses in the present in autism, which may be a sign of a lower level of integrative functioning. Cautious reading of our results may indicate that the network of the senses becomes more integrated and balanced with time in typical development but this may happen differently in autism. Another difference is that while visual perception seems to play a more integrated role in typical development, for ASD children smell seems to play a more important role. Since smell can be considered as a phylogenetically ancient sense (along with tactility, Neisser, 1984) this fact may have significance.

Our results show significantly increased level of hypersensitivity of the proximal senses (specifically, tactility, gustation and proprioception) in ASD, at the same time, ASD children also showed increased level of hyposensitivity in gustation and tactility. Thus, in accordance with other observations (Bogdashina, 2003), we also found evidence for the co-existence of hypo- and hypersensitivity. That is, children with ASD may be simultaneously hypo- and hypersensitive to the same sensory stimuli, and the different sensory modalities display different sensitivities at the same time (Bogdashina, 2003).

Our findings also demonstrate that at an early age hypersensitivity can be present in both typical and autistic development, and later both hyper- and hyposensitivity appear to reduce due to maturation and learning processes. Infants pick up information from their environment by interactions and self-regulated activity. In this process the child learns to discriminate stimuli and discover the meaning of events. Hyper- and hyposensitivity and other kinds of sensory and perceptual experiences all have important influences on perceptual learning and sensory integration (Bogdashina, 2003).

Sensory integration is a vital issue under scrutiny by current neuropsychology. According to the „rule of inverse effectiveness” the integrated signal is strongest when unimodal stimuli elicit weak responses from multisensory neurons and the integrated signal is weakest when at least one of the unimodal stimuli elicits a strong response (Iarocci & McDonald, 2006). Discrepancies among controversial inputs will be resolved by the most appropriate or reliable modality (Iarocci & McDonald, 2006). In this way multisensory interactions seem to have a significant role in grasping contextual information through congruent signals. The lack or the lower degree of this integration highlights problems that are well-known in autism. The higher levels of hyper-, hypo- and other types of atypical perceptual experiences found in our study may lead to incongruent sensory and perceptual experiences and this may result in a perceptually different world. This may induce distorted representation of the environment, as well as unusual behaviour. High level of integration of the senses leads to more efficient understanding of global situations. The more balanced sensory patterns displayed by typically developing children provide better conditions for gaining information from the environment and forming meaningful and useful representations. Due to their hyper- or hyposensitivity, people living with autism are prone to avoiding or generating sensory stimulations as a form of successful adaptation to the environment. In this sense, unusual behaviours can be interpreted as a kind of coping mechanism (Bogdashina, 2003).

Research on sensory – perceptual aspects of autism is important first and foremost because it can lead to better ways of helping children and adults with autism to cope with daily life. In fact, therapies exist that aim at reducing sensory – perceptual difficulties of children living with autism (e.g. sensory integration therapy, Ayres, 2005; auditory integration training, Bérard, 1993). There is, however, little controlled research on the effectiveness of these therapies. Independent evaluation of these interventions have provided no clear, or highly controversial evidence so far (Dawson & Watling, 2000; Zane, 2011). Increasing research efforts along these lines clearly has great practical importance for developing valid methods for early risk assessment and the improvement of quality of life of all afflicted individuals and families.

On the other side, research on sensory – perceptual aspects of autism is also important for progress in the field of theory. Autism has gained significance for cognitive psychology because it promised a look at developmental systems where cognitive mechanisms (such as theory of mind) do not work the typical way. Better understanding of the “autistic mind” promotes the better understanding of the “typical mind”. Comprehending perception in autism arguably takes us closer to comprehending core questions of human functioning.

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