Level of sense-making in children with autistic disorder and intellectual disability: Patterns of delay and deviance in development

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Abstract

The present study examined levels of sense-making in relation to adaptive functioning and autism symptomatology in low-functioning children with autistic disorder. Thirty-six children with autistic disorder and intellectual disability were compared with 27 children with intellectual disability and 33 typically developing children with a comparable nonverbal mental age (2-5 years). Level of sense-making was measured with the ComFor. Delays and deviant behaviors were assessed by using the Vineland Screener 0-6-NL and the Diagnostic Interview for Social and Communication Disorders. Levels of sense-making were substantially lower in the group with autistic disorder. At non-symbolic levels of sense-making, children with autistic disorder and intellectual disability were much lower functioning in terms of social and communicative adaptive behavior than the children in the comparison groups with the same level of sense-making. Within the autism group, lower levels of sense-making were associated with more severe autism symptomatology in the domains of social interaction, communication, and imagination.

Keywords: (non)symbolic communication, autism, intellectual disability, adaptive behavior, autism symptomatology

Introduction

During the first few years of life most children achieve important milestones in symbolic development (DeLoache, 2004). They gradually learn to understand and use symbols, such as words and pictures (Callaghan, 2000). Symbolic knowledge requires understanding of symbol-referent relations, even if the referent is not currently present. Symbolic development is important to increase communication opportunities, as symbols enable people to exchange information efficiently by representing something else even beyond the here and now (Namy & Waxman, 2005). Problems in symbol formation are considered to be a core deficit in children with autism spectrum disorder (ASD) (Noens & Van Berckelaer-Onnes, 2005; Travis & Sigman, 2001; Wetherby et al., 2000). Many studies focused on children with ASD with symbolic communication; children who have not achieved symbol understanding yet have seldom been evaluated (Granlund & Olsson, 1999). Especially in children with ASD and an associated intellectual disability (ID) understanding of symbol-referent relations does not develop in all cases (Preissler, 2008).

Noens and Van Berckelaer-Onnes (2005) conceptualized communication problems in ASD as a problem in 'sense-making', the perception of meaning. Sense-making refers to the cognitive process underlying receptive and expressive communication. The level of sense-making describes

the way someone perceives and interprets incoming stimuli gathered by different senses. Since children with ASD often find it difficult to integrate several pieces of information (Happé & Booth, 2008), it is very likely that they may fail to encode and relate all of the available cues of communication. Comprehension and production of symbolic communication appeals to complex information processing abilities, because various stimuli need to be integrated simultaneously and interpreted in a specific context.

Communication and sense-making can take place at the following four levels: sensation, presentation, representation, and metarepresentation (Verpoorten, 1996). At the level of *sensation*, communication consists of sensory experiences through different senses, such as vision and hearing, but also smell, taste, touch, balance, and kinesthesia. A regularly offered sensory stimulus can appear familiar, but has no functional or symbolic meaning, which is congruent to the developmental level of young infants (Noens & Van Berckelaer-Onnes, 2004). Individuals with ASD who communicate at the level of sensation only, often have a severe to profound ID. Lack of any use and understanding of language is one of the main characteristics of this level.

At the level of *presentation*, one perceives information within a concrete context. The individual understands the functional meaning of objects when they are literally present. At this level, children start to use conventional means of communication, such as gestures and words, but still in a non-symbolic way (Noens & Van Berckelaer-Onnes, 2004). A word or a gesture is used in a specific context where the relationship between the sign and the referent is limited to that context (Stephenson & Linfoot, 1996). For the transition from presentation to representation, generalization and decontextualization are needed to be able to use symbolic means without contextual constraints. This process requires the ability to take a symbol one has learned in one situation and apply it in a new and different context (DeLoache, 1989). It includes for example applying the word to a variety of referents, even when the referents are absent, or using the word with different listeners. Only when a word is generalized beyond the initial learning environment, it may be granted as symbol use and understanding (Namy & Waxman, 2005). This is considered to be the same for the use of pictures. The capacity to match a picture to a referent in one restricted context or to label a picture is also context-bound (Stephenson & Linfoot, 1996). Generally, in typical development, this transition from presentation to representation or presymbolic to symbolic functioning takes up a very short period of a couple of months (Wilkinson & McIlvane, 2001). From studies in children with ASD, it can be found that such limitations in symbol use can be observed for more extended time periods (Wetherby et al., 2000). In case of low-functioning children with ASD, true symbolic capacity and communication may not develop at all (McLean, 1993; Noens & Van Berckelaer-Onnes, 2004). When low-functioning children with ASD do not reach the level of representation, this is also reflected in other problems such as lack of symbolic play and delayed imitation (Blanc et al., 2005).

The level of *representation* is achieved when someone understands the full referential or symbolic function of communication. Symbol formation and object permanence are necessary to achieve the level of representation (Noens & Van Berckelaer-Onnes, 2004). Verbal children with ASD generally communicate at the level of representation, except for children with speech mainly consisting of echolalia (Wetherby et al., 2000). Communication at the level of representation can be characterized as symbolic communication. Language is a complex symbolic communication system, for which symbol-referent relations are arbitrary and conventional. Some non-verbal children with ASD are able to understand and use gestures, objects, or pictures as symbols. In that case, the level of representation has also been reached (Noens & Van Berckelaer-Onnes, 2004).

At the level of *metarepresentation*, information beyond the literal meaning or the primary information is perceived. Human language is interlarded with metarepresentations, such as proverbs and metaphors (Noens et al., 2006). Even for verbal children with ASD, sense-making is often fragmentary or literal. Generally, sense-making at the level of metarepresentation will be less flexible or will be missed, unless the meaning behind the words is directly taught (Twachtman-Cullen, 1998).

So far, no studies sought to investigate level of sense-making in relation to the core behavioral characteristics of ASD. Since ASD is considered as a developmental disorder, it is important to make a distinction between delayed and deviant patterns of development, in particular in relation to adaptive functioning and autism symptomatology (Klin et al., 2007). In ASD, both delays and deviances are present, but the severity of symptoms varies. The aim of the present study was to give more insight into the level of sense-making in low-functioning children with AD in order to formulate recommendations for assessment and intervention for this vulnerable group. To this end, levels of sense-making of a group of children with AD and ID were compared to groups of children with ID without ASD and typically developing children. Also, the relationships between level of sense-making and clinical presentation of adaptive functioning and autism symptomatology in low-functioning children with AD were examined.

Method

Participants

A group of 36 children with AD and ID participated in this study. Participants were included in the AD+ID group if they had received a formal AD and ID classification according to DSM-IV-TR criteria (APA, 2000) prior to the study. All children met diagnostic criteria for AD according to the Autism Diagnostic Observation Schedule Modules 1 or 2 (ADOS; Gotham et al., 2007). Given the classification difficulties in low-functioning individuals, this study focused on the core syndrome instead of the whole spectrum to create a more homogeneous group. The mean nonverbal mental age of the children with AD and ID was 3;3 years (range 2;0 - 5;8 years). The comparison groups consisted of 27 children with ID without ASD and 33 typically developing children (TD). Children in the ID and TD groups did not meet diagnostic criteria for ASD on the ADOS. Children in the ID group all have a formal ID classification (APA, 2000). Levels of ID in the groups with and without autism ranged from mild to severe (APA, 2000). Results on a Dutch nonverbal intelligence test (SON-R 2½-7; Tellegen et al., 1998) confirmed that IQ-scores of participants in both groups were below 70. The main characteristics of the groups are presented in Table 5.1.

Table 5.1 Main characteristics of the subsamples

Groups	n	Nonverbal mental age equivalent (in months)			Chronological age (in months)			Gender (in %)	
		Range	M	SD	Range	M	SD	Male	Female
AD+ID	36	<24 ^a - 68	39.0	13.71	41 - 136	85.6	27.86	89	11
ID	27	<24 ^a - 63	39.1	12.71	50 - 132	80.6	19.12	61	39
TD	33	29 - 65	42.7	9.42	24 - 50	37.9	6.36	41	59

Note. AD = autistic disorder; ID = intellectual disability; TD = typical development

^a minimum score

The TD children were significantly younger than the children in the other two groups ($F_{(2,93)} = 55.55, p < .001$), but all groups were comparable with respect to nonverbal mental age ($F_{(2,93)} = 1.02, p = .37$), since groups were matched on the latter variable. In the AD+ID group significantly more boys were present than in the two comparison groups, $\chi^2_{(2)} = 18.50, p < .001$. There were no differences in outcome variables (level of sense-making, adaptive functioning, and autism symptomatology) between boys and girls within the three subsamples ($p > .05$).

Instruments

SON-R 2½-7. To measure nonverbal mental age, a Dutch test for nonverbal intelligence, the SON-R 2½-7 (Tellegen et al., 1998) was used. Total raw scores were converted into nonverbal mental age equivalents. The SON-R 2½-7 has been found reliable and valid (Evers et al., 2009).

ComFor. The ComFor is a clinical instrument for the indication of augmentative communication in people with ASD and ID, which evaluates visual perception and sense-making (Verpoorten et al., 2004, 2008). The target group of the ComFor consists of individuals with ASD and ID, with limited or no verbal communication and a developmental level of approximately 12 to 60 months. The ComFor addresses two core questions: first, the most suitable form of augmentation, and second, the level of sense-making at which the forms chosen can be offered. With respect to the level of sense-making, three general indications are possible: sensation, presentation, and representation. Sense-making is made operational in the following way. At the level of presentation, identical objects or pictures have to be sorted according to shape, color, matter, and size. Thus, the tasks can be resolved on the basis of concrete, literally perceptible features. At the level of representation, non-identical objects or pictures have to be sorted on the base of sense-making beyond the concrete, literally perceptible features. The level of presentation consists of three series with a total of 23 sorting tasks and the level of representation comprises two series with a total of 13 sorting tasks. In series 1 sorting is first trained by different assembling tasks. Based on the profile of individual scores on all ComFor items an indication of level of sense-making can be given. Both reliability and validity of the ComFor were found to be satisfactory. The coefficients for inter-rater reliability, test-retest reliability, and internal consistency are .80 or higher. Analyses of internal structure, convergent and divergent patterns have shown adequate construct validity; criterion-related validity is not yet determined (Noens et al., 2006).

Vineland Screener 0-6. The Vineland Screener 0-6yrs-NL is a questionnaire which can be used to determine the level of adaptive functioning in age equivalents. This screener is adapted from the American Vineland Screeners, versions 0-2;11 and 3-5;11, developed by Sparrow et al. (1993) and standardized on a Dutch sample. Based on 72 items, this questionnaire distinguishes four domains of adaptive functioning: communication, daily living skills, socialization, and motor skills. The psychometric properties of reliability and validity for the Dutch version are good (Scholte et al., 2008).

DISCO. The Diagnostic Interview for Social and Communication Disorders – version 11 (DISCO-11) is a semi-structured interview to be administered with parents or other primary carers (Wing, 2006). The Dutch translation of the 11th version of the interview was used in this study (Van Berckelaer-Onnes et al., 2008). The instrument can be used to provide a comprehensive description of

individual characteristics and is suitable for individuals of all ages, levels of abilities and the whole autism spectrum. Through the DISCO-11 information about developmental history and a broad range of skills and behaviors can be gathered (Wing, 2006). The interview takes about two to three hours to administer and consists of more than 300 questions grouped under different sections. Only section 7 about the quality of social interaction, communication, imagination, and activities was used for the analyses. The DISCO distinguishes both 'ever' and 'current' ratings of the child's behavior for all items, but only 'current' items and classifications were analyzed in the present study. The quality of social interaction, communication, imagination, and pattern of activities is rated by choosing the type and description that is the most characteristic for a person. With regard to the reliability, the inter-rater reliability proved to be high (Wing et al., 2002).

Procedure

Children with ID with and without autism were recruited from several special day care centers and schools for children with ID. The sample of typically developing children was obtained from regular day care centers. After written informed consent was received, parents were asked to complete the Vineland Screener 0-6. Subsequently, participants were individually administered a non-verbal intelligence test and the ComFor at their day care or school in three or four visits. The child and one of the parents were invited to visit the university, school or day care of the child, where the ADOS was administered. The DISCO interviews were conducted by seven different interview couples at the parents' home. For three children in the AD+ID group, the DISCO could not be administered due to refusal or insufficient Dutch language abilities of the parents. The interviewers were blind to the levels of functioning and sense-making of the children. All data were analyzed using SPSS 18.0. Considering that many variables were not distributed normally and that the groups, particularly subgroups within the AD+ID group, were relatively small, analyses were conducted using non-parametric tests. Chi-square tests were used to compare the distribution of level of sense-making between the three groups. Further, adaptive levels of functioning and autism characteristics were compared using Kruskal-Wallis tests. Mann-Whitney *U*-tests were applied for post hoc comparisons with adjusted *p*-values according to the Bonferroni method (adjusted *p*-value is .017). Typology of autism characteristics was only examined in the AD+ID group.

Results

Levels of sense-making

Table 5.2 illustrates the percentages of participants in each group in relation to level of sense-making as measured with the ComFor. A Chi-square test indicated a significant association between level of sense-making and diagnosis ($\chi^2_{(4)} = 11.41, p = .02$).

The distribution of level of sense-making is comparable for the ID and TD groups. About half of the participants have reached the level of representation, and the other half were grouped at the level of presentation or some in the ID group at the level of sensation. A fourth part of the AD+ID group perceives the world at the level of sense-making, 36% at the level of presentation and 39% at the level of representation. It is important to notice that nonverbal mental age was comparable across all subgroups for each level of sense-making ($p > .05$).

Table 5.2 Cross tabulation of groups versus level of sense-making

Groups		Level of sense-making			Total
		Sensation	Presentation	Representation	
AD+ID	<i>n</i>	9	13	14	36
	%	25%	36%	39%	100%
ID	<i>n</i>	2	11	14	27
	%	7%	41%	52%	100%
TD	<i>n</i>	0	14	19	33
	%	0%	42%	58%	100%

Levels of sense-making and adaptive functioning

Adaptive skills were compared within and between groups according to level of sense-making (see Figures 5.1a, 5.1b, and 5.1c). Kruskal-Wallis tests were conducted to compare mean levels of adaptive functioning between levels of sense-making within the AD+ID group. Significant differences were found for Communication ($H_{(2)} = 12.59, p = .002$), Socialization ($H_{(2)} = 11.29, p = .004$), and Daily Living Skills ($H_{(2)} = 10.51, p = .005$), between low-functioning children with AD at the level of sensation or presentation versus the level of representation. Within the ID group and TD group a comparison was made between the levels of presentation and representation. Mann-Whitney *U*-tests revealed significant differences for the domain of Daily Livings Skills for children at the level of presentation versus the level of representation ($U = 33.0, p = .015$ and $U = 74.0, p = .031$, respectively).

Note. S = sensation; P = presentation; RP = representation

Figures 5.1a, 5.1b, and 5.1c Mean adaptive age equivalents based on level of sense-making for the three groups

Kruskal-Wallis and Mann-Whitney *U*-tests showed that children with AD+ID at the level of presentation achieved significantly lower scores on the domains Communication ($H_{(2)} = 7.90, p = .019$) and Socialization ($H_{(2)} = 9.83, p = .007$), but not on Daily Living Skills ($H_{(2)} = 0.39, p = .822$) in comparison with children with ID and TD at the same level of sense-making. For the Communication domain, only the difference between the AD+ID group and the TD group turned out to be significant ($U = 40.0, p = .013$). At the level of representation, the AD+ID group showed comparable levels of adaptive functioning to the ID and TD groups on all three domains. Due to the lack of comparison groups, no analyses could be performed for the level of sensation.

Level of sense-making and autism symptomatology

Quality of social interaction, communication, imagination, and patterns of activity as measured with the DISCO-11 were compared across the different levels of sense-making within the AD+ID group (Table 5.3). Ratings for quality are on an ordinal scale and compared using Kruskal-Wallis tests. In all domains higher ratings indicated relatively higher quality of skills.

Table 5.3 Rates and percentages of quality of social interaction, communication, imagination, and pattern of activities for AD+ID-subgroups based on level of sense-making

DISCO part 7 ^a	Level of sense-making					
	Sensation (n = 8)		Presentation (n = 12)		Representation (n = 13)	
	n	%	n	%	n	%
Quality of social interaction						
0. Does not interact; aloof and indifferent	1	12	0	0	0	0
1. Interacts to obtain needs, otherwise indifferent	6	76	6	50	4	31
2. Generally does not initiate, but responds to social contact; joins in passively	1	12	3	25	2	15
3. Makes social approaches actively, but usually inappropriate, 'one-sided', naive and peculiar	0	0	3	25	7	54
Quality of communication						
0. No social communication	1	13	2	17	0	0
1. Communicates only / mainly own needs	7	87	4	33	3	23
2. Adequate language; no wish to engage in communication; only brief answers or essential comments	0	0	2	17	1	8
3. Communicates regarding his / her own interests	0	0	4	33	9	69
Quality of imagination						
0. No pretend / role play or imaginative activities	7	88	8	66	3	24
1. Some pretend / role play, but specifically taught	0	0	2	17	2	15
2. Pretend / role play is copied from others	0	0	2	17	4	31
3. Self-invented pretend / role play, but repetitive in theme / content	1	12	0	0	2	15
4. Pretend / role play appears to be shared with others, but restricted to own themes / rules	0	0	0	0	2	15
Quality of pattern of activities						
0. Only repetitive activities	4	50	2	16	3	23
1. Some varied interests / activities	4	50	8	68	7	54
2. Varied and flexible activities	0	0	2	16	3	23

^a Only ratings seen in ASD are listed

Significant differences between levels of sense-making were found for Quality of Social Interaction ($H_{(2)} = 10.42, p = .005$), Communication ($\chi^2_{(2)} = 10.85, p = .004$), and Imagination ($H_{(2)} = 9.56, p = .008$). Quality of Social Interaction was significantly worse at the level of sensation compared to presentation ($U = 21.0, p = .014$) and representation ($U = 14.0, p = .002$). For Quality of Communication children at the level of sensation achieved significantly lower scores than children at the level of representation ($U = 10.5, p = .001$). Children at the levels of sensation and presentation showed significantly less Quality of Imagination than at the level of representation ($U = 20.5, p = .015$ and $U = 34.0, p = .012$, respectively). No significant differences were found for Quality of Patterns of Activities ($H_{(2)} = 3.59, p = .166$).

Discussion

The way someone perceives and interprets incoming stimuli defines the level of sense-making or perception of meaning. The level of sense-making of visual stimuli can be determined by using the

ComFor. Based on the ComFor results a clinical and individualized indication of an augmentative communication strategy can be provided (Noens et al., 2006). In addition to the ComFor results, it is also important to take other developmental and behavioral aspects in account in order to adapt the intervention strategy to individual needs. Furthermore, sense-making plays an important role in different areas of development such as communication, but also social interaction and imagination (Noens & Van Berckelaer-Onnes, 2004). It is important to study level of sense-making, because it determines the most suitable level of approach in daily life situations. In the present study, we characterized level of sense-making and its relation with adaptive functioning and autism symptomatology in low-functioning children with AD. It is important to make a distinction between delayed and deviant patterns of development. The first approach compares the child with the normative course of development and the second approach places the child in a dimensional continuum of severity of autism symptomatology (Klin et al., 2005). Relating adaptive functioning and autism symptomatology to the level of sense-making provides the opportunity to give more specific recommendations for interventions. In this way, interventions can be adapted to abilities and disabilities of low-functioning children with AD, because each level of sense-making requires particular communication strategies.

First, the results of our study indicate that difficulties in sense-making are more pervasive in children with AD and ID compared to typically developing children, but also compared to children with ID without ASD with a comparable nonverbal mental age. In the group with AD significantly fewer children achieved the level of representation. A large part of this group is only able to perceive the world at the level of sensation or presentation, which implies that they do not (completely) understand symbolic or representational means of communication. It must be noted that the ComFor only evaluates visual perception and sense-making. From the studies of DeLoache (2004) and DeLoache and Burns (2004) it is known that in typical development the understanding of language precedes the representational understanding of pictures. The findings from the present study confirm the hypothesis of Noens and colleagues (2006) that in children with AD the development of sense-making evolves at a slower pace or in a different way. In case of AD, the transitions from sensation to presentation and from presentation to representation possibly take place in a later stage of development compared to children without ASD. However, longitudinal research is necessary to validate this hypothesis. A complicating factor is that there is no consensus in literature when symbolic capacities are completely developed. Generalization and decontextualization are necessary to speak about symbolic use and understanding of language or pictures, but there are no guidelines as to how much generalization and decontextualization is needed to identify true symbolic behavior (Wilkinson & McIlvane, 2001). As a result, the duration of the transitional phase before the level of representation is difficult to determine, also in typical development. Nevertheless, there are clear indications that children with ASD have more difficulties with generalization and decontextualization (e.g., MacDuff et al., 1993), as reflected in the distribution of level of sense-making within the groups in the present study.

Second, the results of the study showed that at the level of representation all three groups have comparable levels of adaptive behavior on all domains, also with respect to communication and socialization. This is consistent with other studies in individuals with ASD and co-occurring ID, which indicate that in this low-functioning group the overall level of adaptive functioning is fairly comparable to the level of intelligence (Bölte & Poustka, 2002), whereas in higher functioning individuals adaptive behavior is relatively more impaired (Liss et al., 2001; Perry et al., 2009). Other reports indicated that children with ASD and ID are relatively more impaired in the social domain

than children with ID (Loveland & Kelley, 1991), but this is not supported by our results for children at the level of representation. However, the children with AD and ID at the levels of sensation and presentation are much lower functioning on social and communicative functioning compared to the control groups with the same level of sense-making. In other words, mainly children at the lower levels of sense-making are impaired in adaptive functioning in comparison with their nonverbal mental age matched controls. This implies that at these levels of sense-making developmental level does not entirely determine adaptive scores on the domains of communication and socialization. Thus, level of sense-making is an important underlying factor. This could possibly suggest that low-functioning children with AD have problems in translating their cognitive potential into real-life skills (Klin et al., 2007). An explanation for this finding is that particularly these aspects of adaptive functioning interfere with autism symptomatology or the lack of symbolic skills at the lower levels of sense-making. Another explanation is that it might be difficult for the environment to give instructions and provide interventions to improve adaptive behavior adjusted to these lower levels of sense-making.

Third, level of sense-making is related to autism symptomatology for the domains of communication, social interaction, and imagination. Lower levels of sense-making are associated with more severe problems in those domains and vice versa. Children making sense at the level of sensation are often indifferent in social contact, communicate only to obtain their needs, and have no symbolic play or imaginative activities. At the level of presentation, more variation in types of social interaction, communication, and imagination was observed, but the majority was still very impaired. According to the social typologies defined by Wing and Gould (1979), children making sense at the levels of sensation and presentation might be characterized as aloof or passive. At the level of representation, the subtypes aloof and passive are still present, but to a smaller extent. Half of the group can be characterized as active but odd. They accept or search for social interaction, but interact in an odd or unconventional way. A greater frequency of initiation of social interaction and communication, as well as more symbolic play are seen in this group. The results are in line with previous studies which found that severity of autism symptomatology or social typologies were related to level of functioning (e.g., Joseph et al., 2002; Volkmar et al., 1989).

Some limitations of our study have to be acknowledged. First, the present study examined sense-making in young children with AD, thus additional research would be necessary to extend the findings to older samples with AD and ID and to samples with other ASDs. Another limitation is that the sample of children with AD and ID is rather small when subdivided by level of sense-making in the analyses regarding adaptive functioning and autism symptomatology. Further, a screener version was used to evaluate adaptive level of functioning, whereas the extended interview version would provide a more differentiated picture of adaptive functioning. This study extends previous studies by examining level of sense-making and differentiating between symbolic and non-symbolic communicators regarding the clinical manifestation of ASD. Moreover, only children with a co-occurring ID were included in the AD group, while other studies often use groups of mixed levels of IQ or only higher functioning children.

This research has a number of important implications for clinical practice with respect to assessment and intervention strategies. The findings from the current study suggest that clinicians would benefit from evaluating level of sense-making in children with AD and ID, not only because sense-making might be weaker than expected on the basis of their nonverbal mental age, but also because sense-making is an important underlying factor for social and communicative functioning. The most common communication strategies, naturalistic as well as augmentative, presume

symbolic abilities. Augmentative communication is also possible at the levels of sensation or presentation, provided that pictures, objects, or other forms of communication are used in a different way (see Noens & Van Berckelaer-Onnes, 2004). Visualizations might be helpful, since visual perception is a strength of many children with ASD (Quill, 1997). Sometimes visualizations are not sufficient, in that case tactile or other sensory strategies need to be implemented. Communication tailored to the individual level of sense-making is crucial to improve quality of life, because overestimation and limited comprehension of communication may result in poorer outcome results and challenging behaviors (Bradshaw, 2002). As level of sense-making plays an important role in level and quality of social and communicative functioning, level of sense-making need to be improved within the limits of the individual's possibilities. Furthermore, adjustments of the environment as per level of sense-making can offer new opportunities of change in other areas of functioning as well.

The profiles of adaptive behavior and typologies of autism characteristics indicate that, particularly at the levels of sensation and presentation, improving social, communication, and play skills are important goals for intervention in low-functioning children with AD. At the level of sensation it is impossible to announce activities or to explain different steps within an activity, by using verbal instructions or pictures. At this level, the environment and all activities need to be highly structured and caregivers should stick to fixed routines and activity scenarios. Communication at the level of presentation is limited to the 'here and now' (Noens & Van Berckelaer-Onnes, 2004). Therefore, more independence in daily life skills or more initiation in communication and social interaction can be achieved by using non-symbolic communication strategies in the situation itself. Routines to stimulate initiation of social interaction and communication can be set up around daily routines. The use of pictures as symbols is inadvisable at this level of sense-making. Previous studies showed a difference between concept identification and concept formation abilities in children with ASD (e.g., Minshew et al., 2002). Some children may be able to label a picture, but this does not mean that the child can use the picture in a representational communicative way (Twachtman-Cullen & Twachtman-Reilly, 2007). In case of a child at the level of representation with adaptive functioning below its mental age matched peers, intervention can focus on more independence in several daily life situations. These situations can be explained and practiced by using augmentative communication at the level of representation, for example visual schedules or protocols to indicate the different steps or task components. Due to their non-transient nature, such schedules make instructions clear, help the child to stay focused, and diminish the need for adult support and reinforcement (Wendt, 2009).

In conclusion, difficulties in sense-making are more pervasive in children with AD and ID, hence increasing their need for support in daily life and interventions adapted to their level of sense-making. Future research needs to determine the effectiveness of augmentative communication to improve communication, social interaction, and daily life skills in low-functioning children with AD. Although visualizations, such as visual schedules within and between activities, are used very often in home, institution, and school settings, research in this area is surprisingly scarce (Wendt, 2009).

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