**CAPTURED BY DETAILS:
SENSE-MAKING, LANGUAGE AND COMMUNICATION IN AUTISM**

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Abstract

The communication of people with Autism Spectrum Disorder (ASD) is characterized by a qualitative impairment in verbal and non-verbal communication. In past decades a growing body of descriptive studies has appeared on language and communication problems in ASD. Reviews suggest that the development of formal and semantic aspects is relatively spared, whereas pragmatic skills are considered to be specifically impaired. This unique profile was interpreted mainly within the framework of the theory of mind hypothesis, which links the social-communicative problems of people with autism to an incapacity to attribute mental states to themselves and others. This approach has proven useful, but has also left many questions unanswered. In more recent publications, limited intentionality and symbol formation have been identified as core problems in ASD. Problems in symbol formation in particular might be better understood from the viewpoint of the central coherence hypothesis, which conceptualizes ASD as a weaker drive for the integration of information. Possible links between cognitive findings and communication evoke new perspectives with respect to the complex of communication problems in ASD.

Learning outcomes: The reader of this manuscript will be able to (1) describe the communication deficit in ASD; (2) discuss the central coherence account of ASD in relation to problems in sense-making; and (3) explain how these difficulties might lead to problems in communication in autism.

Keywords: autism, language, communication, central coherence

1 Introduction

Wing's delineation of the triad of impairments in socialization, communication and imagination, usually accompanied by a rigid and repetitive pattern of interests and activities (Wing, 1996, 2001), is commonly used to characterize the clinical picture of ASD. Problems in communication are thus considered to be key symptoms.

Several aspects justify intensive research into the complex communication problems in ASD. First of all, absence or loss of language is usually one of the first problems that worries parents of children with ASD (Howlin & Goode, 1998; Howlin & Moore, 1997; Lord & Paul, 1997). Secondly, impaired communication has proven to be one of the greatest sources of stress for parents (Bristol, 1984). A third reason is the fact that follow-up studies indicate that language and communication problems are persistent and closely related to subsequent prognosis (Howlin, Mawhood, & Rutter, 2000; Lord & Bailey, 2002; Mawhood, Howlin, & Rutter, 2000; Szatmari, Bryson, Boyle, Steiner, & Duku, 2003). Finally, frequently occurring challenging behaviors in ASD seem to be related to communication impairments in general and comprehension problems in particular (Sigafos, 2000; Van Berckelaer-Onnes, Van Loon, & Peelen, 2002).

All individuals with ASD exhibit qualitative impairments in verbal and non-verbal communication, irrespective of their level of functioning. However, language and communication abilities are highly variable. Within the scope of this article, we will confine ourselves to several main themes. For extensive reviews, see Lord & Paul (1997), Tager-Flusberg (1996, 2001) and Wilkinson (1998).

Approximately one-third (Bryson, 1996) to one-half (Bailey, Phillips, & Rutter, 1996; Lord & Paul, 1997) of those with the core autistic disorder never acquire functional speech. Strikingly, these non-verbal individuals usually fail to compensate for their lack of verbal communication with other modalities, such as pointing, gestures, eye contact or facial expression (Howlin, 1999; Mundy, Sigman, & Kasari, 1994).

With respect to the language acquisition of those individuals who do develop speech, one can distinguish formal, semantic and pragmatic aspects, although none of them is an independently developing subsystem (Tager-Flusberg, 2001). The more formal aspects include phonology and syntax. With respect to phonology, evidence is somewhat mixed, generally suggesting delayed, but not extremely deviant, development in ASD. Vocal quality, intonation and stress patterns, however, are strikingly atypical (Lord & Paul, 1997; Sheinkopf,

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Mundy, Kimbrough-Oller, & Steller, 2000; Tager-Flusberg, 2001). Studies on syntax in ASD showed, as a rule, no specific impairments, but recent studies (Kjelgaard and Tager-Flusberg, 1999, in Tager-Flusberg, 2001; Roberts, Rice, & Tager-Flusberg, 2000, in Tager-Flusberg & Joseph, 2003) indicate a considerable heterogeneity in grammatical development and level of achievement within the ASD population. In terms of semantic development, many peculiarities have been documented, including immediate and delayed echolalia, pronoun reversal, the use of metaphors and neologisms, and difficulties with figurative language (Howlin, 1999; Jordan, 1999; Lord & Paul, 1997). Although the development of vocabulary can be an area of relative strength, it appears that certain word classes (in particular, in social-emotional terms) are underrepresented (Tager-Flusberg, 2001). Little attention has been directed to the problems of comprehension of people with ASD, but understanding seems to be more limited than what would be expected on the basis of the expressive vocabulary (Lord & Paul, 1997). Pragmatic difficulties have been studied extensively and are obvious not only in non-verbal communication, as mentioned above, but also in verbal communication. In higher-functioning individuals, the pragmatic difficulties involve mainly deficits in conversational discourse and narrative (Adams, Green, Gilchrist, & Cox, 2002; Losh & Capps, 2003; Tager-Flusberg, 2001).

During the past two decades, cognitive research has undergone striking development. Different theoretical constructs are used to explain the specific behavioral patterns and to find a reference to possible neurological dysfunctions. The three most influential accounts – theory of mind, executive functions and central coherence – have contributed to a better insight into information-processing by people with ASD. The oldest and most-documented account is the theory of mind hypothesis. It tries to rationalize the social-communicative problems of people with ASD from their specific cognitive inability to attribute mental states to themselves and others (Baron-Cohen, Leslie, & Frith, 1985; Baron-Cohen, 1995, 2000). By focusing on the social-communicative deficits, however, many non-social features remain unexplained (Happé, 1999; Plaisted, 2000).

According to Bailey et al. (1996), the theory of mind account is a theory with a narrow perspective, while the executive functions and central coherence represent theories with a broader perspective. ‘Executive functions’ is an umbrella term for a broad array of mental operations. The most robust finding of executive functioning research is that individuals with ASD tend to make perseverating errors and have problems with set-shifting and planning (Griffith, Pennington, Wehner, & Rogers, 1999; Liss et al., 2001). The evidence for other

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executive functions, such as working memory, is still contradictory (Ozonoff & Strayer, 2001; Rogers & Bennetto, 2000); inhibition deficits generally are not found (Ozonoff, 1997; Ozonoff & Strayer, 1997). Executive dysfunctioning is able to explain some of the non-social deficits in ASD, such as the repetitive and stereotyped behavioral patterns (Bailey et al., 1996) but cannot provide a good explanation for the islets of ability and areas of superior functioning that have been documented in ASD (Happé, 2000).

Frith (1989) introduced the central coherence hypothesis in an endeavor to link talents and deficits in ASD to a common cognitive postulate. Central coherence has been defined as the natural built-in propensity to process incoming stimuli globally and in context, pulling information together to acquire higher-level meaning. This tendency would work at the expense of attention to and memory for details (Frith, 1989; Frith & Happé, 1994). People with ASD, on the other hand, tend to process incoming information locally and piecemeal; their thinking is characterized by detachment (Frith, 1989, 2002). The central coherence account predicts skills as well as weaknesses; as such – according to Happé (1999, 2000) – it should not be considered a deficit account but instead a specific cognitive style.

The language and communication deficits in ASD have been interpreted mainly within the framework of the theory of mind hypothesis (e.g. De Villiers, 2000; Mundy & Markus, 1997; Mundy & Stella, 2000; Tager-Flusberg, 2000, 2001). Theory of mind dysfunctioning offers an explanation for pragmatic difficulties in higher-functioning individuals with ASD; at the earlier developmental levels, joint attention has been identified as an important precursor of both theory of mind and language and communication acquisition. But, as noted by Tager-Flusberg (2001) and Tager-Flusberg and Joseph (2003), the emphasis on pragmatic impairments and their relationship to theory of mind seems to have drawn attention away from deficits in comprehension, phonology, grammar, and lexical-semantic knowledge, which are more subtle or only occur in a subset of individuals with ASD. Moreover, the developmental pathway might be different in ASD. A broader view is needed to grasp the complexity of language and communication problems.

Recently, several authors attempted to relate the language and communication deficits in ASD to executive dysfunctioning in general and cognitive inflexibility (problems with set shifting) in particular (e.g. Mundy & Markus, 1997; Rogers & Bennetto, 2000). In our opinion, however, the framework of the central coherence theory offers opportunities to conceptualize the language and communication problems in ASD in terms of problems in the perception of

meaning, or ‘sense-making’. In this publication, some ideas on the relationship between central coherence, sense-making, language and communication in ASD will be presented.

2 The central coherence account of ASD

2.1 A weaker drive for central coherence

In his first descriptions of ‘early infantile autism’, Kanner already mentioned “the inability to experience wholes without full attention to the constituent parts” (1943, p. 38). However, it was not until 1989 that Frith formulated the central coherence theory on autism, inspired by experimental psychological findings that could not be explained by the theory of mind and generally suggesting that children with autism showed a preference for detail-focused processing and a relative incapacity to make use of meaning (e.g. Frith & Hermelin, 1969; Frith & Snowling, 1983; Hermelin & Frith, 1971; Hermelin & O’Connor, 1967, 1970; O’Connor & Hermelin, 1967; Shah & Frith, 1983). As mentioned above, a weaker drive for central coherence was conceptualized as a cognitive bias toward local versus global information processing. The normal drive for central coherence helps human beings to make sense of something, to see structure and meaning. Details lose their individual significance as they become part of a bigger whole; their ‘new’ significance springs from their position within a context. The world of people with ASD, though, remains fragmented and is characterized by detachment rather than coherence. A clinical example might illustrate this point. One of our clients, a four-year-old girl with autism, was asked to label pictures of garments. She did this faultlessly, with the exception of a skirt. She was guided by the literal shape, disregarded the context and labeled the picture as ‘lamp shade’. In essence a good comparison, but strange in the context of garments. Central coherence and the ability to make use of context are thus closely connected. Frith (1989) related strong and weak drive for central coherence to the constructs field dependence and field independence, as defined by Witkin and Goodenough (1981). Weak central coherence and field independence share an unusual ability to disregard context, but differ in quality: where field independence enables one to surpass the gestalt, weak central coherence implies a failure to see the gestalt (Happé, 2000).

2.2 Evidence for weak central coherence in ASD

A growing body of empirical studies has yielded evidence for weak central coherence in ASD in three different domains: visual perception, auditory perception, and verbal semantics. In this respect, we will first describe some main lines of evidence on visual and auditory perception (for detailed reviews, see Happé, 1999, 2000). The studies on verbal semantics will be reviewed in the section on the relationship between central coherence, sense-making, language and communication (3.2).

Data on visual and auditory perception was gathered at different levels of perception. At the lower levels of perception, children with the autistic disorder do not succumb to visual illusions easily (Happé, 1996), benefit less from canonical presentation of dots in a counting task (Jarrold & Russell, 1997), and show impaired ability to detect coherent motion (Milne et al., 2002). In the auditory domain, absolute pitch seems to occur much more frequently in autism (Heaton, Hermelin, & Pring, 1998). Happé (2000) also refers to some studies that were not conducted to test the central coherence hypothesis directly but relate to difficulties in the integration of information from different sense modalities, such as the study of Hobson, Ouston & Lee (1988) who reported that children with autism are less hindered in recognition by inversion of faces. Furthermore, people with autism show a reduced McGurk effect (less influence from visual to auditory speech perception) (DeGelder, Vroomen, & Van der Heide, 1991) and are less susceptible to visually-induced movement (Gepner, Mestre, Masson, & De Schonen, 1995).

On the (higher) level of visuo-spatial and/or constructional coherence, children with autism show superior segmentation in the Block Design subtest of the Wechsler scales (Ropar & Mitchell, 2001; Shah & Frith, 1993). People with autism are also better in the Embedded Figures Test, as first demonstrated by Shah and Frith (1983) and later replicated by Ropar & Mitchell (2001) for children with autism and by Jolliffe and Baron-Cohen (1997) for adults with autism and Asperger syndrome. Weak coherence is also demonstrated by the detail-focused drawing style (Booth, Charlton, Hughes, & Happé, 2003; Mottron & Belleville, 1993; Pring, Hermelin, & Heavey, 1995) and the ability to copy globally ‘impossible’ figures (Mottron, Belleville, & Ménard, 1999).

Data on the use of context in visual processing, thus on the highest conceptual level, are scarce. The experiments of Jolliffe and Baron-Cohen (2001), however, prove very elegantly that adults with autism (and to a lesser extent those with Asperger syndrome) have a diminished ability to integrate objects at the visuo-conceptual level. Their first experiment,

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the Object Integration test (a modified Hooper test), showed that the clinical groups exhibited difficulties in integrating line drawings to produce the most coherent scene; in a second experiment, the Scenic test, they found it difficult to see and identify incongruent objects spontaneously. From a recent study of Ropar & Mitchell (2002), it appears that perception (in particular shape constancy) is less influenced by prior knowledge in autism.

2.3 Revisions and variants of the central coherence account

Weak central coherence implies not only weaknesses but also strengths and even facilitates special talents or ‘bright splinters of the mind’ (Hermelin, 2001). According to Happé (1999, 2000), weak central coherence should therefore be considered a cognitive style instead of a cognitive deficit. Recent findings that fathers of boys with autism exhibit piecemeal processing across four tests of central coherence (Happé, Briskman, & Frith, 2001) fit with the idea of a continuum of cognitive style, varying from strong to weak coherence in the normal population.

The theory of ‘enhanced perceptual processing’ offers an alternative to the central coherence theory. It postulates that ASD is not characterized by poor integration of information in a gestalt (top-down) but rather by enhanced low-level perceptual processing (bottom-up), as suggested by Mottron and Burack (2001). Evidence for this view exists in the visual domain (O’Riordan, 2000; Plaisted, O’Riordan, & Baron-Cohen, 1998a+b; Plaisted, Swettenham, & Rees, 1999) as well as the auditory domain (Mottron, Peretz, & Ménard, 2000). These experiments warrant a readjustment of the formulation of the central coherence theory; other experiments plead against such a modification. Recently, Frith (2002) suggested that the crucial problem might be to join up the top-down and bottom-up information streams, thus bringing the central coherence account and the enhanced perceptual processing account into agreement.

2.4 Some considerations on weak central coherence

During the last decade, the central coherence theory has gained a firm position in the cognitive-psychological discourse on ASD, although it still needs refinement in terms of definition and conceptualization. One of the main challenges for the future will be to specify

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the exact mechanism and to determine the levels at which the weaker drive for central coherence is located, since there is – for example – considerable evidence that people with autism do not find it difficult to integrate the features of one single object (Eskes, Bryson, & McCormick, 1990) or the meaning of individual words (Ameli, Courchesne, Lincoln, Kaufman, & Grillon, 1988; Frith & Snowling, 1983) and objects (Pring & Hermelin, 1993). Other studies have failed to demonstrate a local bias in visual perception using the Embedded Figures Test (Brian & Bryson, 1996), the Navon hierarchical figures (e.g. Ozonoff, Strayer, McMahon, & Filloux, 1994), and visual illusions (Ropar & Mitchell, 1999, 2001). Furthermore, central coherence functioning appears to be dependent on the way information is presented. Lucangeli (1997) suggested that the problem may not be a general inability to connect information but rather an inability to derive coherent information from incoherent stimuli (e.g. perceiving movement in static pictures). Another important nuance is the hypothesis that individuals with autism are not necessarily impaired in central coherence, but instead they have a non-conscious processing preference not to strive for coherence, unless instructed to do so (Jolliffe & Baron-Cohen, 1999; Plaisted et al., 1999).

Controversy exists regarding the mutual relationship between the three cognitive constructs; theory of mind, executive functioning, and central coherence. The results of the few empirical studies that investigated the link between two or more constructs are contradictory and do not provide decisive answers to the question whether or not there are three distinct cognitive dysfunctions in ASD. It does not seem right to consider the three theories as rivals because they are not necessarily mutually exclusive and might all be necessary to explain the broad clinical picture of ASD (Hill & Frith, 2003; Frith, 2002). For the time being, each account should be judged on its own merits, according to the following five criteria; it must (1) be universal, which means that all people with ASD must show the hypothetical cognitive dysfunction to a certain extent; (2) be specific, thus offering discriminative validity: the cognitive dysfunction should only occur in ASD and not in other disorders; (3) be measurable or testable; (4) refer to a neurobiological substrate; and (5) explain the core symptoms of ASD.

So far, it is hard to say whether the weaker drive for central coherence is *universal*, thus present in all people with ASD. Most studies have focused on high-functioning individuals with the core syndrome and/or Asperger syndrome. Individuals with the autistic disorder are generally more impaired than those with Asperger syndrome, but the latter still exhibit more difficulties with complex information processing than control groups (Jolliffe & Baron-Cohen, 1999, 2000, 2001). With respect to enhanced visuo-spatial processing, the evidence is

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somewhat mixed (e.g. results of the Embedded Figures Test: Jolliffe & Baron-Cohen, 1997, versus Ropar & Mitchell, 2001). These data raise the question whether weak central coherence is related to developmental level. Although there are no experimental studies on central coherence in young or very low-functioning individuals with ASD, one could argue that the weak drive for central coherence is general and pervasive in low-functioning individuals, while integration may be *relatively* spared in higher-functioning individuals (Brock, Brown, Boucher, & Rippon, 2002; Lopez & Leekam, 2003; Minshew, Meyer, & Goldstein, 2002).

Weak central coherence appears to be *specific* for people with ASD (and the broader phenotype), although most studies compare people with ASD with normal control groups only. A few studies, however, reported specificity in processing style in comparison to people with mental retardation (Hermelin & O'Connor, 1970; Jarrold & Russell, 1997; Tager-Flusberg, 1991), learning disorders (Hermelin & O'Connor, 1970; Lucangeli, 1997), language disorders (Norbury & Bishop, 2002) and ADHD (Booth et al., 2003). A major problem encountered by researchers is the high frequency of co-morbidity in ASD (Fombonne, 1998; Gillberg & Billstedt, 2000).

In terms of *testability*, many instruments have been developed to measure (weak) central coherence. The limitation of these instruments, however, is that they can only be used for higher-functioning (and mostly verbal) children or adults. Especially if one takes into account the fact that central coherence dysfunction is probably more pervasive in lower-functioning individuals and – consequently – has a major impact on their daily functioning, assessment instruments for the earlier developmental levels are needed; such instruments would also enable longitudinal studies. Furthermore, the reliability and validity of the majority of the instruments are still under debate.

The precise neurobiological *substrate* of weak central coherence is as yet unknown. However if weak central coherence and enhanced perceptual processing are conceptualized in terms of a bottleneck between top-down and bottom-up information streams, then this could be consistent with the exciting suggestion of increased neuronal growth (bottom-up) or reduced pruning and connectivity (top-down) (Frith, 2002; Hill & Frith, 2003; Tager-Flusberg & Joseph, 2003), which can – subsequently – be linked to unusual brain growth patterns, in particular in early or middle childhood (Akshoomoff, Pierce, & Courchesne, 2002; Courchesne et al., 2001).

Last but not least: what is the *explanatory power* of weak central coherence for the behavioral phenotype? The strength is that it can account for assets as well as deficits (Happé, 1999, Noens, I., & Van Berckelaer-Onnes, I.A. (2005). Captured by details. Sense-making, language and communication in autism. *Journal of Communication Disorders*, 38, 123-141.

2000). Hitherto, the central coherence theory has mainly been used to explain the non-triad features of the everyday behavior of people with ASD. The challenge is to relate weak central coherence to the triad of impairments, without being over-inclusive; after all it is possible to consider each problem as the outcome of an inability to give meaning to incoming stimuli. In our opinion (Noens & Van Berckelaer-Onnes, 2002, in press), the central coherence theory can offer insight into the specific communication problems of people with ASD, since a weaker drive for central coherence leads to problems in sense-making, and, consequently, in communication.

3 Connecting language, communication and sense-making in ASD

As previously mentioned, the emphasis on pragmatic impairments in the communication of people with ASD, and their relationship with theory of mind, seems to have diverted attention away from other impairments, on the one hand, and from differences in the developmental pathway, on the other (Tager-Flusberg, 2001; Tager-Flusberg & Joseph, 2003). Since communication is in essence ‘making sense’, a cognitive process in which perception and integration of information within a context play a crucial role, the central coherence theory may shed new light on language and communication of people with ASD. First, the specific development of communication and language in individuals with ASD will be linked to difficulties in sense-making; next, the conceptual and linguistic impairments in ASD will be discussed in relation to a weaker drive for central coherence.

3.1 Communication and language: a different developmental pathway

According to Bates (1979), there are two important moments ‘in the dawn of language’: (1) the onset of communicative intentions, and (2) the emergence of symbols. In recent publications on the development of communication in ASD (Noens & Van Berckelaer-Onnes, 2002, 2004; Travis & Sigman, 2001; Wetherby, Prizant, & Schuler, 2000), limited intentionality and symbol formation have been identified as core problem areas. Difficulties in precursors of theory of mind, such as joint attention, can possibly account for the lack of intentionality (e.g. Loveland & Landry, 1986; Mundy et al., 1994; Tager-Flusberg, 2000,

2001). Difficulties in symbol comprehension and use, however, might be better understood within the framework of the central coherence account.

Bates (1979) gave the following definition of ‘symbol use’: “The comprehension or use, inside or outside communicative situations, of a relationship between a sign and its referent, such that the sign is treated as belonging to and/or substitutable for its referent in a variety of contexts; at the same time the user is aware that the sign is separable from its referent, that is, not the same thing” (p. 43). During normal development, the first conventional gestures (i.e. showing, waving, pointing), the first words, and the first functional acts of playing emerge during the last three months of the first year. At first these behaviors are not truly symbolic, since they do not satisfy Bates’ criteria of substitutability and separability. Through a process of decontextualization, protosymbolic behaviors become more independent of perceptual support as well as accessible in a variety of contexts (Travis & Sigman, 2001).

Children with ASD communicate mainly through presymbolic contact gestures, such as pulling or manipulating someone’s hand (Wetherby et al., 2000). Protosymbolic behaviors show up much later in development, and sometimes they even disappear again. As previously mentioned, a considerable group of people with ASD never learns to speak, and those who do develop speech usually go through a period of idiosyncratic use of language, including echolalia, pronoun reversal, neologisms (e.g. window licker instead of windshield wiper) and so called ‘metaphorical remarks’ (e.g. ”Go crocodile?” asking to go to the swimming pool).

In this respect, the publications of Prizant, Schuler, and Wetherby (Prizant, 1983; Prizant & Schuler, 1997; Schuler, 1995; Wetherby et al., 2000; Wetherby, Schuler, & Prizant, 1997) on gestalt language forms in ASD offer an interesting account. According to Prizant (1983), children with autism use a gestalt strategy in early language learning. Gestalt language forms are “multiword utterances that are learned as memorized forms or whole units but may appear to be the result of productive linguistic processes or the application of combinational rules” (p. 299). Presumably, the speaker is not familiar with their internal semantic-syntactic structure. Echolalia, pronoun reversal, neologisms and metaphorical remarks can be conceived as consequences of a gestalt processing style, which can be contrasted with an analytical style in which experiences or events are analyzed and segmented into meaningful components based upon prior experience. Gestalt and analytical styles are not necessarily mutually exclusive, but rather the extreme ends of a continuum.

At first sight, piecemeal processing (conform the central coherence account) and gestalt processing may appear contradictory. However, they are closely intertwined, since adequate sense-making is a prerequisite for meaningful analysis and segmentation. If one is unable to

extract meaning by interrelating the relevant pieces of information and linking them to previous experiences (as predicted by the central coherence account), the only option is to memorize complete chunks and reproduce them identically. Echolalia can thus be conceptualized as a manifestation of detachment between peripheral processing and a central system that is concerned with sense-making (Frith, 2002). Pronoun reversal is a frequent by-product of delayed echolalia (Prizant, 1983). It springs from using gestalt forms, including second- or third-person references, that were not analyzed meaningfully. The correct use of pronouns is dependent on the point of view of the speaker; pronoun reversal may thus reflect a more general problem with deixis. Other relative terms, such as ‘here’ and ‘there’, or ‘yesterday’ and ‘tomorrow’, are equally complicated because analysis of their position in space and time is a condition for meaningful use in context. Furthermore, neologisms and metaphorical expressions are idiosyncratic utterances with a very specific, private meaning, usually based on a literal association. The unique association is conserved inflexibly, without meaningful analysis and accommodation on the basis of new experiences.

Children with ASD usually go through a first period of predominant use of echolalia without evidence of comprehension, followed by a next phase in which echolalia is used for a variety of functions (Prizant, 1983; Prizant & Duncan, 1981; Prizant & Rydell, 1984). Later, the gestalt forms are split up into meaningful components, thus facilitating spontaneous utterances. Nevertheless, difficulties in symbol comprehension and use are quite persistent, even for high-functioning individuals with ASD.

3.2 Conceptual and semantic evidence in relation to the weaker drive for central coherence

Many (auto)biographic accounts and clinical anecdotes illustrate how stimulus overselectivity can lead to difficulties in *concept formation*. Grandin (1995), for example, clearly describes how her cat concept consists of a collection of ‘videos’ of all the different cats she has ever seen; she cannot think of a generalized generic cat. De Clercq (1999) gave another beautiful example involving her son Thomas, who had learned to classify pictures of human beings and animals. One day he pointed to a lady with curly white hair and shouted out loud: “Mommy, is this a human being or an animal?”

The first studies on categorization in ASD (Tager-Flusberg, 1985a, 1985b; Ungerer & Sigman, 1987) failed to demonstrate a difference between children with autism, children with

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mental retardation and normal comparison groups in their ability to sort objects or concrete pictures on the basis of color, form, and function. More recently, Shulman, Yirmiya, and Greenbaum (1995) proved that children with autism do not have difficulties with categorization *as such* (e.g. geometric shapes) but perform poorly in the categorization of representational objects, requiring higher operational thoughts. They related their results to the central coherence hypothesis by explaining that sorting geometric shapes lends itself to a local and piecemeal ‘matching’ strategy, whilst sorting representational objects requires a more global understanding. Klinger and Dawson (2001) further investigated the process of categorization, showing that individuals with autism were not able to abstract an implicit prototype but could form categories on the basis of the application of rules. The effect, though, was not specific for autism, since individuals with Down syndrome showed similar impairments. The study of Minshew et al. (2002), finally, suggests an autism-specific dissociation between concept identification (rule learning) and concept formation. Within their framework, the most impaired individuals have none of both, less impaired individuals can learn rules and apply them strictly, whereas the most able individuals can discover rules and apply them in a flexible way, but keep having problems with the formulation of original concepts.

Concept formation is closely connected with semantic processing in memory and language. Among the earliest sources of evidence related to weak central coherence are the experiments on *memory* conducted by Hermelin, O’Connor, and Frith (Hermelin & Frith, 1971; Hermelin & O’Connor, 1967, 1970; O’Connor & Hermelin, 1967), which were later replicated by Tager-Flusberg (1991). These experiments revealed that children with autism have specific difficulties processing semantic as well as syntactic information. In recall tasks, they do not derive the usual benefit from related versus unrelated words, or sentences versus word strings. A recent study of Mottron, Morasse, and Belleville (2001) extended these findings, suggesting that individuals with autism – unlike a normal comparison group – do not benefit more from semantic than from phonological (syllabic) cues in a cued recall task.

Frith & Snowling (1983) investigated *linguistic processing* at the word, sentence and text level. At the single word level, their experiments (a.o. with the Stroop paradigm) suggest that processing of meaning is intact in high-functioning children with autism. Eskes et al. (1990), who used a variation of the Stroop task, also found normal interference for concrete and abstract words. When comparing these studies to the studies on concept formation mentioned above, it is important to note that the fact that children with autism show normal interference does not imply that the process of accessing meaning is normal. Furthermore, there are no

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studies on word level in lower-functioning children. One can conclude, however, that (high-functioning) children with autism understand at least some word meanings.

At the sentence level, Frith and Snowling (1983) demonstrated that children with autism are able to fill in gaps in sentences in a grammatically correct way. Though, in comparison with children with dyslexia, they are less able to fill in the gaps using the semantic context. Similarly, they found that children with autism fail to use sentence context spontaneously to disambiguate the pronunciation of homographs (one word with two different pronunciations and meanings depending on context, such as tear, bow, lead, etc.). An interesting extension is the fact that the group differences disappear with the instruction to read for meaning (Snowling & Frith, 1986). This Homograph test has proven to be very robust and has been replicated among high-functioning children with autism (Happé, 1997) and adults with autism and Asperger syndrome (Jolliffe & Baron-Cohen, 1999).

In the case of the combination of sentences, thus text level, Jolliffe and Baron-Cohen (1999, 2000) distinguished between tasks that still occur at a local level and more global tasks. According to the linguistic interpretation, information is local when it is in short-term or working memory at the same time (usually a maximum of three sentences), whereas global tasks usually consist of five or more sentences. In addition to replicating the Homograph task, their 'local' study (Jolliffe & Baron-Cohen, 1999) shows that high-functioning adults with autism and Asperger syndrome are less likely to select the most coherent bridging inference from competing alternatives and are less able to use context to interpret ambiguous sentences presented auditorily, no matter whether the ambiguity is lexical (e.g. 'He drew a gun.') or syntactic (e.g. 'The man was ready to lift.'). In the 'global' study (Jolliffe & Baron-Cohen, 2000), high-functioning individuals were less able to arrange sentences coherently (visual task) and use context to make a global inference (auditory task). Recently, Norbury and Bishop (2002) extended the results on inference in an elegant study comparing high-functioning children with autism, specific language impairment and pragmatic language impairment using more naturalistic story contexts and open-ended questions. Children with autism were more likely to have specific text-connecting and gap-filling inference deficits.

Problems in the processing of context have become manifest in many other studies, although not all of them relate their results to the central coherence hypothesis. Studies on discourse cohesion, for example, indicate that individuals with autism or Asperger syndrome have difficulties with referencing skills (Baltaxe, Russell, D'Angiola, & Simmons, 1995; Fine, Bartolucci, Szatmari, & Ginsberg, 1994), which means that their conversation depends less often on the previous interchange, thus impeding true reciprocity. Furthermore, the recent

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study of Losh and Capps (2003) on narrative competence provided evidence that even very intelligent individuals with autism spectrum disorders encounter problems in producing thematically integrated and elaborated narratives of personal experience independently and are less apt to include causal explanations in both their personal and storybook narratives. With respect to making use of context, Happé's studies on figurative language (Happé, 1993, 1994), which point out that individuals with autism are impaired in their understanding of and their use of appropriate mental state explanations for story character's non-literal utterances, such as lies, jokes, double bluff, metaphors, irony, sarcasm, etcetera, are well worth our attention. At first, Happé related the results to theory of mind functioning, but later she suggested that the results might be better understood within the framework of weak central coherence. After all, subjects with autism did not give fewer mental state explanations than the control groups; instead they failed to give context-appropriate answers. It seems that individuals with autism have difficulties understanding intended rather than literal meanings, which also appears from the studies of Minshew, Goldstein, and Siegel (1995), and Ozonoff and Miller (1996).

Taken together, evidence on conceptual and linguistic processing supports the hypothesis of Minshew et al. (1995), who suggested that language of (even very high-functioning) people with ASD is characterized by a distinction between mechanical and procedural skills, on the one hand, and abilities that require the more complex information processing needed for concept formation, reasoning, logical analysis, and interference, on the other. The central coherence theory offers opportunities to explain this distinction, since integration of information in context is crucial for complex information processing but not for mechanical and procedural skills.

4 Discussion

Conceptualizing the language and communication difficulties of people with ASD within the framework of a weaker drive for central coherence does not necessarily imply rejection of the theory of mind and executive functioning accounts. The three theories all contribute to a better insight into the communication of people with ASD and are not mutually exclusive. However, the central coherence account in particular has far-reaching consequences for education and intervention in everyday life.

Communication requires extremely rapid and multimodal processing of auditory (speech) and visual (non-verbal cues) stimuli, that are transient and temporally organized by nature (Fay & Schuler, 1980). Numerous aspects need to be perceived and placed into a specific context simultaneously. Without coherence one perceives disconnected bits and pieces, thus complicating effective sense-making. Van Dalen (1994), a high-functioning engineer with ASD, refers to himself as ‘seeing blind and hearing deaf’. He is able to see and hear but needs time to process the incoming stimuli step-by-step. Since natural communication modes are so fast and transient, he frequently fails to understand the most essential information.

Fay and Schuler (1980) indicated that individuals with ASD are much more successful with non-transient, spatially organized stimuli, such as objects or pictures. This idea is consistent with the observation of Schuler, Prizant, and Wetherby (1997) that language is often only understood in highly familiar contexts, and that the individual is probably not responding to the speech itself but to other environmental cues such as location in space. Even for high-functioning individuals with ASD, research of Kamio & Toichi (2000) suggests the advantage of pictures over words in access to semantics. It is now generally recognized that reduction of speech input, visual structuring of the physical environment and visualization of daily schedules and activities, as implemented in the well-known TEACCH-program (Schopler, Mesibov, & Hearsey, 1995), help people with ASD to understand their surrounding world.

However, consistent with the central coherence account and difficulties with symbol formation as discussed above, Van Dalen (1994) cautions about another problem. Objects and pictures can still cause him difficulties in sense-making. He explains how he perceives objects and pictures statically; it takes time to translate the perceptual configuration into functional and dynamic aspects. As such, people with ASD might be able to perceive objects or pictures, and even to label them correctly, but still have no idea what they represent, which consequently leads to difficulties in transferring what they see into adequate action. In the case of co-morbidity of ASD and mental retardation, the problems with sense-making (and

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thus communication) will be aggravated. Where Van Dalen laboriously comes to representational understanding of what he sees and hears, people with ASD and mental retardation might not be able to make sense at the level of representation at all. It does not mean that communication is impossible, but that one should introduce augmentative communication making allowances for the specific difficulties in sense-making (Noens & Van Berckelaer-Onnes, 2004).

Through analyzing language and communication in ASD from the viewpoint of a weaker drive for central coherence, more attention is paid to difficulties in symbol formation and comprehension of language in context. Making sense is what it is all about. All human beings are in need of overview and predictability in everyday life. For people with ASD, being captured by details, the world remains chaotic and confused, thus jeopardizing adequate sense-making.

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Continuing education questions

1. In autism spectrum disorders
 - a) the development of formal and semantic aspects is relatively spared, while pragmatic skills are specifically impaired
 - b) the development of formal and pragmatic aspects is relatively spared, while semantic skills are specifically impaired
 - c) the development of semantic and pragmatic aspects is relatively spared, while formal skills are specifically impaired
2. Focusing on sense-making in autism spectrum disorders fits within the framework of
 - a) the theory of mind hypothesis
 - b) the executive functioning hypothesis
 - c) the central coherence hypothesis
3. The idiosyncratic use of language can be conceived as
 - a) the consequence of difficulties in sense-making
 - b) the consequence of a gestalt strategy in early language learning
 - c) both a and b are true
4. Individuals with an autism spectrum disorder
 - a) do not have difficulties with concept formation
 - b) show a specific dissociation between concept identification and concept formation
 - c) all have problems with categorization
5. People with an autism spectrum disorder generally need
 - a) temporally organized augmentative communication
 - b) non-transient augmentative communication
 - c) multimodal augmentative communication

Key:

- 1 a
- 2 c
- 3 c
- 4 b
- 5 b