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***Language Disorders and Autism:***

***implications for usage-based theories of language development***

Kirsten Abbot-Smith, University of Kent

**Abstract**

Usage-based theories explain language development in terms of the specific characteristics of language input in combination with a child’s own inherent ability to engage in shared intentionality and statistical learning. In this chapter, I discuss these mechanisms in relation to evidence from Developmental Language Disorders (DLD) and Autism.

First, there is evidence for the role of language input in both conditions. The specific patterns of morpho-syntax impairments in DLD are clearly affected by the relative perceptual salience, frequency and complexity of morpho-syntax in the specific language a child is acquiring. Regarding autism, the grammatical complexity of parental child-directed utterances predicts child vocabulary and morpho-syntactic skills at later time-points. Nonetheless, both conditions are highly heritable, raising questions about the child-internal mechanisms leading to language learning difficulties. Impairments in statistical learning could potentially account for morpho-syntactic difficulties in DLD. However, any firm conclusions await assessments of statistical learning which have good test – retest reliability. Autistic children might plausibly tend to have difficulties with - or lack motivation for - engaging in shared intentionality. If verified, this could account for patterns of relatively spared nuts-and-bolts (structural, core) language in the face of pragmatic language difficulties. However, to date studies of autistic difficulties with shared intentionality have not stringently ruled out alternative explanations. Both DLD and autism are likely to exist on a continuum with the neuro-typical population. Future research needs to move towards designs which can more fully accommodate the vast heterogeneity that exists within both DLD and autism.

**Introduction**

Without the ability to communicate using language, human society could never have developed. Extended discourse, gossip, most jokes, negotiation and planning complex activities would be impossible without specifically linguistic devices. These include words (lexicon) as well as the conventionalised forms (morpho-syntax) used to convey sentence-based semantics (e.g. schematic representations of events, spatial locations and means for specifying objects). The lexicon plus syntactic-semantic sentential constructions are the ‘nuts and bolts’ of the human communication system. We should not, however, forget that the reason why humans use these nuts and bolts is that they are tools for the purpose of communication. The way in which people use language for the purpose of social communication is called ‘pragmatic language’. Pragmatics thus encompasses a broad range of skills, including the ability to interpret non-literal language, the ability to use context to determine what someone is referring to and the ability to initiate conversation and follow in appropriately on an interlocutor’s conversational turn (e.g. Landa, 2005).

A good theory of ontogenetic language development needs to explain both the acquisition of nuts-and-bolts language and pragmatic language. Moreover, to be all-encompassing, a theory needs to be able to account for patterns of acquisition not only in typically-developing children – but also in children with neurodevelopmental disorders, such as Developmental Language Disorder and Autism. Theories in general need to be able to account for not only the most frequently observed cases but also rare events. In fact, these so-called ‘rare events’ can often provide the best test cases for deciding between various theoretical accounts.

**Theories of language development**

One set of historically very influential theories of language development are those which invoke the concept of cognitive modularity. These types of theories (‘linguistic nativist’ theories) assume that children not only possess a set of innate mechanisms for learning morpho-syntax and the lexicon but that they are also born with access to innate linguistic representations (Pinker, 1989; Chomsky, 2011; Crain, Thornton & Murasugi, 2009; Valian, 2009).

Usage-based theorists, in contrast, explicitly argue against the proposal that language acquisition is dependent on mechanisms that are dedicated to learning language (Lieven, 2016). Instead, they argue that the trajectories of language development are a product of the properties of language input to the child in combination with child-internal learning mechanisms / capacities, which – importantly – are also involved in other (non-linguistic) developmental domains.

**Usage-based theory**

The current chapter will not embody an attempt to argue the advantages of usage-based theory over cognitive modularity accounts of language development, since this debate has attracted much attention elsewhere. Rather, the current aim is to determine the degree to which usage-based theories can accommodate evidence from language disorders and autism. We will start with a brief reminder of the key mechanisms at play in usage-based theories.

*Shared intentionality*

One of the most important ‘child-internal’ keystones for language development, at least according to Tomasello’s (2018) version of usage-based theory, is ‘shared intentionality’. Shared intentionality is a child’s ability to understand that s/he and an interlocutor - or ‘collaborator’ in a non-verbal task - are jointly engaged ‘together’ (as ‘we’) in an activity, whereby the child understands the shared goals and shared intentions. A good example of a task which allows demonstration of an understanding of shared intentionality is one which requires each collaborator to carry out complementary roles (e.g. one holds a tent steady whilst the other hammers in the tent pegs).

The earliest instantiation of shared intentionality is argued in this approach to be present when a child can engage in a true joint attentional frame or ‘shared attention’ (see Siposova & Carpenter, 2019). This is where the child is either having to take into account his or her shared history of the interlocutor in order to interpret non-verbal reference (– see e.g. Liebal, Behne, Carpenter & Tomasello, 2009) or where the child is initiating joint attention in order to comment on something (e.g. Liszkowski, Carpenter, Henning, Striano & Tomasello, 2004).  Tomasello and Moll argue (2010:342):

“..... joint attentional frames […] give cooperative gestures their meaning. Without a foundation in cooperative communication of this type, human language is not even thinkable".

*Statistical learning / distributional analysis*

A learning mechanism which is argued by usage-based theorists to play a central role in morpho-syntactic acquisition is statistical learning; that is, the ability to implicitly learn the probabilities with which particular contexts sequentially predict the occurrence of certain items. There is a wide body of literature which demonstrates that typically-developing human infants can and do use statistical learning to segment words from the language input (e.g. Saffran, Aslin & Newport, 1996) and to determine which sounds are phonemes in their native language (e.g. Maye, Werke & Gerken, 2002). Usage-based theorists argue that this learning mechanism is also used to acquire certain morpho-syntax rules (e.g. ‘*is ……Xing*’ vs. the impossible ‘*can……Xing*’). The latter process is driven by distributional analysis (e.g. Lieven, Pine & Baldwin, 1997). Statistical learning has also been shown to play a role in how children learn to generalise or constrain their use of argument structure; i.e. the mapping of sentential frames to event-based meanings (see Wonnacott, 2011).

*From exemplar-learning to the learning of syntactic constructions*

Of course, statistical learning can only allow a child to pick up probabilities of co-occurrence in the input. Many usage-based theorists have argued that children also use processes of form-to-meaning mapping, which are very similar to those used for word-learning, such as prototype formation, schema extraction, analogy-building and generalisation (e.g. Tomasello, 2003; Goldberg, 1999). These latter mechanisms are particularly implicated in the process of learning how to map syntactic constructions (such as Subject-Verb-Object) onto likely semantic meanings (such as ‘Doer-causative.action-affected-object’). The starting point for learning such syntactic constructions is argued to be the rote-learning of certain very common phrases, such as (1) or (2) below, which are learned as exemplars or ‘big words’ (Pine, Lieven & Rowland, 1998).

1. FORM: Ifindit

MEANING: object.retrieved

1. FORM: Wheredaddygone

MEANING: tell.me.Daddy.location

Lieven and colleagues established that the individual items (words) which are used in these phrases (e.g. ‘find’ or ‘gone’ in (1) and (2)) are not initially used in a combinatorial fashion and only very gradually become used in a more flexible fashion, albeit initially in so-called ‘lexically-specific’ or ‘item-based’ phrases (e.g. Lieven et al, 1997; Pine et al, 1998). Importantly, the initial exemplar-phrases themselves appear to be almost entirely based on the input to the child (see e.g. Lieven, Behrens, Speares & Tomasello, 2003).

*Properties of the language input*

One of the core claims of the usage-based approach is that the specific properties of the language input to the child are of crucial import for the acquisition of both the lexicon and morpho-syntactic sentential constructions (e.g. Lieven, 2010; Cameron-Faulkner, Lieven & Tomasello, 2003). Of particular importance for morpho-syntactic acquisition is the frequency with which certain items co-occur with certain words. To give one example, 2½ -year-olds are much more likely to actively correct an ungrammatical ordering of active transitive argument structure (e.g. ‘the bear the monkey pushed’) when the particular verb (e.g. ‘pushed’) frequently occurs in the input (e.g. Matthews, Lieven, Theakston & Tomasello, 2005). Intriguingly, for passive argument structure (e.g. ‘the monkey was pushed by the bear’), 2½ year-olds perform better with novel than with familiar verbs, arguably because the familiar verbs concerned are much more frequently heard in active transitive than in passive constructions (e.g. Dittmar, Abbot-Smith, Lieven & Tomasello, 2014). Bannard and Matthews (2008) have outlined a particularly well-elaborated account of how children gradually build up sentential-level form-to-meaning mappings based on initially low-level schemas. Importantly, language-input based accounts can explain not only the order of acquisition but also error patterns during development (e.g. Rowland, Pine, Lieven & Theakston, 2005; Kirjavainen, Theakston & Lieven, 2009).

*Usage-based predictions for language development*

In sum, in usage-based approaches, language acquisition is argued to derive from a combination of social learning mechanisms with statistical learning and prototype formation. One key prediction is that morpho-syntactic development should be entwined with lexical development. Crucially, usage-based theories also predict that morpho-syntactic development is at least in part driven by characteristics of input, such as the raw frequency of the particular morpho-syntactic forms concerned, their relative salience and also the frequency with which they combine with certain lexical items.

**Developmental Language Disorder (DLD)**

One neuro-developmental disorder which has received a great deal of attention in the ongoing debate between linguistic nativist theorists, on the one hand, and usage-based theorists, on the other, is that of Developmental Language Disorder (DLD). This term - previously known as Specific Language Impairment - is used when a child’s language difficulties are clearly causing a functional impairment in communication (i.e. not simply an initial delay) and when there is no known biomedical aetiology such as Down Syndrome, hearing loss or autism (Bishop et al., 2016).

 The existence of children who appear to be ‘only’ impaired in language development initially led to much excitement amongst linguistic nativists, with some of the more prominent advocates such as Pinker (1999:262) claiming that the cause of this disorder is a deficit in the ‘rule-based’ system of language (morpho-syntax). The predictions which naturally follow from claims of this type are the following. First, morpho-syntactic forms, which are clearly governed by regular rules (e.g. the English regular past tense *walk – walked*) should be an area of particular difficulty for children with DLD. Second, irregular forms (e.g. ‘*go*  *went*’) should be easier to master than regular forms for these children, since they can use word-learning strategies for these (e.g. van der Lely & Ullman, 2001). Third, the specific areas of morpho-syntax which are particularly impaired should be the same cross-linguistically; that is, if forming the past tense is an area of particular difficulty in DLD, then this should be equally the case for a DLD child learning Italian as it is for a DLD children learning English or German.

 In actual fact, a large body of cross-linguistic studies have found that the degree to which children with DLD are impaired relative to typically-developing controls matched for their Mean Length of Utterance (MLU) does depend quite clearly on the particular language which the children are learning (see e.g. Leonard, 2000: 119, for an overview). Moreover, the relative frequency of a particular form to meaning mapping even within a particular language influences the degree of impairment; English-speaking children with DLD tend to have much greater difficulty with the third person singular -*s* inflection (e.g. he jump*s*) than they do with the noun plural *-s* (e.g. cat*s*) (e.g. Oetting & Rice, 1993), presumably because the noun plural is much more frequent in the input (see Plunkett & Juola, 1999, for a connectionist model).

The perceptual salience of the form of a morphosyntactic item determines whether this is an area of particular impairment for children with DLD; the English third person singular *-s* (which is non-syllabic and not voiced) is impaired in English-speaking children with DLD in comparison to language-matched typically-developing controls, who are several years younger (e.g. Simkin & Conti-Ramsden, 2001). In contrast, Italian-speaking children with DLD are not impaired relative to language-matched controls on the third person singular (-*a* or -*e*) which is a separate syllable and a vowel (hence voiced) (e.g. Leonard, Bortolini, Caselli, McGregor, & Sabbadini, 1987).

Finally, the degree of systematicity of a particular system for marking appears to play a role (e.g. Leonard, Sabbadini, Leonard & Volterra, 1987; see also Lindner & Johnson, 1992). This evidence is highly problematic for linguistic nativist accounts, such as that of Pinker (1999; van der Lely & Ullman, 2001). In contrast, some computational accounts based on the principles of usage-based theory have been able to account for the patterns of morpho-syntactic development, which are specific to particular languages, in terms of characteristics of the language input (e.g. Freudenthal, Pine, Jones & Gobet, 2015;).

It is worth mentioning that the construct of DLD has increasingly come under scrutiny in recent years (at least for those language disorders which are not primarily speech-sound production disorders). ‘Intact’ non-verbal cognition is no longer part of the diagnostic criteria (APA, DSM-5, 2013; see Gallinat & Spaulding, 2014, for a meta-analysis). In addition, meta-analyses have found that sustained attention – including visual sustained attention - (e.g. Ebert & Kohnert, 2011) is impaired relative to typical controls. Non-verbal motor ability is also usually impaired (see Hill, 2001, for a review). Moreover, the core symptoms of children originally diagnosed with DLD frequently change with age; in many children the diagnosis in adulthood is an ADHD-type disorder (see Yew & O’Kearney, 2013; Curtis, Frey, Watson, Hampton & Roberts, 2018) or a form of autism (see e.g. Bishop, Whitehouse, Watt & Line, 2008; Roy & Chiat, 2014; Conti-Ramsden, Simkin & Botting, 2006). Thus, it is certainly not the case that DLD of itself provides evidence in support of linguistic nativist theories of language development, a là Pinker’s (1999) original claim.

From a usage-based perspective, it would make good theoretical sense to claim that impairments in learning morpho-syntax are caused by difficulties with statistical learning (e.g. Evans, Saffran & Robe Torres, 2009). This could potentially also account for evidence that children with DLD have difficulties processing rapidly occurring sequential patterns of tones or visual stimuli (see e.g. Leonard, 2000: Chp 6, for a review). Children and adolescents with DLD have indeed been found to be impaired relative to typical controls on a variety of non-verbal sequence learning tasks, such as visual serial reaction-time tasks (Tomblin, Mainela-Arnold & Zhang, 2007; Park et al., 2018; Hedenius et al., 2011; Lum et al., 2012; Sengottuvel & Rao, 2013; Gabriel et al. 2013)[[1]](#footnote-1). Furthermore, there is some evidence from both children with DLD (Evans et al., 2009) and typically-developing children (Kidd & Arciuli, 2016) that performance on statistical learning tasks correlates with performance in nuts-and-bolts language levels. Unfortunately, questions remain about what exactly many of these tasks measure and, moreover, the degree to which they have good test-retest reliability (e.g. Kidd, Donnelly & Christiansen, 2017; West, Vadillo, Shanks & Hulme, 2017). Therefore, before this possibility can be systematically investigated, the field first needs to develop reliable measures of statistical learning.

**Autism**

The other neuro-developmental disorder, which has received a great deal of attention in the literature, is autism. After briefly reviewing the diagnostic criteria for and heterogeneity within autism, we will first examine whether either statistical learning and the impact of input frequency work in similar ways in autistic language learning as they do in typical development. Our primary focus will, however, be on the conceptualisation of and motivation to engage in shared intentionality and whether difficulties in this domain would be likely to lead to impairments in either formal language or pragmatic language acquisition.

Autism Spectrum Conditions are diagnosed when an individual meets the criteria for impairment in two domains (APA, DSM-5, 2013). The first is that of Social Communication and Social Interaction, which includes a) deficits in social-emotional reciprocity, including back-and-forth conversation, b) deficits in non-verbal communicative behaviours and c) difficulties with relationships. The second symptom domain is Repetitive Behaviours and Restricted Interests (RRBIs) (see Leekam, Prior & Uljarevic, 2011, for a review). Neurological differences between autistic children and typical individuals appear to be diffuse and multiplex (e.g. Cherkassky et al., 2016; Just, Cherkassky, Keller, Kana & Minshew, 2007; Herbert et al., 2005).

There is extreme variability within the autism population in multiple domains. First, both non-verbal IQ and nuts-and-bolts language attainment show extreme heterogeneity in autism (see e.g. Fusaroli, Weed, Fein & Naigles, 2019). Many autistic children who have good outcomes for morpho-syntax and individual word recognition exhibit anomalies in their semantic processing and will have initially exhibited delays in language development (see Boucher, 2012, for a review). Second, there is also great heterogeneity within autism in terms of symptom severity in both the RRBI domain and in the social communication domain (as assessed by – for example – the Autism Diagnostic Observation Schedule (ADOS), Lord et al., 2012). Regarding the latter, there also appears to be variability in exactly how the impairments in the social communication domain express themselves. Some individuals appear (as least superficially – see Jaswal & Akhtar, 2019, for an alternative view) to have very little motivation for social engagement (e.g. Chevallier, Kohls, Troiani, Brodkin & Schultz, 2012) whereas others actively engage in social approach.

It is important to be clear that our goal here is not to ‘explain autism’. Rather, the purpose is to determine whether evidence from language development and language outcomes in autism is consistent with usage-based claims about how language develops.

*Statistical learning in autism*

Regarding statistical learning there is no clear evidence for group-level impairments in autism; two meta-analyses concluded that there are no impairments in statistical / procedural learning in comparison to well-matched controls (see Obeid, Brooks, Powers, Gillespie-Lynch & Lum, 2016; Foti, De Crescenzo, Vivanti, Menghini & Vicari, 2015, for meta-analyses). However, it is worth pointing out that both the starting points and the outcomes for nuts-and-bolts language acquisition are unusually diverse in autism. On the one extreme, some children diagnosed with autism at 36 months show no language impairments (or even accelerated language development) as assessed by the Mullen Scales of Early Learning at 14,18 and 24 months (see Landa, Gross, Stuart & Bauman, 2012, for a latent class analysis). On the other extreme, some autistic individuals have very minimal or no language in adulthood (e.g. Boucher, 2012), and just over half of all children diagnosed with a form of autism have language scores in the language-impaired range (e.g. Loucas et al., 2008). Thus, Obeid et al. (2016:1245) note the possibility that statistical learning difficulties might be found in those autistic children who are impaired in nuts-and-bolts language development.

*The role of language input for language development in Autism Spectrum Conditions*

 Bettelheim’s (1967) now infamous proposal that autism is caused by environmental factors (i.e. his ‘refrigerator mother’ hypothesis) has been undeniably refuted; the key factors contributing to outcome are clearly child-internal and in fact autism is one of the more heritable neuro-developmental disorders (Liu et al., 2008; Hallmeyer et al., 2011; see Tick, Bolton, Happé, Rutter & Rijsdijk, 2016, for a meta-analysis of twin studies). However, this does not mean that specific characteristics of the language environment do not play an important role. To the contrary, randomised controlled trials (RCTs) have found that interventions for nuts-and-bolts language are effective for autistic children (see Paul, 2008, for a review).

The key take-home message to emerge in recent years is the following. The length and complexity of parental child-directed utterances at earlier time points positively predicts child vocabulary, sentence length and morphological skills at later time-points, even when statistically controlling for child language at the earlier time-points *and* when controlling for the influence that child non-verbal IQ has on parental child-directed speech (Fusaroli et al., 2019; see also Bang & Nadig, 2015; Gonzalez-Barrero & Nadig, 2018). Moreover, parental tendencies to use telegraphic speech (e.g. omitting obligatory determiners ‘the’ ‘a’) show negative relationships with later child language in autism; i.e. these parents more frequently had children who (one year later) showed lower lexical diversity in their own speech. Path analysis supports the proposed direction of the effect (e.g. Venker et al., 2015). These findings have led to words of caution regarding the practice of using simplified and shortened speech with children with autism (or indeed DLD) (see Sandbank & Yoder, 2016, for discussion of certain intervention programmes; also the DfE). Fusaroli et al. (2019) note that this practice is unlikely to be fully adequate.

Indeed, the importance of using grammatical sentences (with adequate syntactic complexity) in child directed speech will not come as a huge surprise to usage-based theorists since they have long argued that children learn about the syntactic categories (e.g. Pine, Freudenthal, Krajewski & Gobet, 2013) and even the semantics of words (e.g. Matthews & Bannard, 2010) from their co-occurrence with function words such as determiners. Thus, it would appear that the *form* of the language input impacts the acquisition of nuts-and-bolts language by autistic children in a similar fashion to how language form impacts language acquisition by typically-developing children.

 Where autistic children do appear to benefit regarding modifications to the input does not relate to the form of language but rather in aspects relating to joint attention and motivation (see also McGillon, Pine, Herbert & Matthews, 2017, for typically-developing children). That is, those interventions for nuts-and-bolts language which have met with the greatest success for autistic children aim to manipulate the joint attentional context in which the language input occurs. These types of interventions often focus on changing parental behaviour to make them particularly sensitive (i.e. more so than the typical parent) to the focus of the child’s attention and to ‘following in’ on the child’s own spontaneous verbal and non-verbal communication in a manner which is contingent to the topic of the child’s utterance (e.g. Aldred, Green, Emsley & McConachie, 2012). Another element common to these types of interventions involves so-called ‘sabotage’; that is, the parent or interlocutor deliberately sets up a situation where the child will need to communicate in order to request (e.g. deliberately only giving the child a small serving of juice or putting a favourite toy on a high shelf). Thus, even though these interventions are aimed at improving nuts-and-bolts language, they do so by increasing the chances that the child is engaged in joint attention (or at least the language is describing the child’s focus of attention) and they do so by increasing the motivation of the child to communicate. Both of these factors clearly speak to the socio-cognitive elements of usage-based theory.

*Shared intentionality*

The socio-cognitive aspects of usage-based theory are of clear relevance for autistic children, given the core deficits in social cognition and social communication in autism. Numerous (and highly influential) theories have proposed that the core deficits in autism pertain to one or other aspect of socio-cognitive functioning or social motivation (e.g. Happé, 2015; Baron-Cohen, Leslie & Frith, 1985; Mundy, Sullivan & Mastergeorge, 2009; Klin, Jones, Schultz & Volkmar, 2003; Hobson, 1993; Jones et al., 2018; Chevallier et al., 2012).

 Usage-based theorists have proposed that a number of social learning mechanisms are involved in language learning, including the ability to imitate others and the ability to learn from explicit teaching (see Tomasello, 2003, 2008). However, the key social learning concept which has received most attention in recent usage-based literature is that of ‘shared intentionality’; that is, the ability and motivation to ‘act as we’, where (at least) two individuals share a goal and the intentions to work together towards that shared goal.

It is fairly self-evident that an individual who has difficulties (or a lack of motivation for) ‘acting as we’ would not display appropriate pragmatic language, at least in regards to conversation skills. Indeed, Searle (1990) claims that ‘*the biologically primitive sense of the other person as a candidate for shared intentionality is a necessary condition for all collective behaviour and hence of all conversation*”. Thus, atypical shared intentionality could plausibly explain difficulties with ‘back and forth’ conversation which are part of the diagnostic criteria for autism (DSM-5, 2013). Even autistic children who show a motivation for social approach still tend to respond less during conversation and / or show a tendency to go off-topic and / or perseverate on their own favourite topic (see Sng, Carter & Stephenson, 2018, for a review). This could suggest that these children have difficulties managing conversation as a ‘joint action’, where the topic is ‘co-constructed’ with the partner. Furthermore, autistic children who have unimpaired nuts-and-bolts language and non-verbal IQ (so-called ‘high-functioning’ individuals) still have difficulties in comparison to typically-developing controls with tailoring their language production for the information needs of the listener (see Malkin, Abbot-Smith & Williams, 2018, for a review). It is plausible that one factor here might be difficulties understanding what has or has not been previously shared with the listener (e.g. Clark, 1996).

However, pragmatic language difficulties are evidentally not uniform across across all autistic individuals. It is also possible that the universality of autistic difficulties regarding aspects of shared intentionality has been over-stated (Tomasello, Carpenter, Call, Behne & Moll, 2005). Therefore, before exploring potential relationships between shared intentionality and language in autism, we will weigh up the degree to which shared intentionality itself appears to be atypical in autism.

*Is shared intentionality atypical in autism?* Tomasello and colleagues argue that evidence for shared intentionality can be seen in ‘true’ joint attention (shared attention), in the ability to reverse roles in joint action, in the ability to collaborate and in implicitly feeling the commitment to continue and collaborate, once started.

*Joint Attention:* Joint attention (JA) is defined as triadic attention, whereby an interlocutor and child are both intentionally attending to one another and simultaneously an object (or event or other person). Importantly, for this to be joint attention, the child must also be attending to the reactions of the interlocutor to the third element (e.g. object) and – crucially - be checking that the interlocutor is attending to the child’s own reactions to the interlocutor’s reactions (e.g. Bruner, 1974).

Joint attention difficulties have long been considered to one of the most reliable indicators for a diagnosis of child autism (see Bruinsma, Koegel & Koegel, 2004, for a review; Mundy, Sigman, Ungerer & Sherman, 1986; Carpenter, Pennington & Rogers, 2002). However, there are many reasons why we should be cautious about considering joint attention per se to be reliable indicator of shared intentionality. One key reason is that the term is ambiguous and encompasses a variety of child behaviours. These include children’s responses to interlocutor joint attentional engagement, such as gaze-following and point following (Response to Joint Attention or RJA) and child Initiation of Joint Attention (IJA), as in hold-outs and showing (e.g. Cameron-Faulkner, Theakston, Lieven & Theakston, 2015) and declarative pointing (e.g. Bates, Camaioni & Volterra, 1975). According to Tomasello and colleagues, in ‘true’ joint attention the child has at some level a ‘bird’s eye view’ of the interaction which includes both the child’s roles and goals as well as those of the partner (e.g. Tomasello & Moll, 2010).

Most studies on joint attention in autism have been carried out with children who are at least two years of age (although see Clifford & Dissanayake, 2008, for a review of home video studies). An alternative method is to follow a sample of so-called ‘high risk’ children from early infancy until the time point when (usually around 20%) are diagnosed with autism. These ‘high risk’ children are usually siblings of autistic children. In one such study, Rozga et al. (2011) found that at 12 months, those children who later received a clinical diagnosis of autism using the ADOS did not differ from controls regarding following a point to a picture in a book (which might plausibly be achieved via fairly low-level target-following mechanisms).

It may be that many autistic children do not have difficulty gaze-following or point-following if this only requires a fairly low-level automatic response to physically salient target within the immediate visual field (i.e. an obvious target), in a similar manner to gaze-following exhibited by typically-developing infants at three months (e.g. D’Entremont, 2000). Indeed, Leekam, Hunnisett and Moore (1998) found that the majority of their autistic sample did spontaneously follow gaze; those that did not tended to have a very low verbal mental age for their chronological age, suggesting that mechanical gaze-following deficits in autistic children may be due to attention difficulties associated with severe intellectual disability.

The possibility that joint attention, if defined loosely as e.g. simple gaze-following, may in some cases be driven by fairly low-level mechanisms has led to a movement towards the definition of more precise sub-types of joint attention. Importantly, even a conscious ‘monitoring’ of someone else’s attention (e.g. looking where someone else is suddenly looking to see if there is something interesting) does not necessitate that attention is ‘shared’ in any way. In contrast, *shared* attention does require a consideration of the knowledge shared with the other individual (e.g. Siposova & Carpenter, 2019). For example, another individual might point to a plate but how we interpret this will differ given our shared background knowledge. For example, this point could mean ‘Put that in the dishwasher’ or it might mean ‘why are you using your sister’s special plate?’. The ability to interpret reference in an interlocutor-specific manner might appear to be something we would predict to be impaired in autism.

However, a recent study by Malkin, Abbot-Smith, Williams and Ayling (2018) in fact found equivalent performance between a group of autistic 5- to 7-year-olds and well-matched typically-developing controls. This study adapted a paradigm developed by Liebal et al. (2009), in which each child first engages with one experimenter (E1) in an activity that has a missing piece (e.g. marble). The same child then engages with another experimenter (E2) in a different activity which also has a missing piece – the same missing piece. In this particular study, the test trials required the children to interpret a verbal referring expression ‘it’. On the test trials, either E1 or E2 (Requester) pointed to the missing piece and said ‘Now you can do it’ and the dependent measure was whether the child then inserted the missing piece into the particular activity with which they had previously engaged with the requester. Both groups were equally likely to successfully insert the missing piece into the activity which they had shared with the Requester. To rule out the possibility that children might simply blindly associate the Requester with a particular game, Malkin et al. (2018) included a control condition, in which the Requester had sat next to but had not engaged with the child in that activity. Here, both groups were at chance, indicating that experimental trial performance was not due to blind association.

At face value, one might conclude that these autistic children did understand what they had shared (as ‘we’) with the requesting experimenter. However, this task might in fact be resolved without the concept of shared intentionality, as long as the children have the motivation to help (which is present in autistic children, see Liebal et al., 2008: Study 1) and if they can understand goal-directed action. That is, the children could have tracked the actions of E as she engaged in a task and then have connected her reference to the last activity in which E had engaged.

In contrast to findings for Response to Joint Attention, difficulties with the Initiation of Joint Attention (IJA) are much more consistently found in young autistic children (Rozga et al., 2011; Landa, Holman & Garrett-Mayer, 2007; Macari et al., 2012). However, evidence for early impairments in IJA in autism cannot straightforwardly been taken as evidence for atypical shared intentionality in autism. It is possible, for example, that autistic difficulties with IJA derive from difficulties either with self-generated visual attention and / or atypical visual processing, which makes it difficult to detach visual attention from salient objects (see e.g. Mundy et al., 2009).

*Collaboration*: Collaboration is, in contrast, pivotal for the question of whether autistic children engage in shared intentionality. Moreover, collaborative interactive tasks are more analogous to conversation than are the aforementioned tasks. Collaborative tasks require turn-taking and an understanding of each partner’s ‘role’ in the overall project, just as is the case in conversation. In addition, collaborative tasks implicate a commitment to the partner; one cannot simply abandon the collaborative partner just as one cannot walk off mid conversation.

Before we discuss collaborative abilities in autism, it is important to first define what collaboration means. One of the most widely applied definitions of ‘collaboration’ is that of Bratman (1992), who argues that this term describes a situation where (at least) two individuals are aware that they are engaging in a joint activity which has a joint goal, for which they share the intention to work towards. Notably, while a joint activity includes the co-ordination of the actions of two individuals, this co-ordination of action does not of itself constitute collaboration. Brownell (2011) describes a series of examples from other species (e.g. penguins) where action is jointly co-ordinated but nonetheless does not meet the criteria for collaboration. Moreover, although the two individuals must co-ordinate in order to collaborate, this of itself does not of itself constitute collaboration; that is, when we collaborate, we are committed to the joint goal that both individuals should benefit from collaboration (e.g. Tuomela, 2007). To illustrate, while chimpanzees co-ordinate with one another if this leads to the greatest gains (here: food) for the self (e.g. Melis, Hare & Tomasello, 2006), this does not then lead to a motivation to then share the rewards (e.g. Hamann, Warneken & Tomasello, 2012) – hence, they do not truly collaborate with one another.

We first outline studies which have either utilised the ‘Prisoner’s Dilemma task (see Nash, 1951) or related paradigms such as the Ultimatum Game. While group differences tend to be found, autistic impairments are relatively mild (e.g. Sally & Hill, 2006; Tayama et al., 2012; Kaartinen et al., 2019). However, these tasks do not constitute collaboration for the following reasons. First, no action co-ordination is required. Second, the decisions to act are made on an entirely individual basis and third, the motivation of the individual could simply be one of ‘using’ the other person in order to achieve the end reward (see Tomasello & Hamann, 2012, for discussion). Thus, these tasks do not assess the concept of or motivation for shared intentionality implicit in true collaboration (e.g. Tuomela, 2007).

In contrast, three studies used co-operative social games with a problem-solving element, each requiring two participants. To illustrate, one apparatus involved a set of double tubes where one play partner might insert a ball into the end of one of the tubes so that the other play partner could catch it in a tin. The tubes were too long for the child to play both roles simultaneously. The child needed to flexibly work out a) which tube end was the relevant one on a particular trial and b) switch between the ball-insertion role and the cup-collector role. Importantly, in this paradigm, the experimenter simply desisted playing (fake termination) at one point so that the child’s attempts to re-engage the experimenter could be assessed.

All three studies found deficits in comparison to control groups matched on mental age (Liebal, Colombi, Rogers, Warneken & Tomasello, 2008: Study 2; Colombi et al., 2009; Li, Zhu, Liu & Li, 2014). In the first study Liebal et al. (2008: Study 2) assessed intellectually-impaired pre-schoolers. Their focus was whether the child attempted to re-engage an experimenter after E faked termination. In this particular study, the only real between-groups differences was found in the use of eye-gaze as an attempt to re-initiate an interaction. Since an impairment in the initiation of joint attention (IJA) is one of the core symptoms of autism – and one which is compatible with numerous theoretical approaches - the results of Liebal et al. (2008: Study 2) do not, therefore, support a difficulty with shared intentionality specifically.

That said, Liebal et al.’s (2008) results were replicated (in a sample of intellectually high-functioning primary-school aged autistic children) using a slightly different dependent variable (Li et al., 2014). Here, during E’s ‘fake termination’ phase, Li et al. (2014) awarded children a point *either* if they attempted to re-engage E *or* if they waited patiently at their end of the apparatus. Not only did Li et al. (2014) find significant between-group differences, they also found that the performance in the autistic group was related to difficulties with cognitive flexibility (i.e. perseverative errors on a card-sorting task), when controlling for non-verbal IQ and age.

 Colombi et al. (2009) used the same paradigm but their dependent variable was the degree of co-ordination between the child and experimenter prior to the fake termination (e.g. does the child choose the wrong tube or else not throw the ball / hold the can). Again, the autism group showed significantly less co-ordination than the Developmental Delay control group. Regression analyses indicated that imitation, joint attention skills and child diagnostic status all significantly contributed to the ‘co-ordination’ outcome variable, whereas intention-reading skills and verbal mental age did not. However, autistic individuals might find this type of co-ordination difficult due to the cognitive flexibility requirements inherent in holding two different roles (e.g. baller-thrower and cup-holder) in mind. Worse, cognitive flexibility is impaired in autism (see Lai et al., 2017, for a meta-analysis) and it is also very closely related to social cognition in typical development (e.g. Kloo & Perner, 2003). This suggests that future studies should control for certain aspects of executive functioning, which is an issue we will return to at the end of the chapter.

A more potentially revealing collaboration study is that of van Ommeren, Begeer, Scheeren and Koot (2012). Here autistic individuals were compared to age- and vocabulary-matched typical controls on how they engaged in a collaborative drawing task. Interestingly, the group differences lay not in the willingness or ability to collaborate per se. Instead, there was an interaction, whereby the autistic individuals were impaired only when the goal of the collaboration was determined by the experimenter (rather than by themselves). This would appear to suggest that the autistic individuals did not ‘share’ intentions in these collaborations but instead preferred to ‘direct’ the intentions of others, which fits with anecdotal reports that many ‘active but odd’ autistic children seek to direct or control any joint play they engage in.

 The only study which appears to indicate a clear motivation to socially engage during a co-operative task is that of Kimhi and Bauminger-Zviely (2012). In this study, intellectually high-functioning autistic three- to six-year-olds collaborated with peers on a problem-solving task balancing weights on a scale, where a given child could only manipulate one weight at a time (and thus required a partner to resolve the task). The design crossed Diagnostic Status (autistic / neurotypical) with the Friendship Status of the partner; each child carried out the task twice, once with a friend and once with a (matched) non-friend. The autistic group made less ‘sharing’ comments relating to the success vs. failure of the task but was also more responsive to suggestions from their collaborating peer than was the typical control group. Regarding the latter variable, children (conflated over group) were more responsive to friends than to non-friends. Children were also more reciprocal and showed more signs of having fun (e.g. laughter) when collaborating with a friend than with a non-friend. Interactions between Diagnostic Status and Friendship Status were not reported but the implication is that these were not significant. In sum, Kimhi and Bauminger-Zviely’s (2012) findings are not entirely straightforward to interpret; they imply that this autistic sample were more motivated to engage with friends than non-friends (suggesting a motivation for social proximity, see Over, 2016) but it is not clear from this study whether they understood that they were working towards a shared goal.

Thus, on the whole, almost all published studies of collaboration / co-operation find at least one significant difference between autistic children and their typically-developing peers in a task which could potentially be argued to assess shared intentionality. Nonetheless, there is simultaneously evidence that autistic children co-ordinate and that at least some sub-groups are motivated towards social proximity.

None of this evidence is sufficiently clear cut. We sorely need in the autism literature more stringent tests of engagement in shared intentionality. For example, typically-developing three-year-olds demonstrate an awareness that the establishment of a mutual or joint goal creates the expectation that they should not abandon the collaboration mid-way (e.g. Gräfenhain, Behne, Carpenter & Tomasello, 2009). They also tend to share rewards gained via joint effort over and above their baseline sharing tendencies (e.g. Hamann et al, .2012). These types of paradigms and measures need to be carried out with autistic children before we can draw any conclusions about their engagement in shared intentionality.

*Would difficulties in shared intentionality lead to impairments in nuts-and-bolts language?*

Tomasello (2008) is clear that without shared intentionality, then phylogenetically the evolution of nuts-and-bolts language would not have been possible. If applied to ontogenesis, this might raise a conundrum. As Lieven (2016: 348) notes:

“ Children diagnosed with autism spectrum disorder show impairments in early joint attention and later in the pragmatic uses of language, but some of them show relatively intact structural language….Much more research is needed to work out how these children manage this and to explore the possibility of different routes into the learning of language structure….”

With regards to morpho-syntax (and its conventional mapping onto sentential meaning), shared intentionality is probably *not* necessary for its acquisition (although it might be beneficial) for the simple reason that children do not have to establish through collaboration new linguistic conventions from scratch; the evolution of language has already occurred. Rather, children can use statistical learning to learn the distributional properties of a pre-established system. Importantly, as we have seen, statistical learning does not on whole appear to be impaired in autism, at least not in those children who end up with nuts-and-bolts language test scores in the ‘typical’ range. Therefore, one might think that it is possible to develop a usage-based account in which those autistic children with unimpaired statistical learning are predicted to have an unimpaired ability to learn the phonology and syntax of their language but (due to difficulties with the concept of shared intentionality) impaired pragmatic language skills. This would fit with reviews of language difficulties in autism, in which it is argued that autistic children tend to be relatively unimpaired in phonology and syntax but do show impairments in semantics (particularly more abstract word meanings) and – of course – pragmatics (Boucher, 2012).

 Unfortunately, such an account would fail to consider how children learn word meanings and – worse – the crucial role that words are proposed to play in syntactic development in the usage-based approach. That is, early syntactic knowledge is argued to be organised around certain high-frequency words. A child may have a lexically-specific construction such as *'can't X*' in which she is able to insert certain verbs (e.g. Pine et al., 1998). Moreover, children also have to map the meanings of certain syntactic constructions (e.g. English passive ‘*X gets VERBed*’) onto their prototypical meanings (e.g. ‘AFFECTED-THING’ + ACTION-AFFECTING). If a child has difficulty learning word meanings in the first place, then – according to the usage-based account – s/he would also show an initial delay for syntactic development.

Therefore, the key question is what exactly usage-based accounts predict regarding word learning for children who do not naturally seem to engage in shared intentionality. Unfortunately, usage-based accounts have to date been somewhat ambiguous on this point. What is fairly clear is that typically-developing children can and do use a variety of cues to map word meanings onto new words and that the joint attentional frame is not a prerequisite for word learning (e.g. Brandone, Pence, Golinkoff & Hirsh-Pasek, 2007 ; see also Lieven, 1994, regarding cross-cultural differences). Indeed, typically-developing and even autistic children can learn the meaning of new words by ‘listening in’ to the verbal interaction of third parties (e.g. Luyster & Arunachalam, 2018). The only plausible means by which children could learn word meanings in some of these ‘learning through overhearing’ paradigms is through determining the goals of the speaker. While there is controversy regarding whether the ability to determine the goals and intentions of others is impaired in autism (Huang, Chiang & Hung, 2017; Williams & Happe, 2010), understanding of goal-directed action appears not to be impaired in many contexts (Aldridge, Stone, Sweeney & Bower, 2000; Carpenter, Pennington & Rogers, 2001; Charman et al., 1997; see Hamilton, 2009, for a review).

Logically, the ability to follow the eye-gaze of others would be a useful cue to the intentions of others when learning word meanings. Here, findings for autism are not completely clear cut. In the experimental word learning literature, some studies have found that autistic children do not take the experimenter’s eye-gaze direction cue into account when determining which novel word is the target word and instead map the novel word in a blind associationist manner onto the object they themselves are looking at when they hear the new word (e.g. Preissler & Carey, 2005; Baron-Cohen, Baldwin & Crowson, 1997; see also Parish-Morris, Hennon, Hirsh-Pasek, Golinkoff & Tager-Flusberg, 2007, when object salience conflicts with eye gaze cues). In contrast, there are now a number of studies which have found that autistic children can appropriately use the speaker’s eye-gaze cues in novel word learning tasks (e.g. Luyster & Lord, 2009; Bani Hani, Gonzalez-Barrero & Nadig, 2013; Norbury, Griffiths & Nation, 2010). More research is needed to unpick the key factors involved. But what is clear is that a surprisingly large proportion of autistic children do not have any difficulties in gaze-following (e.g. Leekam et al., 1998) and that word learning can often occur even when children are not adept at gaze following (e.g. Preissler & Carey, 2005).

Nonetheless, while joint attention may not be necessary, it is beneficial for word-learning. The degree of impairment in joint attention has been found in numerous studies to predict later language development (e.g. Charman et al., 2003) and indeed language development many years later (e.g. Sigman & Ruskin, 1999). Many have argued that the ability to initiate joint attention is particularly beneficial for nuts-and-bolts language development in autism (e.g. McDuffie, Yoder & Stone, 2005; see also Mundy et al., 2009). Indeed, some of the most successful interventions for nuts-and-bolts language impairment in autistic children involve treatments which target joint attention (see Murza, Schwartz, Hahs-Vaghn & Nye, 2016, for a meta-analysis). Thus, a large body of evidence from naturalistic child language suggests that relatively unimpaired joint attention skills are a definite advantage for nuts-and-bolts language development in autistic children.

 It is therefore possible to develop a usage-based account in which it is argued that autistic children use the same mechanisms as do typically-developing children to learn nuts-and-bolts language. That is, the abilities to a) understand goal-directed action and b) proficiently engage in statistical learning are both essential for nuts-and-bolts language development. The ability to engage in shared attention is beneficial but perhaps not essential. Interestingly, there is tentative evidence (e.g. Roser, Aslin, McKenzie, Zahra & Fiser, 2015) that some intellectually high-functioning autistic individuals may actually outperform their typically-developing peers in some aspects of statistical learning. This could tie in with other suggestions that some individuals with autism might have enhanced phonological and auditory processing skills (e.g. Norbury et al., 2010), which might plausibly provide an additional boost where joint attentional skills are somewhat lacking.

*Would difficulties in shared intentionality lead to impairments in pragmatic language?*

Regarding pragmatic language development, the usage-based account unambiguously predicts that an individual who either has difficulties understanding the concept of shared intentionality or else is not motivated to share intentions in this way will be impaired in the ability to engage in naturalistic conversation (e.g. Searle, 1990; Tomasello, 2018). That is, conversation requires an understanding of the topic that is co-constructed by both conversation partners, allowing each to follow in on the partner’s previous turn with an utterance which elaborates and expands it (see (3)).

1. Child 1: I saw a lion at the zoo.

Child 2: Oh, when I went, I saw a really cheeky monkey.

 Two studies to date have examined longitudinal relationships in autistic children between their joint attentional skills in the second year of life and their pragmatic language skills mid primary-school age (Greenslade, Utter & Landa, 2019; Gillespie-Lynch et al., 2015). While Greenslade et al. (2019) found significant correlations, Gillespie-Lynch et al. (2015) did not. However, the latter study only assessed pragmatic language via a parental questionnaire and both studies suffered from low power. No studies have assessed potential relationships between the ability to engage in collaboration and pragmatic language skills (although a couple have used collaboration paradigms to ameliorate pragmatic language difficulties in ASD and related disorders, see e.g. Murphy, Faulkner & Farley, 2014; Bauminger-Zviely, Eden, Zancanaro, Weiss & Gal, 2013). Indeed, were a significant relationship to be found between concurrent pragmatic language skills and collaboration, it would be difficult to know the causal direction, since older children use verbal language in order to collaborate. However, there are some promising preliminary findings regarding pragmatics (or verbal social communication) from intervention programmes designed to foster peer collaboration during play (see e.g. Owens, Granader, Humphrey & Baron-Cohen, 2008). If training autistic children to collaborate non-verbally were found to lead to improved conversation skills, this might indicate that the concept of shared intentionality is an important keystone for conversation skill.

**General Conclusions**

Usage-based theories of language development do a good job of providing an internally logical account of how both nuts-and-bolts language (phonology, morpho-syntax, the lexicon) and pragmatic language develop in typically-developing children, on the one hand, and in children with Developmental Language Disorder (DLD) or autism, on the other. Findings from language development in DLD do not support predictions from linguistic nativist theories (see also Thomas & Karmiloff-Smith, 2003). Instead, the specific areas of morpho-syntactic impairment in DLD are determined by characteristics of relative frequency, salience and systematicity of marking in the particular language the children are learning (e.g. Leonard, 2000). Difficulties in statistical learning may well turn out to be causally related to prototypical impairments in DLD but future investigation of this awaits the development of more reliable measures of statistical learning (e.g. Krisnan & Watkins, 2019).

Language development in autism is also consistent with the usage-based approach. Studies of the role of the input, although scant, indicate that nuts-and-bolts language development is positively predicted longitudinally by the degree of morpho-syntax complexity in caregiver speech (e.g. Bang & Nadig, 2015; Venker et al., 2015; Fusaroli et al., 2019), just as is the case for nuts-and-bolts language development in typically-developing children (e.g. Hurtado, Marchman & Fernald, 2008).

Statistical learning appears (at the group level) to be unimpaired in autistic children, who have nuts-and-bolts language scores in the typically-developing range (see e.g. Obeid et al., 2016; Foti et al., 2015; for meta-analyses). Moreover, quite a number of studies have failed to find group-level differences in the ability to interpret the intentions underlying at least certain types of non-verbal goal-directed action (e.g. Aldridge et al., 2000; Carpenter et al., 2001; Charman et al., 1997; Hamilton, Brindley & Frith, 2007; Colombi et al., 2009). Thus, according to usage-based theorists, the fact that these two abilities are relatively intact should be sufficient for morpho-syntax and indeed many aspects of word meaning. However, to be able to draw any firm conclusions here, further research is needed to investigate statistical learning in a sample which includes autistic children from the full range of nuts-and-bolts language abilities. If this were assessed longitudinally, it would be possible to determine whether good (or perhaps even better than average, see Norbury et al., 2010) statistical / procedural learning skills are an important predictor of nuts-and-bolts language development in autism.

This leads us to the role that shared intentionality plays in usage-based theory and whether the development of this is atypical in autistic children. While it is clear that the initiation of joint attention is almost always impaired in autistic children, this is of itself not an indication that the motivation for shared intentionality is atypical, since this could be driven in part by difficulties in generating motor movement, atypical visual processing or difficulties with cognitive flexibility. Experimental measures of shared attention would be more revealing, but the only study to date (Malkin et al., 2018) did not find group level differences. Tests of joint commitment understanding have not yet been undertaken with autistic children (cf. Malkin, Abbot-Smith, Matthews & Nice, in prep). Thus, if shared intentionality turns out to be unimpaired in autism, then studies of pragmatic language development in autistic children are of no relevance for usage-based theory.

However, studies using co-operation paradigms have tended to find that autistic groups perform more poorly than their typically-developing peers (e.g. van Ommeren et al., 2012; Li et al., 2014; Colombi et al.,2009; Liebal et al., 2008). Moreover, it is very easy to make a logically coherent case that the verbal and non-verbal social communicative and interaction difficulties, which are diagnostic for autism (see Bottema-Beutel, Kim & Crowley, 2019), could be at least in part accounted for in terms of either a difficulty understanding how one might work with another towards a joint goal (including a joint communicative goal), or else a difficulty understanding the obligations which this joint goal incurs or else a lack of motivation to engage in either joint action or joint commitment. Of course, one obvious question which arises here is whether proposing that autistic individuals have a core impairment in shared intentionality is the old ‘Theory of Mind deficit’ (e.g. Happé, 2015) in other clothing. In fact, shared intentionality has a much more logical connection than does Theory of Mind with the ability to initiate and respond in conversation, and with using contingent discourse to enable a conversation to flourish. Understanding which follow-in comments are relevant to the conversation topic does not always necessitate an in-depth understanding of the content of the conversation partner’s mental life. It certainly does not require a child to understand whether the conversation partner may hold false beliefs. Rather, the fact that second-order false belief understanding tends to correlate with discourse contingency in autism (e.g. Hale & Tager-Flusberg, 2005) is probably because Theory of Mind is itself derivative of the intermingling of shared intentionality and language development (see Tomasello, 2018, for an elaboration).

In contrast, the difficulties shown by even high-functioning autistic children with greetings, maintaining discourse in an appropriate manner, the increased tendency to give null responses or even wander off mid conversation (e.g. Sng et al., 2018) seem (at least superficially) to suggest that these children do not fully understand the degree to which they are or are not committed to the co-construction of a conversation with another individual. However, to date the connection between shared intentionality and conversation skills remains a hypothesis and it is highly likely that in fact many pragmatic deficits seen in autism have a multi-causal route. For example, there is a prevalent tendency amongst intellectually high-functioning children to talk about the same topic repeatedly and / or direct the same statement or question to the same interlocutor on multiple occasions (see Bauminger-Zviely, Karin Kimhi & Agam-Ben-Artzi 2014; Paul, Orlovski, Marcinko & Volkmar, 2009). This might relate in part to difficulties with understanding what has or has not been shared with a particular conversation partner (shared intentionality via common ground understanding) but it might also be in part due to difficulties with episodic memory (e.g. Lind, Williams, Bowler & Peel, 2014). Similarly, many intellectually high-functioning autistic children tend to monologue ‘at’ their conversation partners, completely ignoring signals that their conversation partner wishes to have the floor (e.g. Paul et al., 2009). This might be in part due to difficulties understanding the ‘sharing’ component of shared intentionality, but it might also in part be due to difficulties with inhibitory control. Thus, studies of pragmatic language in autistic children should ideally include measures of executive functioning as well as stringent tests of the ability to engage in shared intentionality.

**Summary**

In sum, evidence from neuro-developmental disorders provides support for usage-based claims that specific aspects of the language input are extremely important for child acquisition not only of lexical items but also of morpho-syntax. The evidence for this positive influence is now abundantly clear even in heritable disorders such as autism (e.g. Fusaroli et al., 2019). Regarding statistical learning, the link to difficulties acquiring nuts-and-bolts language is certainly suggestive (see also Kidd & Arciuli, 2016, for typically-developing children), but the field ideally needs more reliable measures here. Finally, it would be possible to develop an account of autistic pragmatic language difficulties in which difficulties (or lack of motivation) with engaging in shared intentionality form part of the solution to the puzzle.

**Future directions**

Crucially, future research needs to start taking much more seriously the immense behavioural heterogeneity within both the DLD and the autism population. To give just one example, while for many autistic individuals it might seem plausible to suggest an impairment in the motivation to share psychological states with others (e.g. Tomasello et al., 2005), a sizeable sub-group show a clear motivation to socially approach others. These types of children were originally characterised as ‘active but odd’ (Wing & Gould, 1979). Some autistic children are reported to actively seek friends and even score above the typically-development mean in terms of playground joint engagement (e.g. Calder, Hill & Pellicano, 2013; Locke, Williams, Shih & Kasari, 2017). Thus, solely using group-level designs prevents us from drawing firm conclusions about the developmental pathway leading to difficulties either with nuts-and-bolts or with pragmatic language (or with both). Large-scale longitudinal individual differences study are essential.

 In addition, we need to develop reliable and scalable means of assessing the following: statistical learning, the ability to *understand* that one is working towards a shared goal (as defined by Siposova & Carpenter, 2019) and the ability to understand the joint commitment this entails. An ideal means of assessing the latter would tease apart the *ability* from the *motivation* to engage in shared intentionality.

 Finally, to really tease apart causal mechanisms, we need to include executive functions measures to determine whether these usage-based learning mechanisms can account for language development over and above other plausibly related causal factors. Only these types of studies will allow the field to gain real insight into the degree to which usage-based mechanisms can account for language learning in neuro-developmental disorders.

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1. Difficulties in DLD with visual serial reaction time tasks have also been argued to provide supporting evidence for Ullman and Pierpont’s (2005) ‘Procedural Deficit Hypothesis’ account of DLD. However, the PDH prediction that the lexicon and irregular morphemes should be relatively unimpaired in DLD does not receive consistent cross-linguistic support. [↑](#footnote-ref-1)