THE NATURE OF SYNTACTIC IMPAIRMENT
IN AUTISM

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Introduction

This paper presents a first exploration of the syntactic abilities of autistic children using the framework of truncation theory (Rizzi 1993-4, 2000). It is the first step of an ongoing research project aiming to (a) provide a complete map of syntax in autism, for such work has never been attempted from a sound linguistic perspective (b) develop a targeted remediation program to enhance syntactic abilities of autistic children. Recently, a growing body of work has emphasized the existence of a causal relation between the acquisition of complex syntax (embedding) and the development of a theory of mind (in normally-developing, deaf and autistic children). Early identification and remediation of syntactic deficits is therefore crucial not only to enhance cognitive abilites related to theory of mind, but also because of the critical period hypothesis for language acquisition.

This paper begins with a concise literature review on language in autism, with a particular emphasis on syntax. The possible link between the language deficit found in autism and specific language impairment (SLI) is discussed in the light of existing evidence both from a genetic and a linguistic perspective. We conclude that the two populations have a linguistic profile that isn't entirely overlapping and propose further investigation so as to establish a more precise comparison. The syntactic peculiarities of autistic children are then reinterpreted within the framework of truncation theory. Several hypotheses following from this model are presented and discussed in the light of some preliminary empirical findings gathered in naturalistic data. Some future directions of study are also discussed.

1.1. The language abilities of autistic children

Autism is a developmental disorder found in 1 in 100 children (Kogan et al. 2009), with boys being affected 4 times more than girls. Symptoms of this disorder become noticeable before age 3. According to the American Psychiatric Association

(2000), the three defining characteristics of autism are: (1) impaired social interaction, (2) delays/deficits in language and communication (3) restrained, repetitive and stereotypical behaviours, activities and interests.

Regarding the communication deficit, one of the most robust findings in the field of autism is that verbal autistic children specifically suffer from a deficit in the ability to use language appropriately in context (i.e. pragmatics), as a result of their lack of theory of mind abilities (Frith 1989, Baron-Cohen 1995). The possession of theory of mind abilities broadly designates the capacity to attribute mental states to oneself and to others, and to reason on the basis of this information in order to interpret and predict others' behaviors.

To test the possession of theory of mind abilities, psychologists have developed a method to determine if a subject has a deep comprehension of others' minds that is in all other respects simple enough to be understood even by an autistic child. The method takes into account the fact that, in order to demonstrate the presence of mindreading abilities in a subject, it is not enough to prove that the subject (A) can predict the actions of another individual (B). As Dennett (1978) has argued, in many cases A can perform this task without attributing mental states to B, only by using his own world knowledge. For example, if A knows that the basket in front of him contains biscuits, and sees B trying to find food, A can predict that B will look into the basket, not by attributing mental states to B, but because A knows the biscuits really *are* in the basket. Therefore, in order to make sure that the subjects dissociate their own beliefs from that of others, one has to devise a situation where another individual entertains a belief different from the subject's belief. This reasoning has led to the development of the well-known *false belief task*, which now exists in dozens of different variants.

The most popular version of the task, originally devised to be used with autistic children, is called the *Sally-Anne task ADD* (Baron-Cohen, Leslie & Frith 1985). This task takes place in two successive phases. First, the child hears the following story enacted with two puppets called Sally and Anne:

> Sally has a basket and Anne has a box. Sally has a marble and she puts it into her basket. She then goes out. Anne takes out Sally's marble and puts it into her box while Sally is away. Now Sally comes back and wants to play with her marble.

After hearing the story, children have to answer the following questions:
1. Where will Sally look for the marble?
2. Where is the marble really?
3. Do you remember where Sally put the marble in the beginning?

Only children with functional theory of mind abilities should be able to answer correctly that Anne will act according to her own (false) belief and look for her marble in the basket rather than in the box, where it really is.

Because of their lack of theory of mind, autistic children are for instance unable to follow conversational rules, and show inappropriate turn taking and topic shift (Chin & Bernard-Opitz 2000). They also have trouble adapting their choice of words depending on their addressee (Frith 1989) and the register chosen often makes their use of language seem excessively formal or even pedantic. Another form of pragmatic impairment can be seen in autistic individuals' tendency to interpret all statements in an overly literal fashion, and their failure to understand all non literal uses of language like metaphors (Happé 1995), jokes (Baron-Cohen 1997; Reddy, Williams and Vaughan 2002) and irony (Happé 1993). More generally, autistic individuals are also unable to understand indirect speech acts (Aarons & Gittens 1992) and to perform most kinds of inferential reasoning (Dennis et al. 2001); Frazier Norbury & Bishop (2002). Despite its obvious relation to language, the communication deficit in autism can already be observed during the preverbal period, by autistic children's lack of proto-declarative pointing (proto-imperative pointing is however present).

As can be seen from the above review, the discovery of a link between pragmatic deficits and the theory of mind hypothesis in autism has led to an important number of works during the past twenty years. Autism has therefore been used as an example of dissociation between language competence and performance, because of autistic subjects' deficient language use in the presence of what was considered to be a relatively spared linguistic system (Mundy & Marcus 1997). In the words of Frith (1989/2003: 118): " whatever the level of syntactic or semantic skill in autism, the level of pragmatic skill will be lower".

However, Tager-Flusberg (Tager-Flusberg 2000: 4) observes that "this emphasis on the pragmatic language impairment in autism has led to a relative neglect of **other linguistic deficits** that are found in **most individuals** with this disorder" (our emphasis). In a recent study involving verbal children with autism, Eigsti et al. (2007) have also found that autistic children have "clear language difficulties that go beyond what would be expected based on developmental level".

Moreover, it is worth noticing that language delay is one of the main diagnostic criteria for autism (see point 2. of the characteristics above). When children display autistic features such as repetitive behaviours without language delay, they are diagnosed with *Asperger syndrome* (Howlin 2003). The criteria listed in the DSM-IV (Diagnostic and Statistical Manual of Mental Disorders 4th edition, American Psychiatric Association 2000) regarding the language impairments of autistics are (1) late or lack of development of language without attempt to compensate with gestures, (2) impairment in the ability to initiate or sustain a conversation, and (3) stereotyped, repetitive, and idiosyncratic language.

Again, this description mostly emphasizes the pragmatic component of language. However, in the accompanying descriptors, the DSM-IV also mentions aberrant prosody and **immature syntax**. The reason for this emphasis on pragmatics is that

this deficit is found in all individuals suffering from autism (it is therefore called a *core feature* of autism). On the other hand, the linguistic abilities of autistics display great variability: about 50 to 75% of autistic individuals do not develop any form of language during their lifespan (Rapin 1991) and at the other end of the spectrum, at least some individuals do not suffer from any residual impairment in adulthood (Eigsti & Bennetto 2009). In sum, even though syntactic and lexical abilities can be considered as *relative strengths* in autism with respect to pragmatic abilities, they are by no means unimpaired in most individuals.

As far as the lexicon is concerned, it has often been observed that autistic children have a tendency to make idiosyncratic uses of words and to create neologisms (Happé 1996; Frith 1989). To make a case in point, Attwood (2003) gives the example of an autistic child who coined the word *snook*, to refer to the chocolate bits found in some ice creams. Again, this deficit with the lexicon has been attributed to autistic subjects' lack of theory of mind, since the role of theory of mind abilities in lexical acquisition has been recently highlighted for typically-developing children (Bloom 2000). More precisely, the ability to share one's attention with another speaker, one of the major precursors of a functional ToM typically acquired around 18 months (Baron-Cohen 1995), has been proposed as one possible cause of the sudden *vocabulary spurt*, often documented in the literature (Baldwin 1991; 1993). Contrary to typical children, autistic children are unable to use this cue in order to attribute a new name to an unknown object (Baron-Cohen, Baldwin & Crowson 1997).

In the field of phonology, one area of consensus is that autistic children have an aberrant prosody and often speak with inappropriate volume. Again this deficit has often been explained in the light of the theory of mind deficit hypothesis (Baron-Cohen 1995), the idea being that autistic children are unable to adapt to the context of communication and the physical distance of their addressee. The development of basic phonology has not been the subject of much enquiry, since autism cannot be diagnosed during the first months of life. Besides, the exact phonological abilities of autistic subjects is a matter of controversy[1]. According to Tager-Flusberg (2001), verbal autistic children reach a mature phonological system during childhood, comparable to that of normally-developing children. This finding was again taken as an example of dissociation between a spared linguistic system in the face of an impaired use of language. However, Rapin & Dunn (2003: 166) have presented new arguments that tend to show that even basic phonology might be impaired in autism. These authors have conducted electrophysiological studies showing "auditory input abnormalities erase in lateral temporal cortex even in verbal individuals on the autistic spectrum".

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[1] The DSM-IV does not make any mention of phonology in its despcription of language impairment in autism.

To sum up, in addition to a generalized theory of mind deficit leading to communication difficulties, it is also the case that most of the autistic population suffers from some kind of deficit in the functional domains of language such as phonology and, as we will show in more details below, syntax.

One of the major unanswered questions regarding language and autism is to know if the patterns of language development found in autism parallels that of normally-developing children with a substantial delay, or if language is disrupted in a more fundamental way. There is at least one important known difference between autistics and normally-developing children's acquisition of language: namely the role of echolalia. Echolalia implies the reiteration of a word or phrase stated by others, as if echoing them. It may be immediate or delayed. A classic example of immediate echolalia is a child echoing back a question that an individual is asking him, with the same prosody. If a lapse of time has passed between the occurrence of the verbal utterance and its repetition, this is referred to as delayed echolalia. Examples of delayed echolalia are the echoing of television commercials or parental reprimands some time after hearing these, and just as these were pronounced. Even though all children make use of echolalia, in autistic children this phenomenon lasts longer and is much more frequent. According to Prizant & Duchan (1981), a large proportion of autistic children's early speech is echolalic. The exact roles of echolalia in autistics' speech remain unclear but Eigsti et al. (2007) suggest that it might serve several purposes like covering the inability to provide an answer, as a form of ritual activity or as a way to retain information in memory. The frequency of echolalia is therefore an important factor to take into account for studies targeting natural productions by autistic children.

1.2. The acquisition of syntax by autistics

As observed for phonological abilities, the syntactic abilities of autistic children is a matter of controversy. Eigsti et al. (2007) also observe that "few studies have examined grammatical abilities in autism, with mixed findings". Some studies (Fein & Waterhouse 1979; Howlin, 1984a, 1984b; Tager-Flusberg et al., 1990) conclude that autistic children's syntactic development is delayed but follows a normal trajectory with respect to normally-developing children, while others (Bartolucci, 1976; Bartolucci & Albers, 1974; Bartolucci et al 1980; Dalgleish 1975) conclude that syntax is deviant in a more fundamental way. We will review these findings below but it is already worth noting that one probable reason for this lack of consensus is that many studies were conducted before strict, reliable measures of syntactic development were developed in the 1990s[2] and were solely based on basic

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[2] For instance the Autism Diagnostic Interview-Revised (Cox et al., 1999; Lord, Rutter & LeCouteur, 1994) and the Autism Diagnostic Observation Schedule (Lord et al., 1989; Lord, Rutter, & DiLavore, 2000).

measurements of production like the MLU. In the more recent studies, the general conclusion seems to be that syntax is indeed deviant and not only delayed (Condouris et al. 2003; Rapin & Dunn, 2003; Kjelgaard & Tager-Flusberg, 2001). However, as Eigsti et al. (2007) conclude: "a comprehensive investigation of language in a well-controlled sample of children with autism, compared with both typically developing and developmentally delayed groups, is needed".

One point that seems uncontroversial is that autistic children's syntax is usually more simple than that of their age and IQ matched peers. More specifically, even though basic sentences are usually mastered by verbal autistic subjects, Paul and Cohen (1984) note that grammatical development "eventually reaches a plateau, at least in some individuals". Moreover, Kjelgaard and Tager-Flusberg (1999) have found that 25% of autistic children with a normal nonverbal IQ score more than two standard deviations below the mean on standard measures of grammatical ability.

Here we present an overview of the literature on the emergence of syntax in autistics. We will start from what we know about the status of the highest functional projections and work our way down the tree to the lexical projection.

1.2.1. CP (Complementizer Phrase)

1.2.1.1. Embedding

The fact that the spontaneous speech of autistics includes less sentential complements and relative clauses than MA matched peers has been noted in numerous studies (Bartolucci et al. 1980; Scarborough et al. 1991).

While it is widely accepted that Theory of Mind is delayed in autism, the emergence of embedding in autistic individuals has been found to correlate with the ability to pass false belief tasks: those individuals who make use of CP perform better on ToM tasks. Tager-Flusberg (2000) studies older children and adolescents with autism and concludes that there are 'close connections between linguistic knowledge of complement constructions and a representational understanding of mind (…). The data presented here indicate that (individuals with autism) may depend especially on complements for verbs of communication as their developmental entrance into the ability to represent false beliefs'. The investigation in Tager-Flusberg and Joseph (2005) corroborates this claim that the specific syntax of complement structures is a significant predictor of successful false-belief reasoning.

This link has also been found in a study by Fisher et al. (2005) who conclude that: "language, in particular grammar, and theory of mind appear to be more strongly related in children with ASD (Autism Spectrum Disorder) than in those with moderate learning difficulties. **We speculate that this relationship may be causal, with some grammatical understanding being a precursor of theory of mind**". This finding is crucial because it implies that a targeted remediation

programme focusing on complex syntax may be beneficial for the development of a functional theory of mind in autistic children.

One indication that this hypothesis is on the right track comes from a study of the deaf community conducted by Schick et al. (2007). The study of this population indeed suggests that the acquisition of grammar, and in particular of syntactic (complement) structures, is fundamental to the development of ToM rather than the other way around since deaf children, unlike autistics, do not suffer from other social or cognitive delays which could be the underlying cause of an immature ToM. Nevertheless a delay in ToM was apparent in part of this population: More specifically, the findings revealed that "There was a significant delay on ToM tasks in deaf children of hearing parents, who typically demonstrate language delays (…). In contrast, deaf children from deaf families performed identically as same-aged hearing controls. Both vocabulary and understanding syntactic complements were significant independent predictors of success on verbal and low-verbal ToM tasks".

The link between the level of performance on syntactic tests and the ability to pass ToM tasks has also been investigated for normally-developing children. Astington and Jenkins (1999) conducted a seven-month longitudinal study of normally developing three-year old children and found that once age and previous performance were controlled, their performance on standardized tests of language ability predicted later performance on ToM tasks, but not vice versa. Another crucial finding from this study is that syntactic ability was a more powerful predictor of later ToM ability than was semantic ability.

It should be noted however that complement clauses are not specifically related to ToM abilities. In a study by Smith et al. (2003), relative clauses were also found to be a good predictor of future ToM abilities. Therefore, it seems that the general syntactic principle of embedding is related to ToM rather than complement structures only. Note that these are the very structures that were erase noted earlier as being less present in autistics' speech as compared to that of MA matched peers (Bartolucci et al. 1980; Scarborough et al. 1991).

1.2.1.2. Questions

In typically developing children syntactic transformations such as subject-auxiliary inversion begin around the age of 3 to 3½: e.g. 'Is Daddy mad?', 'Where is he going?' (Crain & Lillo-Martin 1999). Sometimes an intermediate form of interrogative is also used, as in 'Where he is going' which involves fronting of a Wh-element without subject-auxiliary inversion. This is particularly frequent with 'why' as in 'Why they can't turn?'

Eigsti, Bennetto & Dadlani (2007) investigate various areas of morphosyntactic development in 5 year-old children with autism and compare these with 3 year-old typically developing (TD) children matched on non-verbal mental age. For questions, they conclude that 'The children with autism had response patterns that

were significantly different than in the TD group (…)". In fact for this aspect of grammar, they noticed a significant difference not only in comparison with the typically developing group, but also with the group of children with non-specific developmental delays. From a syntactic point of view, it would be interesting to know exactly what sort of properties were found to be different in the interrogative productions of ASD children. This would allow us to assess to what extent these properties are similar to those found in instances of typical acquisition and would then simply be persisting later in autistics (e.g. lack of subject-auxiliary inversion). Alternatively, the patterns may represent errors that are particular to this population and then more indicative of an impairment rather than a delay. It would also be enlightening to know if certain questions are more affected than others, for example 'why' questions as opposed to other wh-questions, since according to recent accounts of the CP (Rizzi 2001) the projection where 'why' may first merge, Int(errogative)P, is arguably higher in the left-periphery than the position targeted by other wh-elements[3].

That interrogatives are affected in autism is also suggested in Condouris et al. (2003). These authors applied various measures of linguistic ability to autistic children, in order to compare the scores obtained with production measures like the MLU and the Index of Productive Syntax (IPSyn) with comprehension tests like Clinical Evaluation of Language Fundamentals and Peabody Vocabulary Test. The results revealed that all measures expect for the IPSyn were strongly correlated. More specifically, Condouris et al. (2003) argue that the IPSyn score artificially lowers the syntactic abilities of the autistic population because of the coding procedure of the IPSyn. This test divides syntactic abilities in four dimensions: NP, VP, Questions and Negation, and sentence structure. According to Condouris et al. "the low scores obtained on the IPSyn were because the children with autism used a narrow range of grammatical constructions and had especially low scores on the question/negation subscale of the IPSyn". This finding suggests that the syntactic deficit in autism seems to be located on the higher projections of the clause.

1.2.2. AgrP (Agreement Phrase)

Third person -*s* in normally developing **5 year olds** has been found to be used correctly 95% of the time (Rice et al 1995), while children with autism with a mean age of **8-9 years** have difficulty with using this third person singular morpheme (Roberts 2004). In a study with SLI (Specific Language Impairment) children, Rice et al. (1995) found that 5-year-old children with SLI got 26% of correct answers. At 8 years of age, the SLI group was at 96% (similar to normally developing 5 year-

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[3] Although this proposal was initially made based on Italian data, its significance in accounting for properties of the acquisition of other languages such as English is evident (see e.g. Thornton 2007).

olds). Using similar scoring criteria, Roberts et al. (2004) have investigated three groups of children with autism divided on the basis of their performance on the Peabody Picture Vocabulary Test III (PPVT; Dunn & Dunn, 1997), using the criteria that Kjelgaard and Tager-Flusberg (2001) adopted for defining language subgroups in autism. Group 1 (Normal) included children whose PPVT standard scores were within the normal range, group 2 (Borderline) included children whose PPVT standard scores were between 1 and 2 standard deviations below the mean and group 3 (Impaired) included children whose PPVT standard scores were two or more standard deviations below the mean. There were no significant age differences between these three groups. They found that children in the Normal group were correct on 81% of trials, the Borderline group on 69%, and the Impaired group on 65% of trials. Thus, the language impaired children with autism (with a mean age of 8-9 years) performed somewhat better than 5-year-old children with SLI but worse than normally developing 5-year-olds and worse than SLI children in the same age range.

1.2.3. TP (Tense Phrase)

Roberts et. al (2004) discuss tense acquisition in autistics ranging from 5 to 15 years old and conclude that a subgroup of these (language impaired) children showed high rates of past tense marking omission, scoring correctly on 68% of the trials, which is less than the scores of typically developing 5 year olds, revealed to attain 92% accuracy on past tense marking (Rice et al. 1995). In fact, autistic children have been found to mark past tense significantly less than even matched controls with Down syndrome (Tager-Flusberg 1989). Such difficulties with handling tense have been attributed by some authors (e.g. Bartolucci et al. 1980) to semantic-pragmatic deficits rather than morpho-syntax.

1.2.4. AspP (Aspectual Phrase)

A study by Bartolucci and Alberts (1974) elicited productions of present progressive *-ing* and past tense *-ed* in autistic subjects and revealed that the children with autism performed well on the present progressive form, although they were less successful on the past tense trials. In addition, Roberts et al. (2004) when probing for third-person singular marking and past tense in this population, noted the presence of responses which 'involved a high proportion of present progressive *-ing* responses' (Roberts et al 2004: 441). An example given is "He fixing teeth" in reply to a question asking what a dentist does.

1.2.5. VP (Verb Phrase)

As observed for aspect, the lexical abilities of autistic subjects also appears to be relatively spared. This is not to say that there are no problems at all: a study by Howlin (2003) on the lexicon of autistic children shows that subjects suffering from Asperger syndrome, even though they did not have any language delay during childhood, have a lexicon significantly smaller than normal once they reach

adulthood. This deficit is found both in comprehension and production: the average delay in comprehension is 12 years and 10 years in production. More interestingly still, this delay was similar for subjects who had been diagnosed with high-functioning autism and with Asperger syndrome during their childhood. This is a remarkable result, since the diagnosis criterion for Asperger syndrome is precisely the absence of language delay during childhood. Howlin's study therefore tends to indicate that the differences between high-functioning autism and Asperger syndrome are irrelevant for adults.

Still, Eigsti et al. (2007) note a sharp contrast between the handling of grammatical and lexical categories, and conclude that "In contrast to syntactic development, the present study demonstrated that lexical knowledge was an area of relative strength". This study illustrates that the use of VP is almost equivalent to that found in typically developing children matched for non-verbal IQ, while sentences and questions/negation were significantly worse. In this respect, the lexical core is intact in comparison to e.g. that reported for Questions (and Negations), which are far below typically developing performance. The finding that the lexicon is relatively unimpaired is not new, as the authors note: "Consistent with previous studies, the children with autism seemed to comprehend and produce as many words as their peers. While some aspects of lexical knowledge in autism are atypical, including the use of idiosyncratic meanings for words and neologisms (Rumsey et al. 1985; Rutter 1970; Volden & Lord 1991), adults with autism often have larger vocabularies than would be predicted from their other language abilities (Lord & Paul 1997)". As a result of these considerations, Eigsti & al. (2007) suggest a need to match autism groups to appropriate control groups through use of other forms of measures to receptive vocabulary, since "receptive vocabulary abilities, such as those measured by the PPVT-III, are likely an inadequate marker of 'language ability,' and studies that match groups based only on lexical measures are likely to overestimate the comprehension of children in the autism group".

That the lexical abilities of autistics are relatively spared is also claimed by Walenski et al. (2008) whose study reveals "better-than-normal performance" for lexical processing in the set of autistic boys studied, since these performed faster than the matched group of male controls on picture naming. They conclude cautiously that although the source of this 'enhancement' is not clear, it may well be linked to the 'seasaw effect' with declarative memory being compensatorily over-developed because of a possible abnormality in procedural memory. It is worth noting here that procedural memory is linked, amongst other things, to syntax.

1.2.6. The nominal group: DP (Determiner Phrase) and NP (Noun Phrase)

To our knowledge, there is no study of autistics that systematically draws a clear division between the acquisition of the lexical versus grammatical sections of the nominal domain. The sort of errors reported often involve what appears to be

omission or misuse of articles, but a precise assessment of the various elements that occur in the extended nominal projection is yet to be provided.

1.2.7. A-chains

It should be noted that in addition to the difficulties associated with sections of the syntax as sketched above, certain syntactic transformations also appear challenging for autistics: Movement operations such as those involved in Passives are revealed by Perovic et al (2007) to be problematic. This same study indicates that children with autism perform poorer than controls on binding, suggesting together with the finding on passives that this population has a general difficulty with A-chains. In sum, the difficulties in building clause structure outlined in the previous sections appear to be accompanied with difficulties in establishing relations within this stucture.

2. A manifestation of SLI?

In the literature on autism, a recent controversial proposal (Bishop 2003) suggests that the language deficit in autism is similar to that observed with SLI children. Although most of the evidence comes from genetics, some studies on language have found similar patterns in both populations: notably an inability to repeat nonwords and problems with tense marking (Kjelgaard & Tager-Flusberg 2001).

According to this explanation, there is no language deficit in autism proper (other than those related to pragmatics), but some autistics have core impairment in linguistic ability similar to that seen in SLI. From a genetic point of view, Tomblin, Hafeman, and O'Brien (2003) found that the prevalence of autism in siblings of children with SLI (1%) was significantly higher than general population estimates. However, there are reasons to doubt that linguistic difficulties found in autism are simply a manifestation of an associated SLI. As Whitehouse et al. (2008) observe, "the sample size [of Hafeman et al.'s study] was very small for an epidemiological study, and the rate of autism cases in siblings of children with SLI did not significantly differ from that of the control group (0.4%)". Several studies also indicate that relatives of autistic children often report language difficulties. However these difficulties were not apparent when they were tested with standardized language assessments (Bishop et al. 2004; Whitehouse et al. 2007).

In sum, most of the behavioral evidence for an SLI sub-group of autistics comes from their inability to repeat nonwords. We argue that this test, while revealing a common symptom in both populations, very probably has different causes in the two cases. A similar problem has arisen in relation to the false-belief task. Some studies (Frith & Corcoran 1996) show that schizophrenic patients as well as autistics typically fail at this task. However, it has been repeatedly pointed out (see Bloom &

German 2000 for a review) that the false-belief task involves more than just mental state attribution – like a good working memory and linguistic abilities – and most probably, these additional demands are responsible for schizophrenics' failure rather than an inability to reason about mental states, as it is the case for autistics.

As Whitehouse et al. (2008) argue, it is likely that autistic and SLI children's failure at non-word repetition tasks is due to different causes. In their words: "nonword repetition deficits in SLI result from genetic factors affecting neuro-anatomical pathways responsible for language, nonword repetition deficits in the autistic population are associated with broader autistic symptoms". Among them we can mention poor attention to others' speech and a difficulty to imitate.

Similarly, some recent studies (e.g. Miller 2001; Gillott et al. 2004) seem to indicate that SLI children also fail at the false-belief task[4]. But once again the reason for failing seems quite different in the two populations. For SLI children, the more linguistically demanding the task, the higher the rate of failure (as could be expected in the light of their linguistic impairment). On the contrary, for autistic children, nonverbal ToM tasks are in fact harder than their verbal equivalents, revealing that their difficulties do not come from linguistic demands but from a real impairment with mental state attribution. Indeed, it seems that autistic children use linguistic cues (like their knowledge of completive structures) to compensate for their lack of ToM abilities. This difference is further confirmed when comparing the kinds of explanations given by both populations in response to ToM tasks. While autistic children provide mostly "physical state answers" (i.e. answers that do not resort to inferences about mental states), SLI children provide as many mental state answers as control children. However, the linguistic complexity of the task results in an inappropriate inference being made.

The other grammatical point of convergence between autistics and SLI children is their problem with grammatical marking of tense. But once again, the two groups' performance is not comparable. In the study by Roberts et al. (2004), the language impaired children with autism (with a mean age of 8-9 years) performed somewhat better than 5-year-old children with SLI but **worse than SLI children in the same age range**.

Some other linguistic markers of SLI have been identified in the literature: Hamann et al. (2003) point out that SLI children acquiring French show difficulty with clitic pronouns, and in particular with pronominal complement clitics. Hamann (2006) underlines that French speaking SLI children further differ from their TD peers in their net preference for in-situ question formation, producing almost twice as many of these than the controls (40.4% vs. 24.2%), as well as in their omission of

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[4] These findings do not however replicate earlier studies (Leslie and Frith 1988; Perner *et al.* 1989) who found that SLI children consistently pass simple (first order) ToM tasks like the Sally-Ann task.

subjects in all types of fronted Wh-questions. The occurrence of missing subjects in Wh-questions was also noted for SLI children acquiring German (Hamann 1998) although was absent from TD German children (Clahsen et al. 1996). It is therefore worth exploring the characteristics of autistic children's speech with respect to these properties as well, in order to get a complete comparison of the two groups' overlapping linguistic problems.

3. A new look at syntactic impairment in autism

Looking over the areas of grammatical delays and impairments in ASD individuals, an observation that can be made is that the higher up one goes in the tree, the more likely it is that autistics encounter difficulty. These difficulties are summarized in the tree below. In light of the area of impairment, the question arises to know whether this population is having a harder time building these higher layers of functional projections.
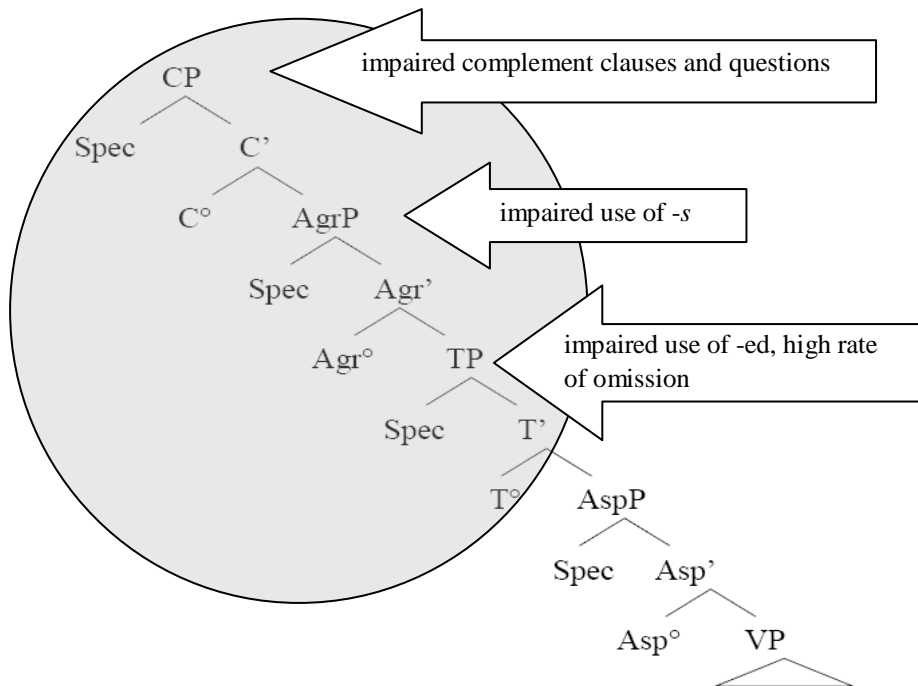
One possible explanation for the data can be provided in terms of truncation. Truncation theory (Rizzi 1993-4, 2000) has been instrumental in accounting for various syntactic properties of typical language acquisition. This theory essentially proposes that children pass through a phase where they have the option of omitting the initial layer(s) of structure, thereby using the most economical amount of structure necessary to accommodate the overt material. More specifically, the theory proposes that an immature system initially does not systematically project to the CP layer, but if and when it does, it must contain the intermediate projections as well. This analysis of 'peeling off' layers from the top explains various phenomena found in early systems such as root null subjects (1) and optional infinitives (2):

(1a)   _ was a green one (1;10)   (Brown 1973)

(1b)   _ have a drink grape juice first (1;10)

(1c)   _ falled in the briefcase (1;10)

(2a)   Dormir tout nu (1;10)   (Pierce 1989)
         Sleepinf all naked

(2b)   Ich der Fos hab'n (2;1)   (Poeppel & Wexler 1993)
         I the frog haveinf

(2c)   Eerst kleine boekje lezen (2;6)   (Haegeman 1995)
         First small book reading

Truncation accounts for root null-subjects (1) by stating that in a clause stripped of the left periphery, subjects occupy the highest position of the syntactic tree (i.e. the specifier of the root) which is a position that is exempted from the identification requirement normally applying to null elements. It therefore follows from the truncation approach that these early null subjects are not commonly attested in interrogatives, since these obligatorily contain a CP and therefore the specifier of the clause would no longer qualify as specifier of the root. The other phenomenon addressed by the truncation approach is that of root infinitives (2): an early system can also apply truncation to lower layers than CP, e.g. TP. This accounts for the frequent appearance of root infinitives in child language, and for their incompatibility not only with wh-constructions but also with functional verbs such as auxiliaries and modals. Once the system matures and truncation ceases to be an option, clauses project up to CP and both null subjects and root infinitives no longer occur. This has been attested for various languages (see Haegeman 1995 for Dutch, Rasetti 2000 for French, Hamann and Plunkett 1998 for Danish). The requirement that the root be a CP emerges in the grammar sometime before the child's third birthday.

Coming back to the autism data, if higher layers persist in being optionally omitted even in older autistics, then we expect to find other properties related to the relevant structural zone to also be affected in this population, with properties related to lower layers being potentially preserved. Moreover if truncation indeed continues later in ASD than in the TD population, it becomes conceivable that this will have a significant impact on the development not only of syntactic but also cognitive abilities, since it has been found that certain cognitive developments are related to the emergence of particular syntactic constructions, as discussed earlier for ToM abilities and the mastery of CP. Indeed it is now a widely accepted view that there is a critical period for language acquisition in early childhood, and that once this window of opportunity is passed then the task of acquiring a language becomes increasingly more difficult, and eventually ceases to be possible (see e.g. Lenneberg 1967, Curtiss 1977, Kegl et al 1999). This underlines the importance of implementing early intervention for triggering language development in such cases of pathology.

4. A corpus study

In order to assess the nature of syntactic impairment in autism, we have searched for relevant examples in natural productions of autistic children. Contrary to SLI, not many resources are available for autism, and some data cannot be used for a syntactic analysis because the children recorded are barely verbal. Overall, only the corpus gathered by Helen Tager-Flusberg (Tager-Flusberg 1990), and made available on the CHILDES database, could be used for our purposes. This corpus contains recordings of 6 autistic and 6 Down's syndrome children. The duration of the study was variable across children, with an average of 22 months. The number of recordings also vary from 8 to 13. Contrary to most naturalistic data, children in this corpus are not recorded during unconstrained interactions, but during structured play sessions with their mothers, aiming at eliciting as many linguistic productions as possible. The reason for this specific context is that, contrary to normally-developing children, autistic children would produce very little verbal interactions if not pressured to do so.

In order to assess the syntactic abilities of autistic children, we have looked at grammatical markings for all layers of the tree. Since most data had to be collected manually, we have circumscribed our search space in the following way. We have selected recordings from two children situated at different points in the autistic spectrum in order to have a comparison of their grammatical difficulties. At the higher end, we chose to concentrate on Brett, the most verbal child in the corpus, who had an MLU of 3.74 at the beginning of the study. We have excluded from our comparison data all the children with an MLU inferior to 2 (3 in total), because we could not reasonably expect them to produce many multi-word utterances. The second child we chose for comparison was Roger, who had an MLU of 2.31 at the

beginning of the study. Even though Brett, 5.8 years at the beginning of the study, is almost two years older than Roger who is 3.9 years, they have a very similar IQ: 108 for Brett vs. 105 for Roger. These two children are therefore very well suited for our comparative purposes.

From a methodological point of view, it is also worth mentioning that cases of echolalia have been eliminated from the data. Multiple repetitions of a same sentence have been credited only once. Productions resulting from direct prompts have also been disregarded.

4.1. CP

The first observation we made for the CP layer is that there is an almost complete absence of relative and complement clauses in the corpus, for both children studied[5].

For questions, we note that there are few of them in the corpus, despite the constant prompts provided by the caregivers. In our data, most of the questions were asked by the most verbal child, Brett. Traditionally, this lack of interrogatives was explained by autistics' reluctance to initiate communication. However true this explanation may be, we note nevertheless that when the pragmatic intention of asking a question is there, access to the relevant structure appears challenging, as illustrated by this exchange with Brett:

(3a)	CHI(LD):	have a diet coke at the refrigerator?
(b)	CHI:	a milk ball?
(c)	MOT(HER):	no.
(d)	CHI:	have milk ball please?
(e)	CHI:	I want milk ball.
(f)	CHI:	a milk ball please.
(g)	CHI:	I want milk ball.
(h)	CHI:	I want milk ball.
(i)	MOT:	I want a milk ball.
(j)	CHI:	I want a milk ball.
(h)	MOT:	good asking.

As far as WH-questions are concerned, the proportion of all WH-words is described in table 1 below.

---

[5] There is a single occurrence of a (subject) relative clause found in Brett's entire corpus, towards the end of his 2 years of recordings: *I saw an elephant then a doggy that goes woof*. There was also one instance of complementizer 'that', produced by Roger with a verb of perception: *People see that I use all the soap*.

wh word	Brett	Roger	Total nb	Total percentage
why	5	0	5	9%
what	29	3	32	55%
who	0	0	0	0%
when	6	0	6	10%
how	1	0	1	2%
where	9	5	14	24%

Moreover, many questions contained some kind of syntactic problem, like absence of AUX/T (example 4), or absence of subject-auxiliary inversion (SAI) (example 5). Null subjects in Wh contexts (6) were completely absent for Brett and quite rare for Roger[6] (1%), unlike that attested for SLI children by Hamann[7] (1998, 2006).

(4)   Brett: Where yellow box?
(5)   Brett: No, why I not do it on the trunk?
(6)   Roger: did you cry when xxx got a brown booboo?

   Table 2 contains a summary of the syntactic problems of all WH-questions in the corpus. Overall, 25% of the WH-questions were ungrammatical. As can been seen, the major grammatical problem is due to an omission of AUX/T. Wh-movement as such seems however preserved[8].

	no AUX/T marking	no SAI	null subject
why	2	1	
what	2		1
when	2		
where	6	1	
total	12 (21%)	2 (3%)	1 (2%)

---

[6] It is worth noting that even the examples that are transcribed showing an absent subject in an embedded context such as that given here are somewhat problematic: here xxx seems to imply that something was mumbled but remained unclear. The other examples of an unspecified subject in an interrogative were all similar to: 'do want some fruit bar?', where the intended sequence appears to be 'do you want some fruit bar?'. In such examples, one is tempted to think of a slight phonological erosion of the pronoun 'you' which might have yielded the resulting transcription, rather than the total omission of the subject. In any event, such occurrences are extremely rare.

[7] Also contrary to what was found for SLI children (Hamann 2003), all questions but one had correct wh-movement with only one instance of WH in-situ found, produced by another child from the corpus: CHI: Smacked who, snoopy?

[8] Some preliminary findings with negation also point to the same conclusion. While negation proper seems to be preserved, negative polarity items appear to be erroneously used, and AUX/T is almost systematically omitted in these constructions.

4.2. AgrP

Our data also confirms problems with AgrP. As far as this projection can be considered responsible or partially responsible for impaired use of the third person singular *-s*, the corpus reveals that this agreement marking is missing in 21% of the productions at the higher end of the spectrum (Brett's data), and in 71% of the production in Roger's data.

(7)   CHI: A cow make woof woof.
(8)   CHI: Brett hold my square.
(9)   CHI: He say that.
(10)   CHI: It feel soaking.

For both children we observe a marked tendency to omit the subject position in declaratives:

(11a)   MOT: What did you do in school today?
(b)   CHI: ∅ did work with Peggy at school.

(12)   CHI: ∅ need to turn the fan on.

(13a)   MOT: What can the knife do?
(13b) CHI: ∅ can cut you badly.

Over the 2 year period, 23% of Brett's productions exhibit null subjects, and 40% of Roger's. It is worth underlining that the corpus reveals the children's mothers providing a good deal of explicit prompting and modeling for subjects throughout, and that this can be thought to have played an important role in the children's significant improvement over the 2 years with respect to this property: Brett's first recording exhibited 53% null subjects, while two years later his productions of null subjects had dropped to 20%; and Roger commenced with 62% null subjects and by the final recording his productions contained only 11% null subjects.

Brett omitted subjects only when these would occupy the specifier of the root, as predicted by a truncation account, as did Roger for 99% of his null subjects[9], with non-root subjects being systematically realized. In some instances, we can observe this trend in the very same sentence, with a null subject in the main clause and an overt one in the embedded clause:

---

[9] Note again that the 1% of cases where Roger allowed null subjects in an embedded context do not constitute entirely clear examples of embedded null subjects. As previously indicated, data such as the following were attested: *did you cry when xxx got a brown booboo*? Where the presence of (xxx) suggests nevertheless that the child is aware of the necessity to specify a subject in such a context, but possibly simply doesn't articulate it precisely in such instances.

(14)   CHI: ∅ happens if [**I'm** a bad boy].

Hamann (2006) revealed that French SLI children differed from their typically developing peers in allowing null subjects in non-root contexts, namely in Wh-questions. The findings here suggest then that the autistic and SLI population differ for this property.

As noted in section 3, null subjects are a characteristic of immature systems, although typically these cease to appear once truncation ceases to be an option, normally occurring before the ages of the autistic children here. Therefore there is at least a visible 'delay' in this respect, suggesting that truncation persists longer in this population[10].

4.3. TP

As far as TP is concerned, we can confirm that regular past tense (-*ed*) is used far less frequently than aspectual (-*ing*). We only count for Brett 38 correct uses and for Roger 9 correct uses of past tense, whereas the -*ing* form is very frequently used instead (see below). We also find a clear example below, taken from Brett's data that illustrates autistics' tendency to struggle with past tense:

(15a)   MOT: No what did you just do?
(b)   CHI: Work on the puzzle.
(c)   CHI: I work on the puzzle.
(d)   MOT: What were you doing?
(e)   CHI: I am working on the puzzle.
(f)   MOT: What were you doing?
(g)   CHI: I was working on the puzzle.
(h)   MOT: That's right.

---

[10] Aside from what looks like a marked delay in realizing overt subjects linked to a prolongation of truncation, there seem to be other issues with subject position. Consider the following:

    CHI: can I have to me?
    MOT: what do you want Brett?
    CHI: I want the big play dough to me?
    CHI: I wanna give it.

Here, we can derive from the general gist of the exchanges that the child is trying to get his mother to give him 'the big play dough', but is having a hard time using language to do so. Striking in the child's last reply is the instance of 'wanna', where the understood subject 'you' should be present structurally if not phonologically, as in 'I want (**you**) to give it (to me)'. As such, the presence of the embedded subject 'you' should block 'wanna'-contraction. As we can see, this is not the case. Further investigation is necessary to elucidate what is happening in such instances.

The auxiliary is sometimes also missing, both in interrogatives and in declaratives, as shown in the examples below[11]. Here again, we note an important difference between the two children under investigation. While Brett has a very low rate of omission of 4.5%, Roger has a rate of omission of 20%. Moreover, in 25% of the cases, Roger omits the auxiliary in a question context. Note that these omissions cannot at first sight be attributed to truncation, since in a *wh* context, the auxiliary does not occupy the specifier position of the root. We will come back to this issue in section 5.

(16) CHI: Where $\varnothing$ yellow box?

(17a) MOT: Who's sitting down?
(b) CHI: We sitting down.

(18a) MOT: Where is the moon?
(b) CHI: Moon in sky.

(19a) MOT: Who's this?
(b) CHI: That Bert.

4.4. AspP

Regarding progressive aspect, this seems to be commonly overtly marked on the verb stem, although often in the absence of auxiliaries as noted earlier:

(20) CHI: why you crying Paul?

(21) CHI: why it not snowing?

(22) CHI: I am working on the puzzle.

---

[11] In Roger's data, we occasionally find examples such as the following:
    'Roger don't touch'
However it is not entirely clear whether this is an imperative repeated to himself (i.e. here an instance of delayed echolalia) or a declarative containing an auxiliary that is unmarked for agreement. In any event, this sort of structure is only ever found in root contexts. If indeed we have an auxiliary lacking in agreement appearing only in root contexts, then this is a crucial observation since truncation of the higher layers would be a straightforward way to account for the phenomenon: In root contexts, as opposed to interrogative contexts, stripping away of CP and even AgrP, is possible, and would yield an auxiliary unmarked for agreement. A similar pattern for auxiliaries was observed in instances of typical acquisition by Guasti & Rizzi (2002). These authors conclude that this state of affairs upholds that Agreement and Tense features are licensed in distinct syntactic positions, with the former being located higher than the latter in the clausal architecture. Given the uncertainty as to the exact intention of the child studied here, we leave the issue open.

(23) CHI: I was working on the puzzle.

(24) CHI: we sitting down.

The most verbal child Brett produced 115 occurrences of progressives through an *-ing* form, which corresponds to three times the amount of correct regular *-ed* past tense used by this child. This comparison provides even more striking results lower down the spectrum: Roger produced 85 occurrences of *-ing* forms, which amounts to 10 times the number of correct regular past tense forms used by this child.

4.5. DP

The data on nominals suggest that articles are commonly dropped: in the case of Brett the rate of omission is 17% and this number goes to up 32% for Roger. On the other hand, the two children make frequent uses of adjectives, as illustrated in (25), (26) and (27) below. Adjectivals are arguably lower in the universal nominal hierarchy than other functional material (Cinque 2000) and so at first sight, indeed the higher projections of the DP are less morphologically realized than the lower ones:

(25) MOT: I want ∅ milk ball

(26) CHI: I want ∅ amusement park.

(27) CHI: ∅ star going around.

(28) CHI: Where ∅ yellow box?

Below we see that numerals are also used, but in the absence of plural *-s* on the noun. The rate of plural omission is 15% for Brett. This number is harder to compute for Roger, who uses many words in isolation, which makes it often difficult to identify where a plural would have been required.

(32) CHI: Two fireplace.

4.6. Reflexives

Some of the productions in this corpus suggest a difficulty with reflexives:

(29a) MOT: Who dressed you this morning?
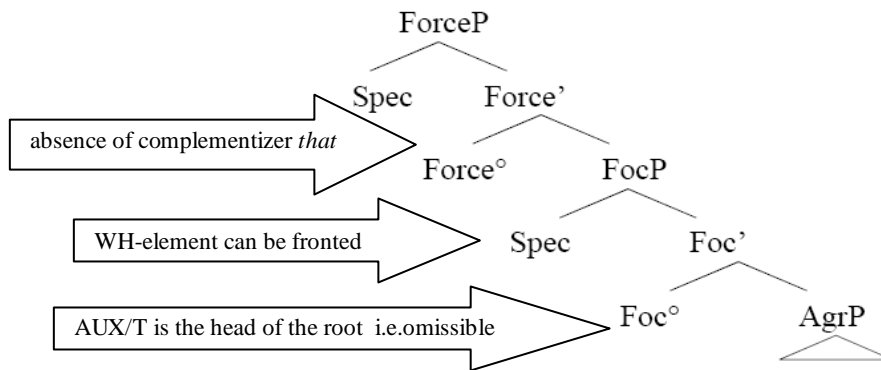(b)   CHI: I dressed me.

(30) CHI: Wanna hold it to me.

This is reminiscent of the observation in Perovic et al (2006) that autistic children struggle with binding.

5. Summary of findings and a first analysis

As already noted, a review of the literature indicates that the higher sections of the clause tend to be more visibly omissible than the lower sections in productions of this population, and this corpus study upholds that initial impression. Also, once the higher layers are present, we observe that the child does not omit the lower ones. For example, although subjects in root contexts were often omitted, once the child produced an interrogative, subjects were overtly realized as they no longer occupy the specifier of the root. All these observations uphold a truncation account, where the children are then exploring the option to project reduced structures. However, while this option is typically found in immature systems (and abbreviated adult registers), ceasing in developing systems around the age of 3, we note that in this instance of pathology the omission of higher material appears to persist.

In light of the critical period hypothesis, it becomes conceivable that this pronounced delay may result in a considerable perturbation of the system on other levels. For example, although these children produce structures that include Wh-fronting, therefore suggesting that they exploit the CP, we nevertheless find auxiliary omission in these productions, unlike in the target language. At first sight this seems difficult to account for in terms of truncation. However in light of the fine-grained maps which have been recently developed for the C-system (Rizzi 1997, 2004), the full left-periphery projects all the way up to ForceP, the projection responsible for encoding illocutionary force. A recent study of interrogatives in a phase of English acquisition (Guasti 2000) proposes that what some children peel off is this last layer, which implies that they form interrogatives where Focus° has become the head of the root, unlike in adult language where the head of the root is always Force°. As a result of this application of truncation to a more articulate map, we are able to understand why the children here may also omit the auxiliary in these contexts: in such reduced structures building only up to Foc(us)P, the auxiliary occupies the initial head position, a position which is not subject to the Principle of Clause Internal Identification. This approach in terms of truncation then explains the particularity of null auxiliaries found in interrogatives of this corpus as well.

Moreover, the peeling off of ForceP has other repercussions on the language of the children under investigation: This projection is the one responsible for hosting the complementizer *that* which encodes declarative force. If children with autism truncate ForceP, they are not projecting all the way up to the position typically used in embedding. It is interesting to note that subordinate constructions were extremely rare in this corpus, with only two occurrences of complementizer *that* found in the 20 recordings over a two year period. To summarize these findings, consider the following tree:

```
                                    ForceP
                                   /      \
                              Spec        Force'
absence of complementizer that  ⟹        /      \
                                    Force°       FocP
                                            /        \
WH-element can be fronted  ⟹            Spec          Foc'
                                                     /      \
AUX/T is the head of the root i.e.omissible  ⟹   Foc°      AgrP
```

   In light of the research discussed in section 1.2.1 which upholds that complement structures go hand in hand with theory of mind abilities (Tager-Flusberg 2000, Tager-Flusberg & Joseph 2005, Schick et al. 2007), it becomes increasingly important to conceive of a way to build the syntactic apparatus in autistics all the way up to ForceP, with a remedial program working its way through consolidating the intermediate projections along the way. This is because, on the one hand, cognitive abilities such as a delay in ToM may crucially rely on the development of this part of the syntax and therefore never fully develop in its absence. On the other hand, if this section of the clausal architecture is not consolidated because of the extended delay in the language acquisition of autistics, characteristics of the grammar which build upon this full architecture, arising later in typical acquisition, may never be entirely mastered by autistics. This view has been applied to other populations to explain their achieving a certain level of grammatical ability and then no more and has been named 'Specific Grammatical Impairment' (Perovic & Wexler 2007). These authors conclude that certain aspects of grammar that arise earlier in the typically-developing population are intact in the Williams syndrome subjects but those that arise later "seem exceptionally delayed, and even unattainable". As a result of these observations, they propose that:

> "it is misleading to speak about grammatical development in Williams syndrome as either 'normal' or 'abnormal'. Rather, it is both, if the terms can be applied at all. Grammatical development in Williams syndrome is 'normal' in that children with Williams syndrome have Universal Grammar (UG) and the properties of UG mature in the order in which they mature in typical development. In this way, the language of children with Williams syndrome looks like that of typically-developing children. But certain grammatical operations never develop in children with Williams syndrome. In this way, the

> language of children with Williams syndrome looks quite different from the
> language of typically-developing children".

We claim that a similar scenario appears to hold for children with autism, but frame this in terms of a prolonged application of truncation, delaying, and in some cases prohibiting, the acquisition of the higher layers of the clause.

6. Conclusion

This preliminary investigation of syntax in autism suggests the relevance of truncation theory in accounting not only for phenomena of typical language acquisition, but also for the instance of pathology examined here. We have seen that the distribution and restriction on the occurrence of null elements follow from a view where what is stripped away is every projection higher than the truncation site, but all projections dominated by it are present. As such we account, for example, for subject omission being a readily available option once it occurs in the specifier of the root. We also explain the dramatic increase in overt subjects in Wh-contexts, where the projection of FocusP implies that the subject no longer benefits from the privilege of the root, yielding the almost complete absence of null subjects in such configurations.

Moreover this approach to syntax in autism provides support for the hypothesis that when language develops too slowly, the higher layers of the tree are the ones most likely to remain affected since they are the ones systematically vulnerable to the truncation mechanism: We speculate that persistence in truncation of these layers, induced by the pronounced language delay beyond the critical period, may well result in the top structural levels never being solidly acquired. Given that theory of mind abilities have been precisely linked to the development of structures that make use of the highest layer of the clausal architecture (namely complement structures and relative clauses which are articulated by means of the CP layer), the impaired theory of mind in autism may plausibly stem not only from a pragmatic deficiency, but also from a syntactic one.

Admittedly much more empirical work needs to be conducted before this hypothesis can be proven: for now, although complement clauses have been noted to be impaired in many autistics, relative clauses have yet to be investigated. However if future research continues to confirm the view that complex syntax associated with higher clausal layers are affected in autism, then such findings will ultimately be enlightening with respect to remediation programs. Notably, programs aiming at developing theory of mind abilites would therefore need to include exercises targeting syntax of the higher layer of the left-periphery. More generally, speech therapists could consider detecting which layer the child has been able to build to, and then develop exercises to trigger subsequent layers from that point in a systematic fashion, as this may well begin much lower than the CP layer for some.

It is worth noting that the findings here further suggest that language difficulties in autism differ somewhat from those in SLI: Certain properties in SLI do not follow directly from a truncation approach, such as omission of subjects in Wh questions (Hamann 2006). If future investigation of autistic children continues to uphold that they generally avoid null subjects in such contexts, as the children studied here appear to, then this would be one way in which the two populations do not overlap and their speech therapy would then diverge in such respects.

Hopefully this first attempt to examine language in autism from a syntactic perspective will add another dimension to the current trend in research whose focus is mainly the pragmatic deficiency evident in this condition. As researchers look more precisely at syntax, and disentangle its role from pragmatics as much as possible, we should finally arrive at a more balanced view of the linguistic challenges of autistic individuals and develop more complete remediation programs for them, fine-tuned to their needs.

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