Language Acquisition in Autistic Children: The role of Joint Attention

1. Introduction

One of the major characteristics of the autistic syndrome is the considerably delay in language acquisition (DSM-IV 1994). This delay produces, during adulthood, an absence of language in 50% of cases (excluding Asperger's patients). Additionally, the linguistic level of autistic adults with a normal IQ remains lower than that of non-autistic subjects (Howlin, 2003). In addition to the delay, language acquisition seems different in that autistic children do not acquire language through immersion as typically developing (TD) children do but need an extensive speech-therapy support, in order to speak.

Despite the importance of language in both the diagnosis and the deficits of people with autism, longitudinal studies of how language develops in autistic children do not seem to exist, either in France or in other countries. To our knowledge, the existing works amount to a corpus collection gathered in the mid-1980s by Tager-Flusberg (collected over a period of approximately 24 months) but unanalyzed, and to Elizabeth Hennon's (2002) PhD thesis, which however is not a longitudinal study: children were tested only once on their use of social-pragmatic cues in lexical acquisition.

The goal of Nadège Foudon's PhD is to fill this gap, to describe the ways in which the language acquisition of autistic children is similar or different to that of TD children and to refine hypotheses which explain the delay and difficulties of language acquisition in autistic children. The final goal is to try and to give some directions for speech therapy to deal with problems of autism.

Thus, we pursue a dual goal: on the one hand, producing fundamental research on language acquisition in autistic children, and on the other hand, applying the knowledge acquired to recommendations for improving speech therapy for autistic children.

We will start with a rapid introduction to autism.

There are three crucial factors in the diagnosis of autism:

- Autistic children have communication and socialization deficits;
- Absence of symbolic play: autistic children do not have pretend play;
- Autistic children have repetitive behaviors and in others instances too restricted centers of interest.

If we look at autism from the point of view of language acquisition, autism is one among a set of developmental pathologies, which are known under the general term of

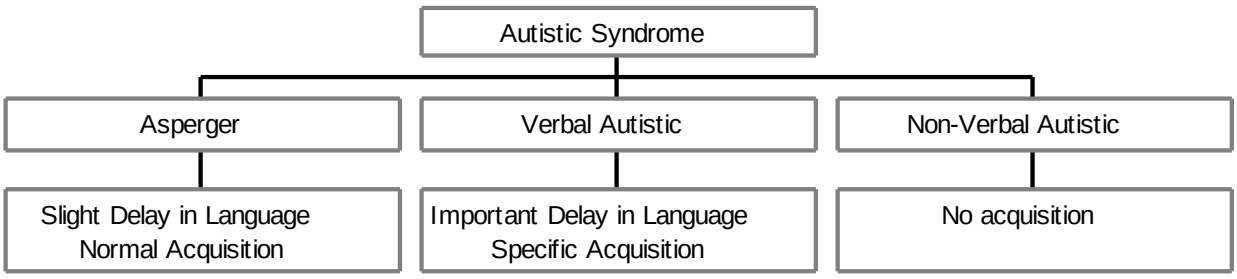
autistic syndrome. The patients suffering from autistic syndrome are different on some points, which are crucial for this study, i.e. the acquisition and development of linguistic communication. From this point of view, a first distinction can be made among autistic syndrome, despite the similarity of their social behavior deficits (first described in classical works on autism such as Kanner, 1943):

- The first population, suffering from what is called Asperger's syndrome, acquires language in the typical way and have a normal IQ. Asperger patients differ from all the other autistic syndrome partients in the way they acquire language.
- In the second group, language acquisition is strongly delayed and children do not acquire language in the same way as TD children.
- A third group is made of patients who do not communicate linguistically because they never acquire language.

Thus, there is a trichotomy in the autistic syndrome:

- Asperger people who have a typical language acquisition but with a slight delay, and who have a normal IQ;
- Verbal autistic people who are extremely slow to acquire language and who acquire it in a specific way, and who are frequently mentally retarded;
- Non-verbal autistic people who never acquire language (frequent mental retardation).

Figure 1: The three variants of the autistic syndrome from the language acquisition point of view



When one compares the timing of language acquisition in TD children, Asperger children, blind children, autistic children[1] and children suffering from a language

[1] We use the term « autistic children » in the remain of the article for « verbal autistic children »

specific impairment (SLI)[2], but TD otherwise, one obtains the following chronological table:

Table 1: Comparative chronology of language acquisition (computed from data in Bloom, 2000; Howlin, 2003; Leonard 1998)

Population	First words	First combinations	Interval 1st words / 1st combinations
TD	11 months	17 months	6 months
Asperger	15 months	26 months	11 months
Blind	19 months	25 months	6 months
SLI	23 months	37 months	14 months
Autistic	38 months	52 months	14 months

Regarding first word production, autistic children are very late not only when compared to TD children (38 months vs. 11 months) but also when compared to Asperger children (15 months) and when compared to all examined populations. This delay increases for the first combinations stage (52 months vs. 17 months in TD children). Moreover, they never catch up: in adulthood, high-functioning autistic people (with normal IQ) do not reach the language level of normal adult people (Howlin, 2003). Another interesting fact is the interval between first words and first combinations. This interval is equal in TD children and blind children (6 months) even though the latter are initially late, whereas it is longer in Asperger children (11 months) and much longer in SLI and autistic children (14 months).

We distinguish, concerning language acquisition in TD children, between syntactic acquisition and lexical acquisition. Without discussing in details the validity of this distinction, it should be noted that a currently popular hypothesis claims that syntax cannot develop under a critical size of vocabulary, evaluated at around 200-250 words (Locke, 1993; 1994). Thus, the longer interval between first words and first combinations in autistic and SLI children might be explained by a slower acquisition of lexicon which leads to a delay in syntactic development. Hence, our study focuses on lexical rather than syntactic acquisition.

[2] The SLI, which touch a relatively important number of children (approximately 7%), is identified by the following criteria: normal hearing, absence of recent oto-rhino troubles, no cerebral dysfunction identified, normal social behavior, normal oral motricity abilities, and important language delay which subsists in adulthood and results in persistent deficits.

The data indicated above regarding language acquisition in autistic syndrome patients raise some questions:

- Why is language absent in 50% of autistic people?
- How can we explain the severe delay of acquisition in those autistic people (first words: 38 months against 12 months in TD children) who finally acquire language?
- How can we explain the less severe delay of acquisition (1st words: 15 months) shown by Asperger patients?
- How can we explain the fact that the interval between first words and first combinations is identical in autistic (14 months) and SLI children; and that it is higher than in TD (6 months) and even Asperger children (11 months)?

We propose three hypotheses:

- There is a dissociation between linguistic comprehension and production in autistic children. In other words, they are linguistically competent and their linguistic deficit lies in their performance.
- Given that the autistic syndrome population suffers from a deficit in ToM (Theory of Mind), in verbal autistic children, an SLI is compounded with the deficit in ToM, which explains the delay and the difference with the Asperger population.
- Finally, autistic children might have a problem limited to ToM, as do Aspergers. However, the difference in language acquisition between Asperger, verbal and non-verbal autistics could be due to different degrees of impairment in ToM in the different groups (Asperger, verbal and non-verbal autistic patients).

We will start by introducing the theoretical background of our study, i.e. the Emergentist Coalition model. We will then outline testing procedures for our different hypotheses. To test the first assumption, we reproduced in a simplified way the test Savage-Rumbaugh designed to evaluate the comprehension of Kanzi (the bonobo chimpanzee taking part in her ape-language project) and we also constructed a vocabulary questionnaire that parents and educators had had to complete independently. To test the two last hypotheses, we have carried out false-belief tests and a corpus comparison. Finally, we will discuss our results and propose some new directions for our research.

2. Theoretical Background

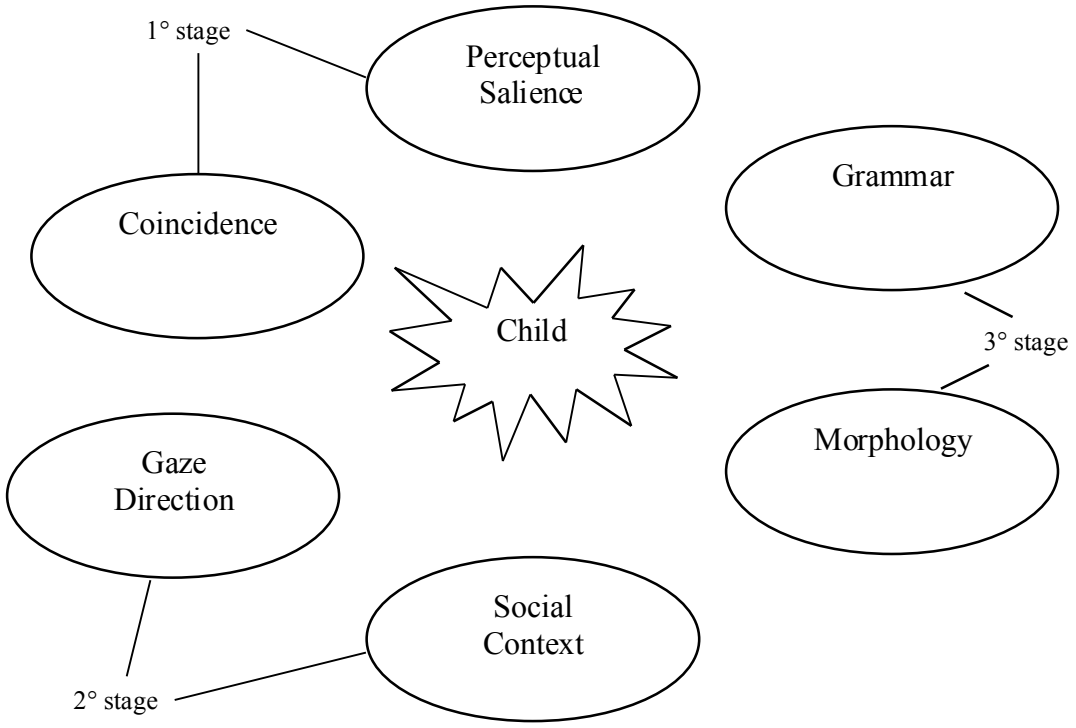
A child acquiring the lexicon has to solve three problems:

- Segmenting the stream of speech into words;
- Segmenting the environments into objects and events;
- Relating words and objects or events.

Let us begin by introducing a current model of language acquisition in TD children which was proposed by Hollich, Hirsh-Pasek and Golinkoff (2000): the Emergentist Coalition model. This model has the advantage of having been empirically vindicated (cf. Hirsh-Pasek and Golinkoff, 1996; Golinkoff *et al.,* 2000) in a great number of experimental studies with TD children. The Emergentist Coalition model suggests that the child uses all the available cues to make out the link between the word and the object: from salience to morpho-syntactic cues, through social-pragmatic cues (Golinkoff *et al.,* 2000). The emergentist coalition model thus presupposes three successive phases in lexical acquisition. In the first phase, the only mechanism involved is association. For children to acquire a word, there must be perceptual salience and coincidence between the word and the object to which it refers.

In the second phase, children use gaze direction and social context (i.e. the goal and situation of the interaction) which supplant perceptual salience to infer the meaning of words. And finally, during the third phase, the linguistic data (grammar and morphology) play an additional role in helping the child to infer the meanings of new words.

Figure 2: Different Stages of Language Acquisition according to the Emergentist Coalition Model



Thus, according to the Emergentist Coalition Model, lexical acquisition is not a static mechanism, but a dynamic one: depending on the stage of acquisition the child is in, (s)he will take into account different cues.

As noted previously, the Emergentist Coalition Model presupposes three successive phases where the child has to solve three different problems. During the first phase, between 0 and 9 months, the child has to extract the acoustic packaging. Language assists the child in segmenting the nonlinguistic events to be internalized and approximately interpreted. The second phase of language acquisition is the phase of segmentation and linguistic mapping. From 9 to 24 months, the child begins to analyze within the acoustic units extracted in phase 1 and to map the resulting product (words and phrases) onto their corresponding representation of objects and events. Finally, in the last phase, the child proceeds to a complex syntactic analysis. Sentence comprehension can occur more often in the absence of the events being described, and the child can perform a complex syntactic analysis to gain meaning. This is summed up in table 2.

Table 2: A three-phase model of language comprehension (Hirsh-Pasek and Michnick Golinkoff, 1996)

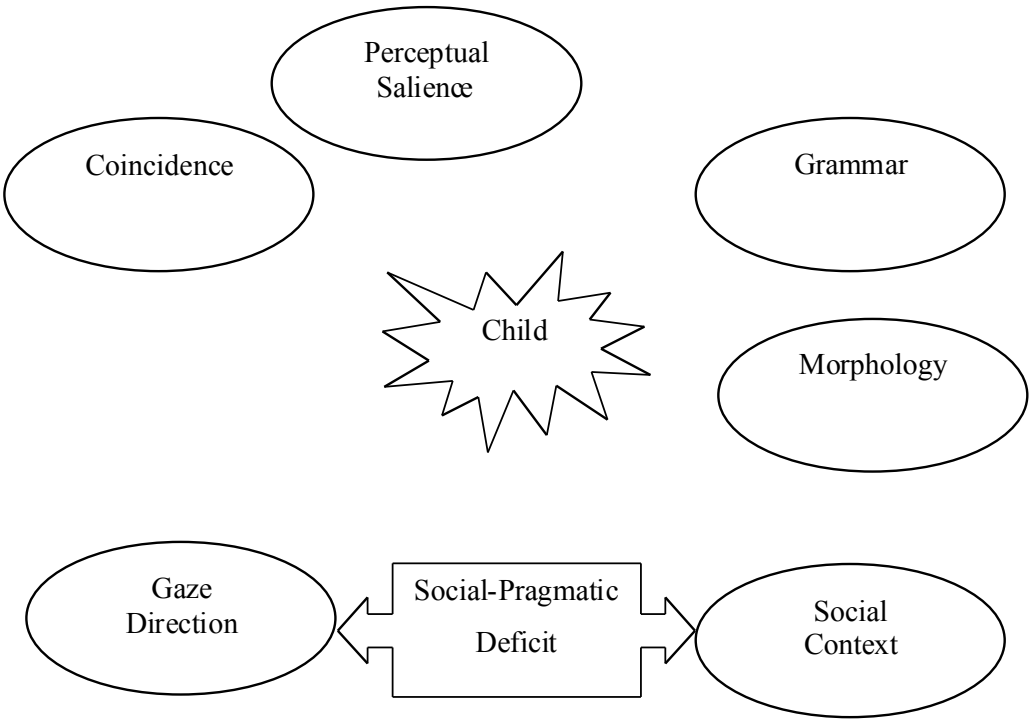
Phases	Dominant process	Form of representation	Language Comprehension	Language Production
Phase 1 0-9 months	Internalization	Acoustic correlates of linguistic structure / Images-schemas (not propositional)	Some words	Few, if any, words
Phase 2 9-24 months	Internalization and Interpretation	Words, some early grammar / Propositions, cuts becoming language dependent	Syntactic, when redundant cues from context, semantics and prosody coincide	Prototypical transitive and intransitive sentences, often incomplete
Phase 3 24-48 months	Interpretation	Hierarchical representation of linguistic structure / propositions, language dependent in nature	Syntactic, even when redundant cues fail to coincide, can compute interclausal relations	Complete sentences, variety of structures

The dominant process of phase 1 is internalization. Children use acoustic correlates of linguistic structure and image-schemata for comprehension. They produce and understand few words. Phase 2 is a transition between internalization and interpretation. Children have representations of words and some early grammar. Propositions become language dependent. They understand syntax, semantics and prosody only when cues coincide. They can produce some prototypical transitive and intransitive sentences but these are often incomplete. Finally, the children are in the interpretation phase. They have a hierarchical representation of linguistic structure. They know that structure can be embedded in higher structures. They can have representations of events even if these are not present. They know that events are governed by structure-dependent rules. They understand all syntax and can compute interclausal relations. They produce complete sentences and can vary the structure (for example transforming active to passive).

Concerning autistic people, a classical view of autism postulates that they suffer from a cognitive deficit. According to Frith (1996), one of the major hypotheses regarding

autistic syndrome is that they have a central deficit in theory of mind. Theory of mind provides the ability to attribute thoughts, desire and feelings to others in order to predict and explain their behaviors. TD children are able to do this at around the age of four. This capacity is universal except in pathological cases such as autism. Frith's hypothesis explains the social deficit from which autistic children suffer and it is in accordance with the Emergentist Coalition Model. Indeed autistic children often start to learn some words in the associative way, but their deficit in the treatment of social-pragmatic cues (gaze direction and the treatment of social context) hinders the normal acquisition of the lexicon, which, in turn, delays the beginning of syntax (see Figure 3).

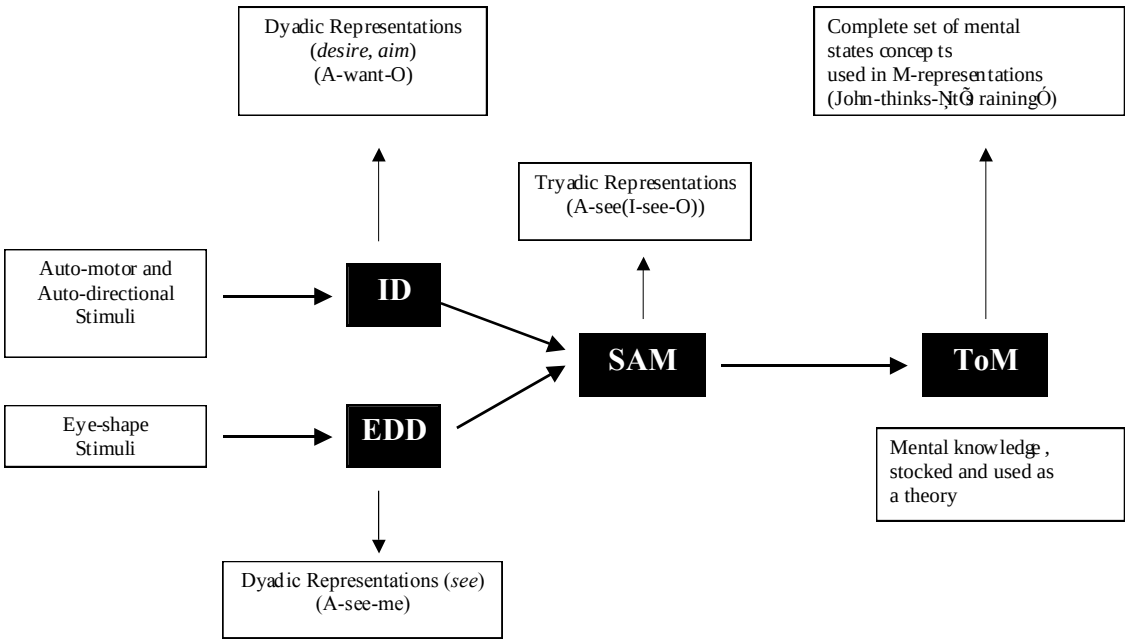
Figure 3: Social-Pragmatic Deficit and Emergentist Coalition Model



Thus the social-pragmatic deficit is explained by a basic deficit in theory of mind which is characteristic of the autistic syndrome.

Baron-Cohen (1995) has proposed the following model of the development of theory of mind:

Figure 4: Theory of Mind Model (Baron-Cohen, 1995)



Baron-Cohen suggestion is that very young children, before 9 months, begin with 2 modules: Intention Detection (ID) and Eye Direction Detection (EDD). Both of these modules produce dyadic representations and their output is fed into the Shared-Attention-Mechanism (SAM), which is in place around 18 months. The shared-attention-mechanism is able to produce triadic representations. These triadic representations will be fed into the Theory of Mind module (ToM). The ToM module is the complete set of mental state concepts and rules which intend to link mental state concepts and mental representations with both other mental representations and behaviors. This developmental model was designed with TD children in mind, and in fact autistic children never reach SAM. Autistic children are able to detect direction and intentionality of gaze in experimental conditions but they do not do this spontaneously in everyday life. Thus the information on which the shared-attention mechanism develops is not or only seldom available.

Language acquisition and theory of mind are intimately connected. TD children can cope successfully with false belief tests (such as Sally-Ann[3]) at around 4 years old, but they use socio-pragmatic cues from the age of 18 months according to the Emergentist

[3] Sally and Ann are two dolls. Sally put a ball into her basket. Then she goes out. Ann takes out the ball and puts it into her box while Sally is away. Now Sally comes back and wants to play with her ball. The child is asked : « Where will Sally look for her ball ? » If the child answers correctly (« in her basket »), it is considered that ToM is acquired.

Coalition model. Let us compare the chronology of language acquisition and theory of mind development:

Table 3: Comparative Chronology of language acquisition and theory of mind development in TD children (Reboul 2004, 2007)

Age	Language Acquisition	Theory of mind
0 - 9 months	-	ID and EDD
9 - 18 months	40 words	SAM
48 months	+ 600 words	success at false belief

In TD children, between 0 and 9 months, lexical acquisition has not yet started. But children have already acquired the Intention Detector (ID) and the Eye-Direction Detector (EDD) mechanisms. Later, while the Shared-Attention Mechanism is developing, children start to acquire some words by association. This corresponds to the first phase of acquisition. At 18 months, SAM is operational, giving access to socio-pragmatic cues and children undergo a dramatic increase in lexical acquisition. Around the age of four, children have learnt more than 600 words and they can cope with false-belief tasks. This corresponds to the two last phases. Autistic children, as we have said previously, cannot manage false belief tests. They are able to detect intentionality and eye direction but they do not reach the next step, the Shared Attention Mechanism (SAM).

A distinction must be made between joint attention and shared attention. Basically, joint attention is following someone else's gaze (i.e., looking in the same direction), while shared attention is checking whether the other is looking in the same direction as the agent (i.e., alternating gaze between object and partner). Autistic children do not spontaneously demonstrate joint attention, which slows down their language acquisition.

Belkadi (2006) does not agree with the hypothesis of a single theory of mind deficit. She says that normal acquisition of language in autism is possible despite severe deficits in ToM. Additionally, she argues that the language difficulties of children with autism and children with Down's syndrome present a few similar patterns (Tager-Flusberg, 2000; Rondal, 1988). However, unlike children with autism, children with Down's syndrome do not have any difficulty with mind reading and ToM (Baron-Cohen, 1995). Belkadi concludes that such facts support the claim that impairment in the non-social language of autistic children is not due to a deficit in ToM but is a consequence of a more general problem in communication, and specifically SLI – Specific Language Impairment. As

suggested by Frith (1998), she believes that a model of research into the origin of autism should recognize not one, but several distinct cognitive deficits. Such a model should integrate deficits in ToM, executive functions and central coherence, as well as vulnerabilities of the language faculty as underlying deficits causing Autistic Syndrome Disorder (ASD). This point of view concords with the genetics and anatomy of the autistic brain – especially with mirror neurons deficits (Williams et al., 2001) – and a model recognizing that it is both a deficit of language faculty and of ToM which cause the ASD seems coherent. This research does not really challenge our hypothesis. We do not exclude that autistic children could have a deficit in ToM combined with a SLI but we still are very interested in joint attention. Incidentally, the hypothesis of a difficulty in lexical acquisition being explained by a difficulty at the second stage (social-pragmatic cues) in autistic children has been experimentally confirmed by Hennon (2002).

3. Method

3.1 Participants

This being a longitudinal study, we followed the same children for 3 years. Participants were 9 children with autism (3 girls and 6 boys) between 3 years 9 months and 9 years 2 months at the beginning of the study. The children were chosen on the basis of their linguistic productions (see below) which explains the age range (see Table 1). All children were recruited at the Isatis and La Tarentelle departments of the Saint-Jean-de-Dieu hospital (Lyon, France), where they were initially diagnosed as suffering from Autistic Disorder in accordance with DSM-IV (1994). In these two institutions, children have a structured education following the TEACCH (Treatment and Education of Autistic and Communication-handicapped CHildren) principles and they learn to communicate, also linguistically, via the PECS (Picture Exchange Communication System) method. Two children changed hospital during the second year and they stopped using these methods. Our sample of autistic children had a mean Child Autism Rating Scale Score (CARS) of 38.64 (standard deviation = 12; range = 35-47) and developmental age between 12-16 months and 28-32 months at the beginning of the study (January 2006).

We divided children into three groups: first words, first combinations and first sentences. The stages of language acquisition are evaluated relative to mean length of utterance (MLU), i.e., respectively 1, 2 and more than 2. We distributed the nine

children in three groups as follows: three children at the first words stage (Victor, Eliott, Lyne); three children at the first combinations stage (Matthieu, Charlotte, Félix) and the three last children at the first sentences stage (Maeva, Ahmed, Grégory). We have changed the names of the patients to preserve anonymity. The distribution in the three groups is not related to the child's age but to his/her linguistic abilities (evaluated as indicated above by their MLU, see Leonard (1998)). Given the slowness of language acquisition in autistic children, this means that the children's ages span a wide range.

3.2 Procedure

We collected corpora for the nine autistic children described above (one corpus per child). At the end of the study, children will have been recorded approximately every three months and for 3 years at the Isatis and Tarentelle medical daycare centres. We have already recorded two years at three-month intervals and we will continue during the 2007-2008 school year. Children are recorded in three types of situation: work, lunchtime and playtime. These situations are not experimental contexts: autistic children and adults interact as if they were alone.

We have carried out Savage-Rumbaugh tests but we will not discuss the results in the present paper. We just describe the experiment because we used the recording made during this experiment to examine the joint attention abilities of two children with different developmental trajectories.

3.2.1 Corpora collection

We transcribed the corpora according to the recommendations of CHILDES – Child Language Exchange System (http://childes.psy.cmu.edu), an international project on language acquisition which puts on-line corpora of TD or language-impaired children in various languages. We then compared our corpora with those of TD children and children with SLI at similar stages of language acquisition which are available on the site of CHILDES.

3.2.2 Savage-Rumbaugh tests

We have adapted Savage-Rumbaugh experiment to French in order to evaluate the comprehension of the autistic children we follow. Originally, this experiment aimed at comparing linguistic understanding between Kanzi (a bonobo at the Language Research Center in Atlanta) and an 18-month-old child, with the following hypothesis: the competence (comprehension) of the bonobo is better than his performance (production),

just as is the case in TD children. Similarly we wanted to see whether, in autistic as in TD children, language understanding precedes language production.

This experiment consists in asking the subject to perform different actions which are described linguistically by the experimenter. Here are the different sentence types, that, following Savage-Rumbaugh *et al*. (1993), we used:

(1) Type 1: A: *Put object X in/on transportable Y*
Put the dog on the truck.
B: *Put object X in/on nontransportable object Y*
Put the pen on the table
Type 2: A: *Give (or show) object X to animate A*
Give the book to Christine
B: *Give object X and object Y to animate A*
Give the duck and the orange to Jacques
C: *(Do) action A on animate A*
Do a kiss to Marie
D: *(Do) action A on animate A with object X*
Put the scarf around the Christine's neck.
Type 3: *(Do) action A on object X (with object Y)*
Push the car with the cat.
Type 4: *Announce information*
There is chocolate on the kitchen table.
Type 5: A: *Take object X to location Y*
Take the car to the kitchen table
B: *Go to location Y and get object X*
Go to the bedroom and get the dog
C: *Go get object X that's in location Y*
Go get the fireman that is in your bedroom
Type 6: *Make pretend animate A do action A on recipient Y*
Make the dog bite the duck
Type 7: *All other sentence types.* (coordinated action)
Take the doll and put the book on the floor.

3.2.3 Joint attention observations

Given that it is not the theory of mind proper which was involved in lexical acquisition but rather shared attention and gaze detection, we decided to examine the joint attention abilities of two autistic children: Félix and Matthieu. They were at the same stage of acquisition at the beginning of the study and had rather different trajectories of lexical acquisition: the first one (Félix) has really improved in language acquisition, whereas Matthieu has stagnated. As the Savage-Rumbaugh experiment consists in asking the child to perform an action, which is linguistically described by an experimenter, most experimenter's initiations are just verbal. But, as some autistic children have comprehension problems, some of the experimenter behaviors are accompanied by pointing, showing or giving. We have then coded the responses of the children to each initiation of the experimenter:

- No response, the child does not do anything;
- Passive looking/holding (joint attention), the child looks or takes the right object but does not perform the asked action;
- Toy manipulation (we have distinguished right and wrong choice of object);
- Type of action (the child does the right or the wrong action);
- Speech acts (the child asks for a clarification or anything else);
- Echolalia (the child repeats the order of the experimenter);
- Vocalization (the child makes some noise);
- Coordinated eye gaze behavior (the child looks at the experimenter's eyes) or shared attention.

We can code several different responses to one experimenter initiation.

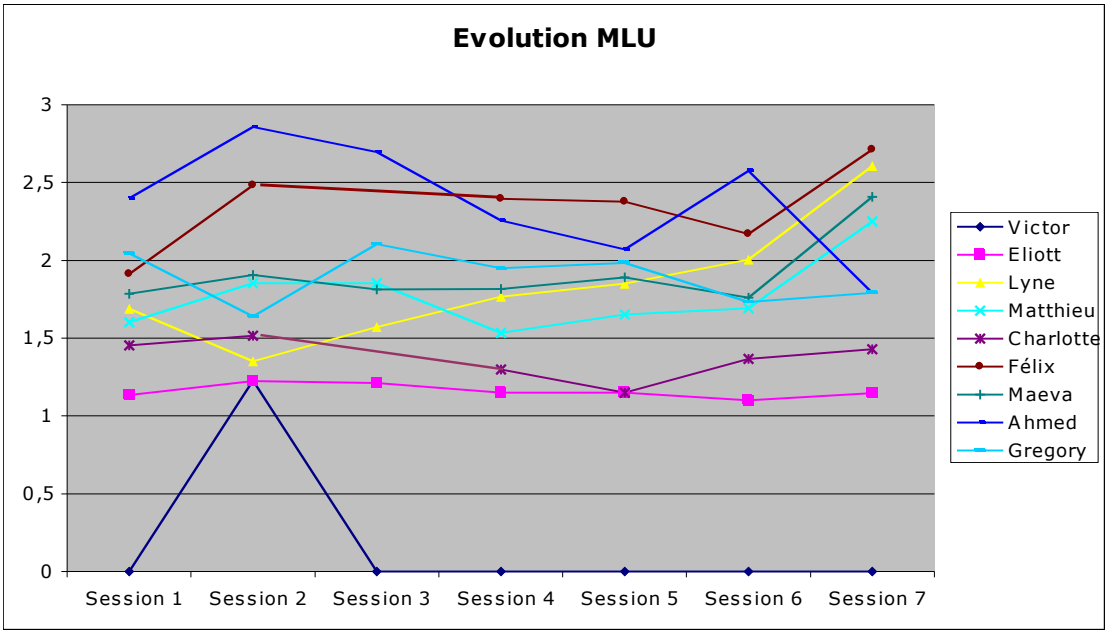
4. Results

4.1 Corpora results

We have studied the evolution of the MLU[4] of the nine autistic children. The CLAN software provided by CHILDES calculates the MLU according to our transcription.

[4] MLU = Mean Length of Utterance

Figure 5: Evolution of MLU



If we except Victor (in dark blue) who does not really speak (he just repeats the word "allo" when playing with a phone toy, during the second session but it never happens again), we can see that the MLU of all the children is currently in stabilization even if there are considerable variations between the children.

We want to highlight the performance of two children in particular: Félix and Matthieu. Felix's MLU (in red) increases greatly between the first and second sessions. He changes stages of acquisition (from first combinations to first sentences). Then his MLU stabilizes. Though Matthieu (in turquoise) was deemed to be at the same stage of acquisition at the beginning of the study, his evolution is very different. His MLU stagnates, its slowly increases at the beginning of the study, decreases in the fourth session and then comes back to the same level as in the first session.

We have compared the MLU evolution of autistic children with that of TD children (whose language transcriptions are available on the site of CHILDES) who had identical MLUs at the time of the first session.

Figure 6: Comparison of MLU evolution TD/autistic (MLU = 1)

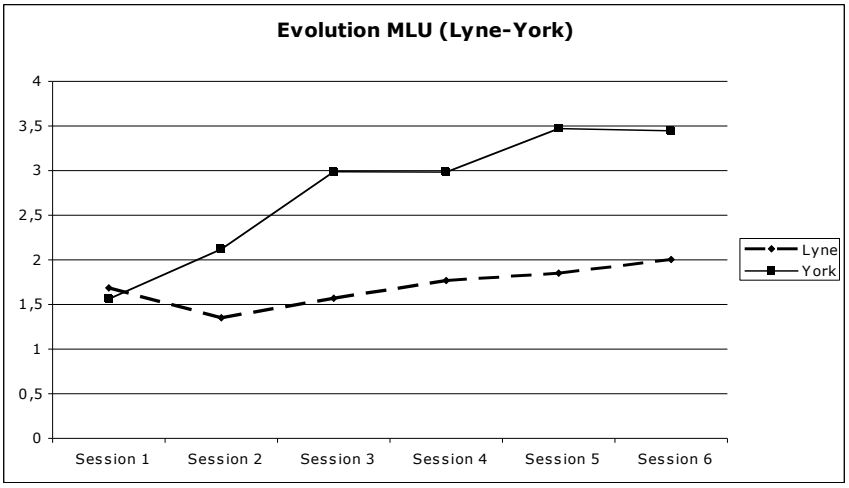


Figure 7: Comparison of MLU evolution TD/autistic (MLU = 2)

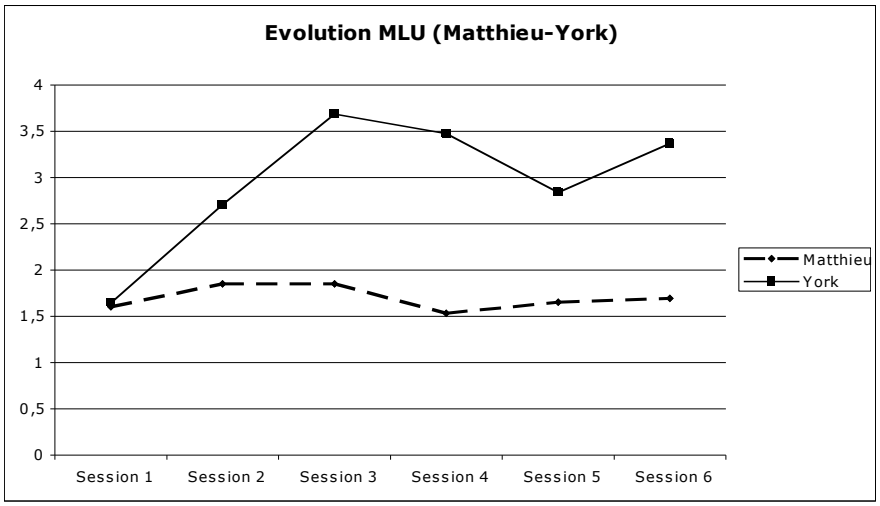


Figure 8: Comparison of MLU evolution TD/autistic (MLU ≥ 2)

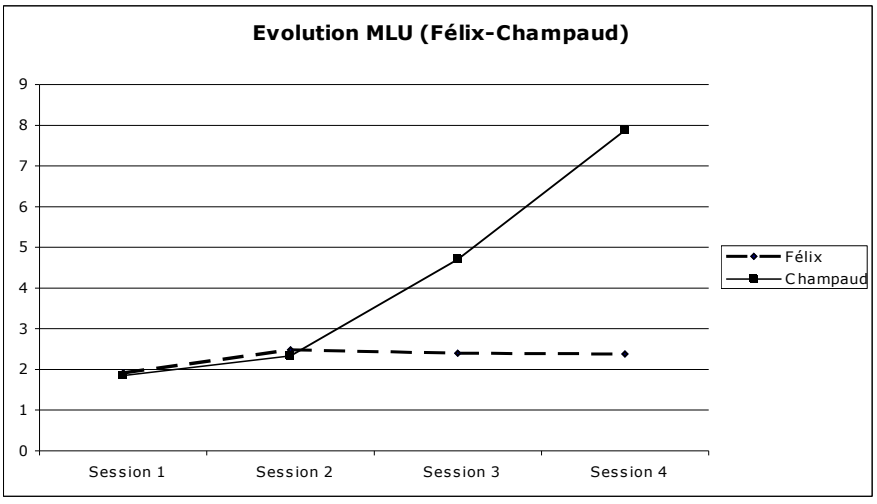
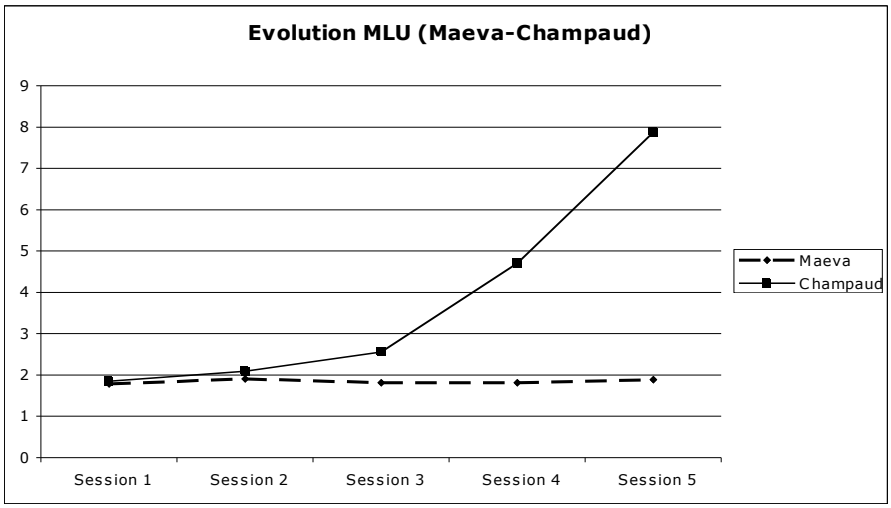


Figure 9: Comparison of MLU evolution TD/autistic (MLU > 2)



Regarding Figures 6 to 9, it is clear that whatever the stage of acquisition is at the beginning, the MLUs of TD children increase whereas those of autistic children (in dotted lines) stabilize or increase very slowly. Apparently, the MLUs of autistic children follow the same scheme as TD children but the evolution is so slow that the difference between these two populations is greater at more advanced stages.

In conclusion, the linguistic level of autistic children remains limited and evolves slowly compared to TD children.

4.2 Joint attention abilities

Table 4 presents the results of the observation of the joint attention abilities of Félix and Matthieu. The numbers are in percentages (except for the total score) and the numbers in italics correspond to Matthieu and the others to Félix.

Table 4: Joint Attention results (in percentage)

Experimenter		F	M	
Saying	97,12 *86,36*	11,16	*19,11*	No response
		2,68	*0,26*	Passive looking/holding (joint attention)
		26,79	*18,32*	Toy manipulation (good object)
		24,55	*9,42*	Toy manipulation (good action)
		4,46	*9,16*	Toy manipulation (bad object)
		6,25	*7,33*	Toy manipulation (bad action)
		8,48	*3,66*	Speech acts
		10,71	*15,45*	Echolalia
		1,34	*1,57*	Vocalization (noise)
		0,01		Coordinated eye gaze behavior (gaze alternation)
Pointing	0,72 *3,85*	0,01	*2,09*	Toy manipulation (good object)
		0,01	*1,05*	Toy manipulation (good action)
			0,26	Toy manipulation (bad object)
			1,31	Toy manipulation (bad action)
			0,52	Echolalia
Showing	2,16 *5,59*		*1,57*	No response
			0,26	Passive looking/holding (joint attention)
		0,89	*2,09*	Toy manipulation (good object)
		1,34	*1,05*	Toy manipulation (good action)
			0,26	Toy manipulation (bad action)
			0,52	Echolalia
Giving	0 *4,20*		*3,14*	Toy manipulation (good object)
			1,57	Toy manipulation (good action)
Total	139 *286*	224	*382*	

Numbers are percentage except for the total.

When looking at the total number of responses, there are many more responses by Matthieu (382 vs. 224). He was not as good as Félix, so the whole experiment took longer and necessitated more repetitions from the experimenter (286 initiations for Matthieu vs. 139 for Félix) and elicited more reactions from the child. Likewise the limited number of responses of Félix is due to the fact that his performance was much better.

The joint attention abilities of Matthieu and Félix are very different. Félix understands the order simply upon hearing it whereas Matthieu needs gestural cues from the experimenter and from his educator who was present.

For most requests, Félix immediately performs the right action with the right object whereas Matthieu just repeats the order or does nothing. Supposing that he does not understand the order of the experimenter, we asked the educator to say it to see if his

failure depends on the fact that the child does not know the experimenter very well. But the results were the same. Matthieu needs to be helped with gestural behaviors to respond appropriately to a request. Finally, during all the time of the experiment Matthieu never directed his eyes at the gaze of the experimenter or of the educator. By contrast, Félix often looks at the experimenter's eyes. For example, if he was not sure of the object he had to use, he would start to take an object and look at the face of the experimenter to see if he was right. Of course, when we look at Table 4, the percentage of coordinated gaze behavior by Félix is very low (0,01%). But this behavior is so rare in autistic children that it is noteworthy. It is really encouraging and one may wonder whether it might be the beginning of shared-attention behaviors.

In any case, this experiment shows that differences in joint attention abilities may have an influence on language acquisition in autistic children. Félix and Matthieu were at the same stage of acquisition at the beginning of the study, but Félix progressed considerably in language acquisition whereas Matthieu just stayed at the same level. Félix starts to use the gaze of his interlocutor and Matthieu still avoids it. Thus the observation of these two children at least partly confirms our hypothesis because the child whose joint attention is more developed progressed in language acquisition better than the other one.

5. Conclusion

Our corpus analysis results show that the MLU of autistic children evolves very slowly, especially compared with that of TD children. The passage from first combinations to first sentences is difficult. It may be due to a limited number of referential words (nouns and verbs) which, as we said earlier, delays the start of the acquisition of grammar and morphology.

Concerning language acquisition and more precisely lexical acquisition, it is probable that the socio-pragmatic deficit is characterized by shared attention failure. Shared attention is an advanced stage of joint attention. Joint attention merely consists in following the gaze of someone else. In shared attention, the child additionally verifies the direction of the other's gaze. Baron-Cohen's studies (1995) show that autistic children are able to detect the eye direction, if it is explicitly asked for. However, they do not seem to produce spontaneously and systematically this behaviour as TD children do. This observation confirms some studies which note, not the inability, but the absence of interest for some social behavior.

Thus, it seems that joint attention deficit in autistic children is not due to an inability, but rather to a lack of interest (Ames and Jarod, 2007). This conclusion has several consequences. First, given that joint attention is an early mechanism (it appears around 12 months) it could help diagnose autism much earlier (most autistic children are diagnosed at around 30 to 36 months, when the delay in language acquisition becomes obvious). Additionally, if the joint attention deficit is not due to inability but to a lack of interest, it may be possible to rehabilitate autistic children and to encourage them to develop this capacity. If the rehabilitation works and if joint attention is a precursor of the shared attention mechanism which is itself a precursor of theory of mind, there could be an improvement in both social deficits and language acquisition.

So we are taking an interest in joint attention abilities and in how to improve them in autistic children. We have set up a rehabilitation of gaze following in two young (two year old) autistic children and we hope to have worthwhile results very soon.

References

Ames, C.S. and Jarod, C. (2007) The problem with using eye-gaze to infer desire: a deficit of cue inference in children with autism spectrum disorder? *Journal of Autism and Developmental Disorders* 37: 1761-1775.

Belkadi, A. (2006) Language impairments in autism: evidence against mind-blindness, *in SOAS Working Papers in Linguistics*, 14: 3-13.

Baron-Cohen, S. (1995) *Mindblindness: an essay on autism and theory of mind*. Cambridge, MA: MIT Press.

DSM-IV. (1994) *Diagnostic and Statistical Manual of Mental Disorders.* Washington, DC: American Psychiatric Association (4th edition).

Frith, U. (1996) *L'énigme de l'autisme*. Paris: Odile Jacob.

Frith, U. and Happé, F. (1998) Why specific developmental disorders are not specific: Online and developmental effects in autism and dyslexia. *Developmental Science* 1,2: 267-272.

Golinkoff, R.M., Hirsh-Pasek, K., Bloom, L., Smith, L.B., Woodward, A.L., Akhtar, N., Tomasello, M. and Hollich, G. (eds) (2000) *Becoming a word-learner: a debate on lexical acquisition*. New York: Oxford University Press.

Hennon, E.A. (2002) How children with autistic disorder use attentional and intentional social information for word learning. Unpublished Ph.D. dissertation: Temple University.

Hirsh-Paseck, K. and Golinkoff, R.M. (1996) *The origins of grammar: Evidence from early language comprehension*. Cambridge, MA: The MIT Press.

Hollich, G.J., Hirsh-Pasek, K. and Golinkoff, R.M. (2000) *Breaking the language barrier: an emergentist coalition model for the origins of word learning*. *Monographs of the society for research in child development* 65. Chicago: Chicago University Press.

Howlin, P. (2003) Outcome in high-functioning adults with autism with and without early language delays: implications for the differentiation between autism and Asperger syndrome. *Journal of Autism and Developmental Disorders* 33,I: 3-13.

Kanner, L. (1943) Autistic disturbances of affective contact. *Nerv Child* 2: 217-250.

Leonard, L.B. (1998) *Children with specific laguage impairment*. Cambridge, MA: The MIT Press.

Locke, J. (1993) *The child's path to spoken language*. Cambridge, MA: Harvard University Press.

Locke, J. (1994) Gradual emergence of developmental language disorders. *Journal of speech.*

Reboul, A. (2004) Evolution of language from theory of mind or coevolution of language and theory of mind? Conférence virtuelle *Aspects of the coevolution of language and theory of mind*.
http:// www.interdisciplines.org/coevolution/papers/1.

Reboul, A. (2007) *Langage et cognition humaine*. Grenoble: Presses Universitaires de Grenoble.

Rondal, J.A. (1988) Down Syndrome. In: D. Bishop and K. Mogford (eds) *Language Development in Exceptional Circumstances.* Psychology Press.

Savage-Rumbaugh, S., McDonald, E.S.K., Sevcick, R.A., Hopkins, W.D. and Rupert, E. (1993) *Language comprehension in ape and child*. *Monographs of the society for research in Child development* 58. Chicago: The University of Chicago Press.

Tager-Flusberg, H. (2000) The challenge of studying language development in children with autism. In: L. Menn and N. Bernstein Ratner (eds) *Methods for studying language production.* Mahwah, N.J.: Erlbaum, 313-332.

Williams, J.H.G, Whiten, A., Suddendorf, T. and Perrett, D.I. (2001) Imitation, mirror neurons and autism. *Neuroscience and biobehaviral reviews* 25: 287-295.

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