

# Language Acquisition in Autistic Children: A Longitudinal Study

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The acquisition process of autistic children differs from that of normal children (acquisition by immersion) in that they need speech therapy support. Additionally, only half of autistic patients speak as adults and their linguistic level remains lower than that of normal subjects (Howlin 2003). Despite the importance of language in the diagnosis (it is one of the main criteria for autism in DSM-IV (1994)) and the deficits of autistic people, longitudinal studies of language development in autistic children don't exist. The aim of our study is to describe language acquisition in autistic children, and to propose more precise hypotheses regarding the language acquisition delay, as well as answering other questions:

Why is there a severe delay of acquisition in verbal autistic people (first words: 38 months against 12 in normal children)?

Why do Aspergers show a less severe delay (1<sup>st</sup> words: 15 months)?

How can we explain the identical delay between first words and first combinations in autistic (14 months) and SLI children; and that it's higher than in normal (6 months) and even in Asperger children (11months)?

There are three main (mutually compatible) hypotheses: (a) Dissociation between comprehension and linguistic production in autistic children. (b) Deficit in ToM (Theory of Mind) in autistic population, in addition to an SLI in verbal autistic children explaining the delay. (c) Deficit in ToM in all autistic population but with different degrees of impairment. To test these assumptions, we have collected and transcribed corpora from nine autistic children at different stages of language acquisition. We have compared our corpora with those of healthy and SLI children at similar stages. Additionally, we use parents' questionnaires, plus an experimental test (borrowed from Savage-Rumbaugh et al., 1993) to evaluate the first hypothesis. We do standard false belief tests to assess ToM.

## 1 INTRODUCTION

One of the major characteristics of the autistic syndrome is an important delay in language acquisition (DMSM-IV 1994). The acquisition process of autistic children also differs from that of normal children in that autistic children do not seem to acquire language through immersion as normal children do but need speech therapy support. Additionally, only about half of children with autism speak as adults and their linguistic level remains lower than that of normal subjects (Howlin 2003). Despite the importance of language in both the diagnosis and the deficits of autistic people, longitudinal studies of how language develops in autistic children do not exist.

There are three important criteria in the definition of autism:

- Communication and Socialization deficits
- Absence of symbolic play
- Repetitive behavior

Patients within the autistic syndrome split up in three categories:

- Asperger people who have a slight delay in language acquisition but with a normal acquisition;

- Verbal autistic people who show an important delay in language acquisition. Moreover, whereas normal children acquire language by immersion, autistic children need important speech therapy support;
- Non-verbal autistic people who never acquire language

Let us compare the timing of language acquisition processes in four different populations (normal, Asperger, Specific Language Impairment (SLI), autistic):

Populations	First words	First combinations	Delay word/combination
Normal	11 months	17 months	6 months
Asperger	15 months	26 months	11 months
SLI	23 months	37 months	14 months
Autistic	38 months	52 months	14 months

*Table 1*

Comparative chronology of language acquisition

Regarding first word production, autistic children are late not only when compared to normal children (38 months vs. 11 months) but also when compared to Asperger children (15 months). This delay increases for first combinations. Additionally there is a delay between first words and first combinations, which is considerably longer in autistic children (14 months) than in normal (6 months) and Asperger (11 months) and indeed is equivalent with the delay for SLI children. These data 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 normal children) who finally acquire language?
- How can we explain the less severe delay of acquisition (1<sup>st</sup> words: 15 months) shown by Asperger patients?
- How can we explain the fact that the delay between first words and first combinations is identical in autistic (14 months) and SLI children; and that it is higher than in normal (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're 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).

In order to test the first assumption, we did Savage-Rumbaugh's test and we constructed a comprehension questionnaire that parents and educators have had to fill in. To test the two last hypotheses, we have done false-belief tests and a corpus comparison.

## 2 METHOD

### 2.1 Participants

Participants were 9 children with autism (3 girls, 6 boys) between 3 years 9 months and 9 years 2 months at the beginning of the study. All children were recruited at the Isatis department of the Saint-Jean-de-Dieu hospital (Lyon, France) where they were initially diagnosed with DSM-IV (1994) Autistic Disorder. They 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 2007).

We have divided children in three groups: first words, first combinations and first phrases, as evaluated relative to mean length of utterance (MLU), i.e., respectively 1, 2 and superior to 2 (Victor, Elliott, Lyne = 1; Matthieu, Charlotte, Félix = 2; Maeva, Ahmed, Grégory > 2).<sup>1</sup>

### 2.2 Procedure

We collected corpora of nine autistic children who are at different stages of acquisition. Children have been (and will continue to be) recorded approximately every three months and during 3 years at the Isatis and Tarentelle medical daycare centers. Children are recorded in three types of situations (work, lunch-time and play-time). We have done Savage-Rumbaugh tests and false belief tests at the end of the first year.

#### 2.2.1 Corpora collection

We transcribed the corpora according to the recommendations of CHILDES (<http://chilides.psy.cmu.edu>), an international project on language acquisition which puts on line corpora in various languages of normal or language impaired children. We then compared our corpora with those of normal children and children with SLI at similar stages of language acquisition which are available on the site of CHILDES.

#### 2.2.2 Savage-Rumbaugh tests

We have adapted Savage-Rumbaugh experiment in order to evaluate the comprehension of our autistic children. Originally, this experiment aimed to compare linguistic understanding between Kanzi (a bonobo in the LRC in Atlanta) and an 18-month-old child, with the following hypothesis: the competence of the bonobo is better than his performance, just as is the case in normal children. Similarly we wanted to see whether, in autistic as in normal children, language understanding precedes language production.

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

- (1) Type 1: A: *Put object X in/on transportable Y*  
B: *Put object X nontransportable object Y*
- Type 2: A: *Give (or show) object X to animate A*  
B: *Give object X and object Y to animate A*  
C: *(Do) action A on animate A*  
D: *(Do) action A on animate A with object X*
- Type 3: *(Do) action A on object X (with object Y)*
- Type 4: *Announce information*
- Type 5: A: *Take object X to location Y*

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<sup>1</sup> The names used have been changed to preserve anonymity.

B: Go to location Y and get object X

C: Go get object X that's in location Y

Type 6: Make pretend animate A do action A on recipient Y

Type 7: All other sentence types.

### 2.2.3 False belief tests

The false belief test is used to assess Theory of Mind. Normal children usually succeed at passing it at around 4 years. We presented to the children illustrated stories inspired by the Sally-Ann test. We tested only the children at the third stage of acquisition.

## 3 RESULTS

### 3.1 Corpora results

We have studied the evolution of the MLU of our children.

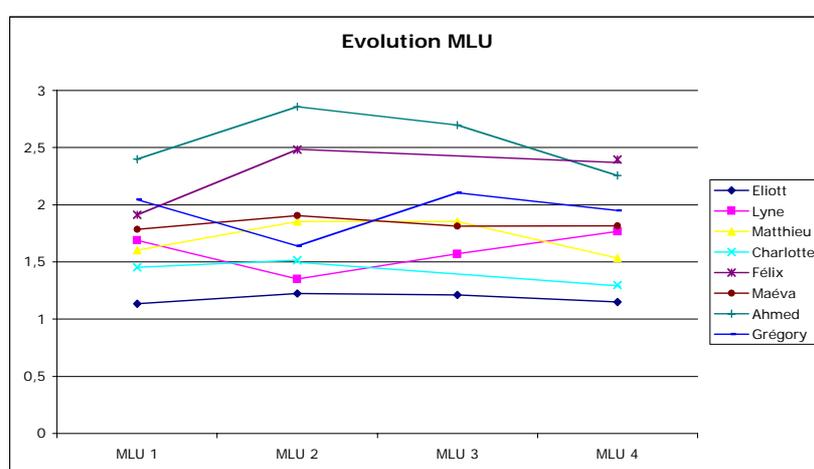


Figure 1

#### MLU Evolution

We can see a current stabilization even if there are big variations between children. For example, Gregory's MLU (in blue) decreases a lot between the first and the second sessions, because of the interruption of the PECS method of communication (which was supposed to allow him to develop a more spontaneous language). Given that it did not work, the educators have come back to the PECS method and his MLU has risen again and is currently stabilising. As another example, Felix's MLU (in violet) increases a lot between the first and the second session. He changes stages of acquisition (first combinations to first sentences). Then his MLU stabilises.

We have compared the MLU evolution of autistic children with that of normal children with identical MLUs at the time of the first session. Whatever the stage of acquisition is at the beginning, the MLUs of normal children increase whereas those of autistic children stabilise or increase only slowly.

We have analyzed the children production with respect to the lexical categories used:

<sup>2</sup> PECS program: the child has to put pictures (representing actions or objects) in the right order. This helps him to produce a grammatical sentence.

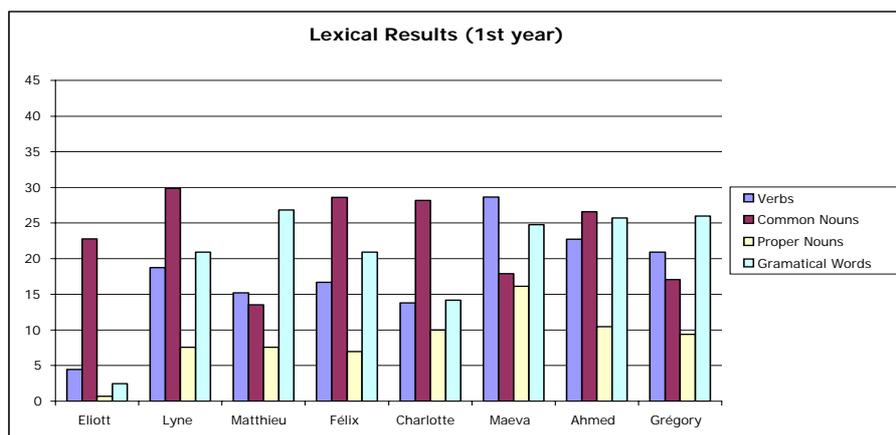


Figure 2

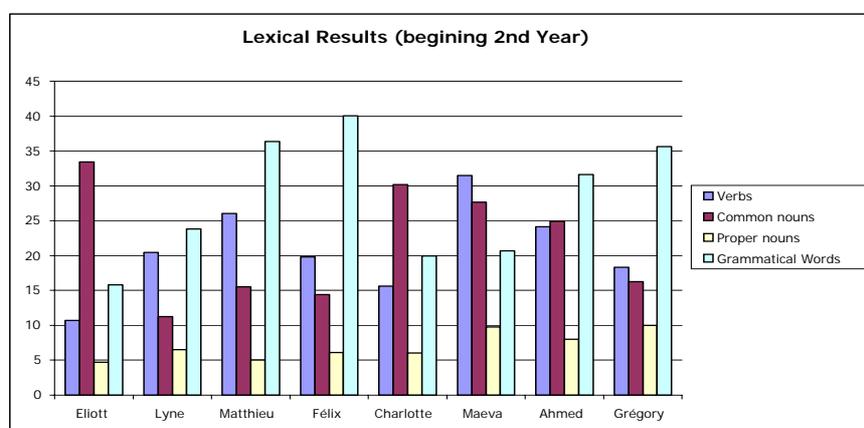
Lexical Results (1<sup>st</sup> year)

Figure 3

Lexical Results (2<sup>nd</sup> year)

However, we cannot isolate homogeneous tendencies in autistic children.

At the first stage of acquisition (represented by Eliott and Lyne), we notice a predominance of common nouns (in keeping with what is observed in normal children). This predominance decreases during the language acquisition process.

At the beginning of the second year, we notice an important increase of grammatical words. In all children, except Eliott, Charlotte and Maeva, grammatical words represent the biggest part of their production.

We have compared the results of the first year for our autistic children with the results of normal and SLI children with an equivalent MLU.

For the comparison SLI/autistic, we notice that SLI children produce a lot of grammatical words compared to their verbs and common nouns production. For autistic children, proportions are somewhat equivalent.

For comparison between normals and autistics:

At the first stage of acquisition, normal children produce the same proportions of each lexical type whereas autistic children produce more common nouns.

This difference dwindles at the second stage of acquisition. Normal and autistic children produce more or less equal proportion of verbs and common nouns. However, normal children produce more grammatical words.

Finally, at the third stage of acquisition, normal children overstep the three-hundred-words point and syntax acquisition is engaged as we can see by the strong proportion of grammatical words. Autistic children have progressed slowly in each lexical type.

We have made a t-Student test on our data. The difference between autistic and SLI children is significant for each lexical type. Concerning the comparison with normal children: the difference is significant only for common nouns for children at the first stage of acquisition. This difference extends to verbs and grammatical words for children at the second stage of acquisition. Finally, at the last stage of acquisition, the difference between autistic and normal children is significant for all lexical types. Thus, differences between autistic and normal children increase with age.

### 3.2 Savage-Rumbaugh results

If we except Victor, all children have more than 60% of correct or partially correct responses.

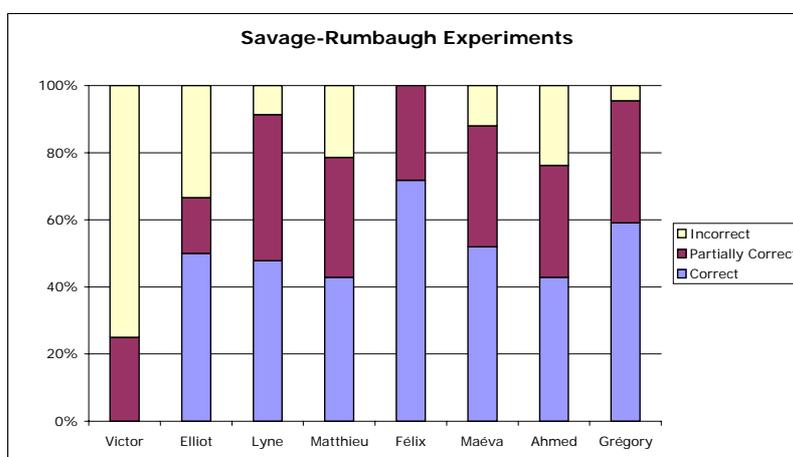


Figure 4

#### Savage-Rumbaugh Results

However, we had to repeat a lot and to reformulate sentences for the children to completely understand what we were asking them to do. For example, for the sentence “Put the fork on the truck,” if the child did not do the action immediately, we had first to say “Take the fork” and, once the child got it, to tell him to put it on the truck.

We investigated which type of errors children make.

- They make errors on verbs: the child does not understand the meaning of verbs. For example if we ask him to show an object, he will give it to someone.
- They do errors on nouns: the child does not identify the object. So he looks at the table to find the object or takes any object and waits for the response of the experimenter.
- They do errors on agent: the child reverses the agent with the patient. For example, we ask the child to push the dog with the car but he pushes the car with the dog.
- They do errors on preposition: the child does not know the meaning of the preposition. For the sentence “put the cat *next to* the house” the child puts the cat *in* the house.
- They do errors on location: the child cannot identify the location mentioned. E.g., we ask the child to fetch his taxi card on his diagram. The child looks around him and moves only if the experimenter shows him where to go.
- Children add an object for the action. For example, when we ask the child to take the doll and to put the pen on the floor, he will put both objects on the floor.

We have compared the errors of our two best children (Félix and Grégory) who are both at the third stage of acquisition.

	Félix (6 years old)	Grégory (9 years old)
Errors on verb	3	3
Errors on object	1	2
Errors on agent	4	0
Errors on preposition	0	1
Errors on location	0	3
Add an object	2	1

*Table 2*

#### Errors Comparison

They do not make the same errors. For example, Félix has difficulties with agency and Grégory does not. In the same way, Grégory has difficulties with location and Félix does not. What seems common to all autistic children is that they have problems with the comprehension of verbs.

### 3.3 False belief results

All children failed this test. It was difficult for them to understand the whole story and it was difficult for us to catch and keep their attention on the story.

## 4 DISCUSSION

Our corpus analysis results show that the MLU of autistic children evolves very slowly, especially compared with that of normal children which quickly increases. The passage from first combinations to first sentences is difficult. It may be due to a lack of referential words (nouns and verbs).

We can propose a tentative explanation, based on the comparison of normal and autistic children on lexical results. During the two first stages of acquisition, the lexical results of normal and autistic children are somewhat equivalent, in terms of the proportion of each lexical group. The true difference concerns the size of vocabulary, which is bigger in normal children. At the last stage of acquisition, the proportion of grammatical words of normal children increases and that of autistic children does not. One possibility is that autistic children do not have enough referential vocabulary to trigger syntax and the grammatical lexicon increases with the progression of syntax.

The linguistic evolution of autistic children remains limited which can be explained by the relative stagnation of grammatical words. The extension of non-grammatical vocabulary is followed by an increase of grammatical vocabulary. Below 250-300 words, production, the MLU and grammatical vocabulary remain limited. So we may insist on the acquisition of non-grammatical vocabulary (in particular on verbs) for various reasons:

- grammatical acquisition remains limited because of the relatively poor size of the lexicon of referential words in autistic children;
- the referential lexicon is more important for communication even though the underdevelopment of the grammatical lexicon limits linguistic expression;

- the hypothesis is that if autistic children reach the 300 words-point, the grammatical vocabulary and syntax would develop rapidly. It is better to be realistic about the possibilities for autistic children to follow the same development as for normal children, but it is nevertheless possible that the increase of referential vocabulary would trigger syntactic development.

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