PROCESSING CONSTRAINTS IN
CHILD FOREIGN LANGUAGE ACQUISITION

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1. Introduction: the nature of processing constraints

The aim of the present study is to determine how memory limitations influence child foreign language acquisition. Before any discussion of how processing constraints affect linguistic processing is attempted, it must be explained what a processing constraint is and where it results from. Processing constraints have many a time been referred to in both L1 and L2 acquisition literature as a possible explanation of observable phenomena (e.g. Olson 1973; Ervin-Tripp 1974; Clark 1978). However, available treatments of processing limitations in child language acquisition literature are either unnecessarily cursory or show a lack of understanding of how memory works and develops. Most of these accounts were written when still little was known about the psychology of memory.

Constraints on linguistic processing were often referred to in the literature on language acquisition in the 1970's but, as there was no attempt to investigate the issue in an empirical way, most of those references were speculations which allowed different authors to reach conflicting conclusions. For example, Bloom concluded that

> The memory load for saying a sentence is presumably greater than for understanding, inasmuch as the individual needs to recall the necessary words and their connections to say them, but these linguistic facts are immediately available to him when he hears them spoken by someone else. (Bloom 1974: 300)

which certainly means that processing constraints should primarily affect spontaneous speech. On the other hand, Clark argued the opposite saying that

> ...it is speech reception that is paced by the speed of other people's utterances, and hence is more likely to suffer because of limited channel capacity. Speech production can take its own time. (Bloom 1978: 397)

Thus, the topic seems to need a re-investigation. In the first place, the findings of experimental psychology have to be considered to obtain an insight into how memory works and to clear a number of misconceptions prevalent in the acquisitional literature. Secondly, it must be established what is affected by processing limitations and in what ways.

The following quote might serve as a typical example of a number of misconceptions related to memory operation:

> One explanation is that memory span and physical ability are not developed enough for the child to produce more than two words in a string. However, in this study, we have similar data even though Paul obviously had the physiological ability and the memory necessary to repeat much longer utterances. For example, at the same time he said 'This+++kite' he could also say such things as 'Okay, this is your turn' or 'I want to open the window.'
> And of course, he spoke much longer sentences in Taiwanese.
> (Huang and Hatch 1978: 124)

In the first place, while it is not surprising that Huang's five-year-old subject had sufficient memory capacity to produce long sentences in his mother tongue, this fact alone is not a legitimate justification to rule out processing span limitations as an explanation for his two-word utterances. This is because an individual's memory span is different for various types of material. Generally speaking, the more familiar the subject is with the subject matter, the better the memory span for a given type of material can be expected, which has been profoundly demonstrated in the psychological literature (e.g. Chase and Simon 1973; Chi 1976; Dempster 1978; Chi and Koeske 1983). Thus, the subject's better knowledge and more skill at using Taiwanese result in higher processing capacity for Taiwanese, which is his mother tongue, than for English, which is just being learnt. It does not come as a surprise then that the learner's memory span for L2 material is lower than for L1 material, which has been correctly recognised by Ervin-Tripp (1974).

Secondly, what we are dealing here with is not memory span for orally presented material that has to be stored and retrieved from the short-term memory, as the case is with repetition. The memory material needed for most of natural speech production consists of language items which have been stored in and have to be retrieved from the long-term memory. This posits limitations of its own, especially considering the subject's tender age. As has been demonstrated by numerous researchers (Belmont and Butterfield 1969, 1971; Ceci and Howe 1978; Perlmutter and Myers 1979), young children often cannot use retrieval or search strategies effectively. This means that it is easier for a child to recall and produce a memorised sentence or phrase, which has been stored in the LTM as a single chunk, than to produce a spontaneous utterance where separate searches have to be carried out for two or more items. Hence, the length of utterances such as *This+++kite* and *I want to open the window* is determined by the organisation of the material to be retrieved, and not by memory span.

Finally, the use of the term memory span in this context is misleading, since this term has traditionally been used in connection with the number of stimuli items that can be simultaneously stored for a limited time. In spontaneous speech production, the subject not only has to retrieve appropriate lexical items from his long-term store but also to perform certain operations on them in order to produce grammatical utterances. All this requires processing space, hence the term processing capacity would be more appropriate. A speaker's processing capacity consists of storage space for active memory material, i.e. both incoming material and items retrieved from the LTM, and operating space for processing that material. As the speaker becomes more efficient at executing a given process or processes, i.e. the processing becomes less controlled and more automatised, less space is required for processing information and more space is freed for storage, and an increase in short-term memory span can be observed (Case, Kurland and Goldberg 1982; Kail and Bisanz 1982).

Having considered the nature of processing constraints, it is obvious that they will differently affect sentence repetition, speech comprehension and production, due to differences in the nature of the processing involved. When asked to repeat a sentence, the subject has to recode the words and grammatical structure of the utterance from the LTM, i.e. identify as already familiar, and store in the STM for immediate reproduction. Recoding has been defined by Chi (1976: 563) as a process whereby two or more stimuli are chunked together if the concatenation produces a familiar third stimulus which must already exist in the LTM in order to replace the two or more items in the STM. In linguistic terms, this means that the sound forms presented for repetition must be identified as familiar words and/or grammatical markers. Recoding may not take place if a recognisable chunk either does not exist in the LTM, i.e. a particular stimulus or class of stimuli is totally unfamiliar to the subject, or the chunk has not been correctly accessed by the subject, e.g. due to low degree of familiarity. From this it follows that the more recoding takes place the more accurate the reproduction will be.

Speech comprehension is similar to repetition in that it also involves recoding from the LTM. STM storage is required for the subject to access the relevant chunks in the LTM, analyse and store the information. Contrary to repetition, it does not require STM storage of the exact forms.

The above presentation of the nature of processing limitations has been based on research carried out in experimental psychology and the implications those findings carry for linguistic processing, which no doubt is a specialised kind of processing. These implications form a theoretical foundation on which the research reported in this paper rests. It has already been shown in a diary study of one child that working memory limitations form a constraint on both speech comprehension and production (Ewert, in press). In this study, data from four subjects have been compared to see how young children process a foreign language. A preliminary typology of memory-related language acquisition phenomena will also be proposed.

2. The study: the subjects and method

This is a diary study of three children aged five to eight who were taught English as a foreign language by the present author. All of them are male and come from middle-class Polish families. Two boys are brothers (KF and WF) and have been taught together for two years. The third child has been instructed individually for one year. The instruction involved two 45-minute sessions per week and consisted of a number of typical EFL activities, such as story telling, role-plays, dramatisations, games, rhymes, songs, arts, etc. An attempt was made to make the activities as appealing for the children as possible and to make the linguistic input the children received resemble that L1 learning children receive. More language was presented during the sessions than the children were expected to actively use during the lesson. This language for comprehension has also been carefully graded both structurally and lexically and presented mainly in story-related activities. All the children had received some instruction in English before the experiment but the results were minimal. Two children (KF and WS) also attended English lessons at their kindergartens twice a week for one year during the experiment. None of the children had any contact with native speakers of English. For comparison, where this is relevant and informative, data from a fourth child, Witek, (discussed separately in Ewert, in press) has been provided. Table 1 lists the children's ages at the beginning of instruction and the number of sessions each of them received. For KF and WF the number of sessions for each respective year has been given separately. The number of sessions for Witek has not been given as he received shorter sessions on a daily bases in the relevant period, i.e. the first two years of instruction.

Table 1

Name	Age at the beginning of instruction	Number of sessions received
Witek	4;3	
WF	7;2	51+43
KF	5;4	51+43
WS	6;3	40

As there were considerable differences between the children in attitude and learning style, a test was administered to establish an overall level of linguisitic functioning. WF and KF were tested in session 2.44 (44th session of the second year of instruction). WS was tested in session 1.41. All the children were tested individually.

3. The test: results and discussion

The test consisted of four tasks: description of a picture, recall of nouns, recognition of nouns, comprehension of questions. No time limit was set, the children were allowed as much time as they needed to complete each of the tasks. The test tasks are discussed here in the order in which the children were asked to perform them.

Picture description. First, the children were asked in L1 what they can see in a picture from the textbook they were using (Concari *et al.* 1990: 33) to check if they understood what they were expected to do. Then they were asked to describe the picture in L2. The subjects were explicitly instructed to describe it in complete sentences. No cues as to the contents of their descriptions were provided in L2 before or during the description.

While performing this assignment, KF produced three words, which were uttered so quietly as to be incomprehensible, and concluded that that was all he had to say. WF produced three sentences, quoted here in full. WS produced eight sentences – three representative sentences are quoted below. For comparison, three sentences produced by Witek on an identical task towards the end of the second year of instruction are also provided. For each sentence, a gloss has been added in brackets extending the intended meaning and translating the L1 intrusions. The intended meaning was easy to guess in each case both from the picture and the child's gestures (pointing).

WF 2.44:   *Totty is dance doll.* (Totty is dancing with a doll.)
             Chubby's mum bije brawo. (Chubby's mum is clapping.)
             Mrs Mouse is eat... mmm... cheese. (Mrs Mouse is eating cheese.)

WS 1.41:   *Pussycat trump... gra na trąb... gra na trumpet.*
             (Pussycat trump... is playing trump... is playing the trumpet.)
             Little mouse hand, hand, hands up, a w jednej dłoni trzyma nie toys, tylko powiem jakąś zabawkę.
             (The little mouse has raised her hands, and in one hand she's got not toys but I shall say some toy.)
             Mouse (incomprehensible) eating chch... , zaraz, ch... ch... cheese.
             (The mouse is eating chch..., a moment, ch... ch... cheese.)

Witek: *Mysz piano.* (The mouse is playing the piano.)
             Pussycat's guitar. (Pussycat is playing the guitar.)
             Mrs Mouse eating chair. (Mrs Mouse is eating cheese.)

The results show clearly that the children could hardly keep the two codes apart. Code-mixing occured when a child did not know the word or, most frequently, could not access it momentarily. Momentary problems with accessing the LTM store are exemplified by both hesitations:

WF: *... mmm... cheese*
WS: *chch... , zaraz, ch... ch... cheese*

and the following pairs co-occurring in the children's utterances:

WS: *trump*(et) - *trąb*(ce) - *trumpet*
                toys – zabawkę
                hand – dłoni
Witek: *mysz – mouse*

Recalling the necessary words is clearly the greatest obstacle for successful production for all the children. It can be hypothesised that getting access to the right entry in the LTM store took so much processing space as to affect the structure of the children's utterances (on the level of performance). Each of the four children employed a different strategy to deal with this increased processing load:

1. KF did not even attempt to produce utterances longer than one word;

2. WF (the oldest at the time of testing) used a sentence frame:

     subject+is+verb+object

to decrease the processing load;

3. WS constructed his utterances predominantly in L1, translating into L2 those words or fragments that he could. He was the only one of the four who used incomprehensible fillers for words he could not remember;

4. Witek (the youngest at the time of testing) concentrated so hard on recalling the nouns that he forgot to insert the verb into the utterance (when the verb is correctly recalled, the noun is not, i.e. chair instead of cheese). This strategy led him to producing mostly two-word utterances. It must be emphasised here that, contrary to WF and WS, he never hesitated in mid-sentence looking for words.

Noun recall. The children were shown a number of pictures (see Appendix 1 for a complete list) presenting objects whose names had been introduced in various instructional activities throughout the period in question. They were asked to name the object in L2. Table 2 shows the percetages of correctly recalled items for the three subjects.

Noun recognition. The same pictures as in the previous task were shown in random sequences. The children were asked to point to the relevant picture on hearing its name spoken in L2. Table 2 shows the percentages of items correctly recognised by the three subjects.

Table 2. Noun recognition results

Subject	Percentage of correctly recalled nouns	Percentage of correctly recognised nouns
WF	64.62	96.92
KF	53.85	90.77
WS	64.29	92.86

The difference between the recall and recognition of nouns is not surprising in the light of research in experimental psychology and shows that foreign language vocabulary acquisition (i.e. the acquisition of sound forms) is subject to general memory limitations. It should be emphasised here that it has not happened in a single instance that a child would recall a word that he could not recognise. This means that all the recognised words have been successfully stored in the child's long-term memory. Hence, the lack of recall cannot be equated with lack of acquisition.

Question comprehension. Another picture from the same textbook was used for this first task (Concari *et al.* 1990: 17). The children were told explicitly that the aim of this part of the test was to determine if they understood the questions asked by the experimenter (see Appendix 2 for a list of questions in the order in which they were asked). If a child was unable to answer any of the questions, it was repeated and then paraphrased wherever this was possible. Except Question 8, no nonverbal cues were provided. The children were instructed to answer the questions in either L1 or L2, whichever was more convenient for them.

WF answered correctly all of the questions, WS answered all but the first one. KF showed comprehension of only half of the questions asked. Table 3 lists the questions he did not answer on the left-hand side (as well as the paraphrases), and those he understood immediately on the right-hand side.

Table 3. Comprehension of questions results (KF)

Questions KF did not answer	Questions KF answered
1. Who can you see in the picture? Who's in the picture?	5. Who's sleeping?
2. Where are Mum, Dad, Simon and Lottie? Where are they?	3. Where's Lottie?
7. What's Mum saying? Guess. Guess what Mum's saying.	4. What's the cat doing?
9. Do you like cake?	8. What's this?
10. How many chairs can you see? Count the chairs.	6. What has Mum got?

A brief glance at Table 3 is enough to see that it was not the question words *who, where* and *what* that inhibited KF's comprehension of questions. As a matter of fact,

it is difficult to establish if he distinguished between them or not. This conclusion is suggested if one compares answers to pairs of questions from both columns, i.e. Questions 1 and 5, 2 and 3, 7 and 4. In the case of Questions 1 and 7, it seems that the subject did not comprehend the following fragments respectively: *can you see in the picture* and *saying*. A similar interpretation, however, will not hold for Questions 2 and 3 since all the proper names were very familiar to all the children. Moreover, the perceptual difference between *Where's* and *Where are* does not seem to be significant enough to block comprehension.

It seems then that analysing the beginning of a question was not for this child crucial for its comprehension. It is possible that he simply did not pay attention to the beginnings of the questions. It is even possible that he just could not hold them in the short-term memory for long enough to analyse the meaning of the whole sentence. This interpretation becomes more probable if one considers the fact that the questions he did not comprehend contain on average 5.6 words each (4.7 words if the paraphrases are included as well), while those he did comprehend contain on average 2.8 words each.

As it has already been pointed out, it is not certain if KF comprehended the interrogative pronouns at all. It is possible that he processed only the ends of the questions and induced their meaning using cues contained in the picture. If this is true, then KF's processing of the questions would look more or less like in Table 4.

Table 4. Approximation of KF's processing of questions

Question number	Recoded and stored fragment of the question	Visual cues	Response
2.	... Mum, Dad, Simon and Lottie?	all of them are in the picture, Mum and Dad are standing, Simon is sitting at the table, Lottie is in the tree	none
3.	... Lottie?	Lottie is in the tree, only her legs can be seen in the picture	correct
4.	... cat doing?	the cat is drinking milk	correct
5.	... sleeping?	only the puppy is sleeping	correct
6.	... Mum got?	Mum has got a glass of milk in one hand and a cup of cocoa in the other	correct

This interpretation is in accordance with Ervin-Tripp's (1974) claim that foreign language learning children base their comprehension on those items which survive best in the short-term memory, i.e. those in the sentence-initial or sentence-final position. In KF's case this is the sentence-final position. In psychological terms, this recency effect means that the subject processes the material in most rudimentary ways and has not as yet developed any strategic behaviours to effectively process the input (cf. e.g. Flavell 1970). This, in turn, means that he regressed on processing strategies considerably as compared to his L1 and has to relearn them.

4. The diaries: description of child foreign language learners' linguistic processing

The diary data have been analysed to pinpoint any of the four children's linguistic behaviours that might have been influenced by processing span deficiencies. Six types of phenomena related to insufficient processing space have been identified, although none of the children has demonstrated all of these behaviours. In the examples that follow the children's utterances are printed in bold italics.

(i)   *Allocation of attentional resources to a specific task may leave none left for STM storage.*

This type of behaviour has been most clearly and consistently displayed by WS. In a number of sessions he was asked to carry out a number of instructions. Immediately after he performed the desired activity, he was asked a question related to it. In most instances, he had no problems with understanding the instructions but could not answer the questions asked:

WS 1.6, 1.7, 1.8, 1.9: *Jump! What are you doing?* ...
WS 1.28, 1.30:   *Go to the kitchen. Where are you? Nie wiem... Chair.*
(I don't know... Chair.)

He was not only unable to carry out the transformations required to produce a correct answer, but he was also unable to repeat the instruction when explicitly asked to do so immediately after having performed the action. *Chair* was at that time a dummy word he used fairly consistently when he could not recall a name of a room or furniture item.

(ii)   *Processing constraints may affect comprehension, e.g. the strategy of focusing on key words has to be relearned.*

This phenomenon has already been discussed above for KF and separately for Witek (Ewert, in press), who was unable to hold in the STM both the agent and the action in a recognition task despite perfect comprehension.

(iii)   *Processing strategies have to be reconstructed, e.g. substitution has to be relearned.*

The following sentences are the first recorded instances the children ever used substitution spontaneously. WF's utterance was recorded immediately after the training session when he jumped off a sofa and commented on what he was doing. KF's utterances were produced in a session when the children were playing with puppets and are the longest sentences he has ever produced in L2. Witek's sentence was produced during a holiday after the first year of instruction. Spontaneous use of substitution has not been recorded for WS.

WF 1.27:   *I is jumping.*
KF 2.41:   *I'm going to the zoo/garden,* etc.
Witek: *I like this tea... and I like this sugar... too.*

WF's and KF's sentences are related to sentences the children most frequently heard and practiced during the training sessions. Witek's sentence is a variation of a dialogue line he heard several months earlier (*I like your bed and I like this cocoa, too*).

(iv)   Available processing span restricts utterance length, although individuals may opt for varied production strategies to reduce the processing load.

This phenomenon has been first observed in Witek (Ewert, in press), whose utterances, produced at approximately 2 week intervals, cannot be explained by simple forgetting as acquisition of the relevant vocabulary and sentence structure is evidenced by other diary entries for that period.

Witek: *Simon's making a house. No, Simon's making a car.*
Witek: *The dog playing bębenek.* (The dog is playing the drum.)
Witek: *Pussycat guitar. ... Pussycat's guitar.* (Pussycat is playing the guitar.)

The first of these, along with other similar utterances, was produced when he was asked to identify sentences describing a picture as true or false. He spontaneously corrected all of the false sentences providing a grammatically correct version of each. In terms of processing, this task was relatively easy for the subject, as all he had to do was to recode and store in the STM the sentence he heard, recall one word from the LTM and substitute it for the incorrect one.

The second sentence, along with other similar ones, was produced in a different task, which was relatively more difficult than the first one. Here the subject had to describe on his own a scene consisting of several toy animals playing various musical instruments. A model was provided as well, but this time the subject had to recall two nouns: one for the subject and one for the object. As can be seen from the example, the subject was not able to meet these recall requirements. Moreover, these increased recall requirements can be held responsible for loss of the auxiliary. It must be observed here that the subject begins the utterance correctly but is not able to finish it correctly due to processing constraints induced by increased recall requirements.

The third task was a description identical with the first test task described above. This was clearly the most difficult as it required the recall of two nouns and a verb. Allocation of additional attentional resources to vocabulary recall totally disrupts the grammatical structure of the whole utterance, which in most cases leads to two-word verbless utterances. A remarkable oddity is a sentence containing an auxiliary but no verb, i.e. *Pussycat's guitar*, as a self-corrected version of *Pussycat guitar*.

Similar two-word utterances have been recorded for both KF and WS:

KF 2.28:   *I'm guitar.* (I'm playing the guitar.)
WS 1.33:   *Podge piano.* (Podge is playing the piano.)

However, since none of them produced sentences containing progressive verbs at that time, these two-word utterances must be of slightly different origin. This issue will be discussed below in Section 5.

It has already been noted that a very young foreign language learner may not be able to store two semantic units in the STM for long enough to demonstrate comprehension of a sentence. Slightly older beginners display a processing deficiency which makes it difficult for them to construct three-word utterances. How difficult it is can be seen from the following early utterance by WS:

WS 1.23:   *Don't coke!*

This was produced in a game-like activity in which his task was to tell the wolf (a puppet) not to consume particular items of food or drink (pictures). When it was pointed out to him that some word denoting activity is missing from his sentences and examples of desired output provided, he produced sentences of the type:

WS 1.23:   *Don't milk drink!*
WS 1.24:   *Don't eat milk!*

With age and practice vocabulary recall becomes more automatised. However, the need to allocate more attentional resources for successful vocabulary recall influenced utterance length even in the oldest and most mature learner of the four children compared. While discussing the contents of a picture story, WF said:

WF 2.43:   *But where is Shorty? Shorty is in the car.*

Immediately after this response a picture of Shorty (a dog) was put in different locations on a cross-section of a house and a question asked:

WF 2.43:   *Where's Shorty? Shorty in the kitchen/bedroom,* etc.

After each response a correct model was provided and Shorty was put in a different room. In spite of this WF continued to omit the copula. It cannot be argued here that he did not perceive the copula since he spontaneously produced it seconds earlier in an almost identical sentence while no model was available. The explanation

here is that *car* was for him a well-known and frequently used word whose recall had been automatised, while the names of the rooms were consistently poorly recalled and their recall was still controlled.

Two of the children developed and consistently used some strategies to deal with increased processing load. WF consistently used sentence frames:

WF 2.28:   **The Mrs Squirrel is playing the drum.**

WF 2.42:   **The Simon and Lottie are going in Tom house.**

He never produced the definite aritcle in front of proper names in contexts other than describing actions, which is sufficient evidence that this constituted part of a memorised sentence frame and not a cognitive guess about the linguistic system of the L2. Increased use of substitution and sentence frames allowed him to produce longer utterances towards the second year of instruction of the four children compared. He often attempted to speak in complete sentences even when this was not required, e.g. while answering wh-question. He even attempted to tell stories in L2, in which he only partially succeeded due to problems with recall of the necessary vocabulary and lack of sufficient communication strategies in case he did not know the required words. The second example above was produced in such a story-telling activity.

WS resorted to a strategy of producing incomprehensible fillers whenever he did not remember the necessary words or was not certain what word or words to use in a sentence. The following examples were recorded when he was asked to repeat dialogue lines from a story:

WS 1.33:   *Let's visit my star.* [incomp] *my star.*
             Let's go in my spaceship. [incomp] *in my spaceship.*
             I've got my spaceship in the garden. [incomp] *spaceship in the garden.*

All those incomprehensible fillers reproduced faithfully the rythm and intonation of the model sentences. Apart from this, he sporadically pretended to speak English or even tell stories in L2. All those attempted productions contained some English words and lots of filler syllables. All sounded incredibly English-like in terms of rythm and intonation and all were meaningless.

(v)   Recall cues can extend utterance length.

This was most spectacularly demonstrated by WF in session 1.32. In the preceding sessions he demonstrated uniformly poor recall of the names of the rooms in a house. In session 1.28 he correctly recalled 2 out of the 4 words previously introduced and practiced, in session 1.29 1 out of 4, and in session 1.30 he did not recall any of the words at all. No recall cues were provided at that time. None of the 4 words in question appeared in any context in session 1.31. After session 1.32 the boys' mother came to collect them and asked about their progress. WF opened his notebook on a page containing a cross-section of a house with all the rooms labelled, which the boys made several weeks ago. In the picture there were altogether 8 items

located in the different rooms. The names of the rooms were the only written words on that page. Then WF proceeded to describe the picture in complete sentences:

WF 1.32:   **The car is in the garage**, etc.

No model for this description was provided and that was the first time he ever produced complete sentences of this type.

(vi)   Processing constraints may interfere with monitoring utterances.

In session 2.29, while we were discussing a picture story, the following exchange took place:

WF 2.29:   *Who lives in this house?* **In this house lives is Mr Owl.**

Then, WF asked to have his utterance translated into Polish as he was not certain what he had actually said. He knew he had made some mistake but he could not remember what he had actually said. A brief moment of hesitation between *lives* and *is* and visible determination with which he finished the sentence after that permit a speculation that it was at that particular moment when he lost control over what he was saying, which resulted in the unnecessary insertion of *is*.

5. Perception, memory and learning

There can be no doubt that perception plays a crucial role in all learning. However, it seems very difficult to estimate what young learners perceive of the structure of the language they are learning. It certainly cannot be assumed automatically that the learners perceive accurately everything that they can hear. For example, WS did not perceive the contracted forms when he was asked to repeat sentences:

WS 1.11:   *Granny's making cocoa.* **Granny is making cocoa.**

Here he clearly recoded *Granny's* as *Granny is*. It seems that both *Granny* and *is* were part of his long-term store at that time while the contracted form was not. However, sentence repetition is not a reliable tool for tapping the learner's language perception since what it tests is short-term retention of the model in the first place. Consider the following example taken from Slobin and Welsh (1973):

Echo: *Mommy ate the candy and mommy ate the ice cream.*
             Mommy eat the ice cream and mommy eat a candy.

The clearly existed in Echo's long-term store as she reproduced it in one proposition, and there seems to be no reason why she should not have perceived it in the other proposition. However, as she often reversed the order of the propostions in the repetition tasks, it seems that she had developed a particular strategy for dealing with these long sentences: she would first reproduce what was still fresh in her short-term memory and then attempt to reconstruct what was not so well remem-

bered. In this way, an elicited imitation task becomes a short-term memory test. Therefore, if something has been immitated accurately, it must have been perceived accurately as well. However, if something has not been immitated accurately, it means that it either was not perceived or not remembered. Only if something has been remembered it can be subsequently analysed by the subject. Hence, in examining the role of memory in language acquisition we must be cautious that it comes between perception and cognitive analysis.

In the preceding section it has been analysed how processing limitations influence speech comprehension and production in a young language learner. In this section it will be analysed how processing limitations influence language learning. The examples that follow are a complete list of all the utterances of one learner (WS) learning to say that someone is playing a musical instrument produced in two consecutive sessions.

In session 1.33 WS was shown a picture in which five characters were playing musical instruments. At first, he was asked what instrument each of the characters was playing to revise the names of the musical instruments:

WS 1.33:   *What is Podge playing? Podge piano.*

This utterance was expanded:

            Yes, Podge is playing the piano,

to which he apparently paid no heed as he continued:

WS 1.33:   **Simon drum.**
            Lottie trumpet.
            Dodo maraca.
            And Tolly maraca.

Then a toy orchestra was assembled in which four toy animals were playing a different instrument each. The experimenter acted as an absent-mided announcer who frequently made mistakes and the role of WS was to correct the false statements:

WS 1.33:   *The cat is playing the trumpet. No, piano.*
            The monkey is playing the piano. No, maraca.
            The bear is playing the trumpet. No, drum.
            The dog is playing the maraca. No, trumpet.

Then WS was asked to say what each of the animals was playing:

WS 1.33:   **The cat is playing piano.** *Yes, the cat is playing the piano.*
            Monkey is the maraca. *Yes, the monkey is playing the maraca.*
            The bear is drum. *The bear is playing the drum.*
            Dog is the trumpet. *The dog is playing the trumpet.*

In session 1.34 this procedure was repeated. Correction in the form of expansions was again provided but less systematically as his production was somewhat more fluent:

WS 1.34:   (describing picture)
            Podge is playing piano.
            Lottie is playing trumpet.
            Simon is playing drum.
            Dodo is playing maraca.
            And Tolly maraca.
            Yes, Podge is playing the piano, Lottie is playing the trumpet, Simon is playing the drum, Dodo is playing the maraca, and Tolly is playing the maraca.
            (practice with toys)
            Monkey is playing the maraca.
            Cat is playing the drum.
            Bear is playing the trumpet.
            Puppy is playing the piano.

This sequence illustrates how the learner gradually moves from two-word utterances to almost accurate sentences. The utterances produced while describing the toy orchestra in session 1.33 show that he was able to perceive all the sentence constituents but, since all the processes necessary to produce a grammatical sentence were not sufficiently automatised yet, the sentences show a lot of variation. It seems that he has reached some kind of realisation that the target sequence should consist of six items but he has reached sufficient automatisation of the component processes to produce serially only three items:

(animal) – is – (instrument)

plus a fourth randomly selected item. In the picture description task in session 1.34 he displays a larger degree of automatisation as almost all the sequences produced show a stable pattern:

(person) – is – (playing) – (instrument).

This sequence is further developed in the last task in these two sessions:

(animal) – is – (playing) – the – (instrument).

It must be emphasised here that this learning sequence described here does not show how the learner learns to simply remember more words, but it shows how the learner learns to execute and coordinate all the processes necessary to construct an utterance.

6. Conclusions

There is ground to suspect that both L1 and L2 learners in naturalistic environments process language in a similar fashion as many of the phenomena discussed in this study have already been described in the acquisitional literature, for example gradual learning to comprehend longer utterances in L1 (e.g. Huttenlocher 1974), the use of sentence frames and substitution (e.g. Clark 1974, Moerk and Moerk 1979, Hakuta 1974), reproducing the melody but not the words (Peters 1977), switching to L1 when the learner cannot remember particular words (Swain and Wesche 1975).

The above presentation shows that the role of memory and processing span in language acquisition is a very complex one and should be analysed both synchronically and diachronically. A fuller understanding of it can be reached when we are able to identify all the processes necessary to comprehend and produce speech and demonstrate when and how the learner masters them. Pedagogical implications of this research should be examined as well to see if and how a learner's processing can be improved.

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APPENDIX 1

List of nouns used in the recall and recognition tasks.

1. sun
2. cow
3. pig
4. sheep
5. apple
6. milk
7. cocoa
8. cake
9. chick
10. hen
11. puppy
12. sweater
13. jacket
14. sofa
15. sandwich
16. cheese
17. butter
18. yoghurt
19. tree
20. cat
21. chair
22. table
23. bed
24. cupboard
25. garden
26. house
27. piano
28. drum
29. trumpet
30. maraca
31. train
32. shoes
33. farm
34. bike
35. truck
36. flower
37. jeans
38. boat
39. plane
40. beach
41. spade
42. umbrella
43. bucket
44. ball
45. guitar
46. hat
47. scarf
48. coat
49. squirrel
50. nuts
51. elephant
52. lamb
53. monkey
54. duck
55. duckling
56. kitten
57. meat
58. bread
59. eggs
60. sweets
61. zoo
62. fish
63. horse
64. carrots
65. basket

APPENDIX 2

List of questions used in the comprehension task

1. Who can you see in the picture?
2. Where are Mum, Dad, Simon and Lottie?
3. Where's Lottie?
4. What's the cat doing?
5. Who's sleeping?
6. What's Mum got?
7. What's Mum saying? Guess.
8. What's this? *(experimentor points to cake)*
9. Do you like cake?
10. How many chairs can you see?