The Acquisition of NP-Trace in English

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1. Introduction

How the passive construction is learned has been one of the important issues in the study of language acquisition. (See Pinker (1982), Berwick & Weinberg (1984), Borer & Wexler (1984), Maratsos, Fox, Becker, & Chalkley (1985), Lebeaux (1985), Teng (this volume), among others.) It seems that it is an established fact that children learn the passive of actional verbs earlier than the passive of non-actional verbs. That is; (1) is learned earlier than (2), for example.

(1) Bill is hit.
(2) Bill is hated.

All theories which deal with the passive construction must answer the question why this is the case, and indeed this has been a main issue of study. In this paper, we will, however, focus on the theory of empty category acquisition, another important aspect involving the acquisition of the passive construction. I will argue, as opposed to Borer & Wexler(1984), that very young children do have an NP-trace in their passive construction. We will see the results of two experiments that clearly suggest that this is the case.
Let us consider the passive construction first.

2. Passive Construction

There are two types of passive construction in adult grammar; verbal and adjectival. Adjectival passive participles can be distinguished from verbal ones by the criteria below. (See Wasow (1977) and Levin & Rappaport (1986)).

(3)a. Negative \textit{un-} attaches to the adjective and thus to the adjectival passive participles, but not to the verbal ones.

- unshaven, unmarked, untouched
- *unhit, *unkilled, *unkicked

b. Adjectival but not verbal passive participles appear after \textit{seem, remain, sound}, and \textit{look}.

The vase seems broken.

- *Bill seems hit.

c. Adjectives but not verbs appear prenominally.

- broken toy
- *killed man

In adult grammar, adjectival passives are lexically-generated, as opposed to the syntactically-generated verbal passives.

Borer & Wexler (1984) argue that children's passives are all adjectival. These are not syntactic passives like adults' verbal passives. The reason why children do not have syntactically-generated verbal passives is because they do not have a mechanism of A-chain formation. Only after the A-chain formation becomes available, that is; only after children mature to that stage, do syntactic verbal passives become possible. In other words, young children do not have an NP-trace in their passives.

Since NP-movement, which is involved in the passive construction, is structure-preserving, as opposed to WH-movement, it is unclear whether there is an empty category in children's passives. It seems possible that children understand passive participles as adjectives.

I will argue, however, that the children's passives are in fact syntactic verbal passives. Thus children do have an NP-trace at a very young age.
experiments were conducted with three, four, and five year olds.

Lebeaux (1985) argues that children have an NP-trace in their grammar. He argues that what motivates the placement of a trace is the notion of affectedness. He proposes that children have a constraint which says that if an argument is [+affected], then it is an internal argument. This constraint, called "Affected Argument Constraint" (AAC), is claimed to be a part of Universal Grammar (UG), and a child identifies the word order of his language using this constraint. Since the [+affected] argument is an internal argument, if it occurs after the verb, the language is a head-initial language. If it occurs preceding the verb, the language is a head-final language.

When a child hears a sentence like "Bill is hit", he assumes that Bill originates in the object position because it is a [+affected] element. Thus he posits a trace in the object position. On the other hand, a child cannot posit a trace in the object position when he hears a sentence like "Bill is hated". Bill is not an affected argument. Thus Lebeaux argues that the AAC is the cause for the delay of the acquisition of non-actional verb passives. The surface subject of non-actional verb passives is [-affected]. Lebeaux claims that children undergo five steps in the acquisition of passives.

(4) 1. The passive form is recorded from surface structure.
    2. In passives where a [+affected] element moves, a trace is posited by the AAC.
    3. A chain is formed. Since a chain is always Case-marked, a child finds out that the object position is not Case-marked.
    4. A child notices that passive morphology absorbs Case since verbs usually Case-mark objects.
    5. Passive is grammaticalized.

Note that the AAC is present in adult grammar as well. As noted in Anderson (1978) and discussed in Lebeaux (1985), it plays a role in the passivization of nominalization. (For the AAC's role in compound and middles, see Roeper (1985).) The [+affected] object in a nominalization can be raised to the subject position, as shown in (5), but not the [-affected] object, as in (6).
city's destruction
town's development
crop's damage
problem's solution
goal's accomplishment

*play's enjoyment
*rule's observation
*mosquitos' attraction
*desire's satisfaction

The fact that the AAC is present in adult grammar supports the claim that it is part of UG, and provides strong support for Lebeaux's claim that the AAC is a trigger for positing a trace in the passive construction in children's grammar.

Let us now consider the "Adjective hypothesis" proposed by Borer & Wexler (1984). They argue that children's passives are adjectives because they do not use by-phrases with their passives. B & W claim that adjectival passives do not have agents, and thus no by-phrases. However, as Tom Roeper points out, adjectival passives do have a sense of agency, as shown below.

(7)a. a bounced ball
    b. a stuffed animal
    c. a moved doll

The phrase in (7a) means "a ball which is bounced by someone", not "a ball which bounced". The phrases in (7b) and (7c) also mean "an animal which is stuffed by someone", and "a doll which is moved by someone" respectively. Thus adjectival passives can have implicit agents. For a detailed discussion of implicit agents, see Roeper (1984, 1986). Therefore, a lack of the sense of agency cannot be the reason for children to understand all passives as adjectival passives.

Borer & Wexler cite the work of Horgan for their claim that the reason why children do not use by-phrases is because their passives are adjectival. However, the percentage of children who use by-phrases is not very low. In Horgan's experiment, 19.2% of the girls and 6.45% of the boys, who were between 24 months and 48 months used by-phrases. If children's passive were all adjectival, we would expect no or little manifestation of by-phrases.
3. Construction of the Experiments

In order to examine the presence or absence of an NP-trace, one must consider the whole array of constructions which involves an NP-trace. We should especially look at a construction whose interpretation depends on the presence of an NP-trace. Thus the passive of the resultative construction was chosen. Examples are shown below.

(8)a. Bill made the room clean.
   b. The room was made clean.

(9)a. John painted the house red.
   b. The house was painted red.

In the active sentences in (8a) and (9a), the adjectives following the verbs indicate the result of the action. This resultative reading is maintained even when the sentences are passivized, as in the (b) sentences.

The structure of the resultative construction is considered to involve a small clause. For a discussion of small clauses, see Stowell (1981) and Kayne (1984). The structure is shown in a tree below. SC stands for a small clause.

(10)

```
IP
  / \
 NP  I'
   / \
  VP  I
     / \
    V  SC
       / \
      NP* Adj
```

The sentences in (8) and (9) do not yield resultative readings without adjectives, as shown in (11) and (12).

(11) Bill made the room.

(12) John painted the house.

Thus we can conclude that the string of "NP* + Adjective" yields the resultative interpretation. Even when sentences are passivized, the trace remains in the NP* position, and the string of the trace + Adjective yield a resultative reading. Thus if children have an
NP-trace in their grammar, we would expect them to understand passives like (8b) and (9b) with resultative interpretations.

Note that the small clause analysis of the resultative construction is not crucial to our claim. The structure could as well be as shown in (13), where the NP* is not a sister of the adjective.

(13) IP
       / \         
      NP  I'     
          / \       
         VP  I      
            / \     
           V'  Adj   
              \   
               V  NP*

Our point is that it is the string of NP* + Adjective that yields the resultative interpretation. Thus in order to have a resultative reading in a passivized sentence, a trace must be posited in the original NP* position.

Let us consider what the "Adjective hypothesis" predicts. If children did not have a trace in the NP* position and understood the passive participles as adjectives, there would be two ways of analyzing, as shown in (14) and (15).

(14) The room was $\text{Adj}[\text{made clean}]$.

(15) The room was $\text{Adj}[\text{made}] \text{Adj}[\text{clean}]$.

In (14), the string of the passive participle and the adjective is considered to be a compound adjective. In (15), the passive participle is understood to be an adjective followed by another adjective, a kind of coordination structure.

The prediction that (14) makes is as follows. Since the whole passive participle and the adjective is a compound adjective, we would expect it to appear prenominally, as in (16) and (17), in children's grammar. However, this is not the case.

(16) *the made-clean room

(17) *the painted-red house
If these sentences were understood as in (15), that is; as a coordination structure, we would expect a resultative interpretation to be given consistently. The sentence in (15) would be exactly like (18), where two adjectives separately modify the Noun.

(18) The big house is red.

If the two adjectives modified the Noun house independently from each other, (18) could be paraphrased as (19). They would have the same denotation.

(19) The red house is big.

Now, if (15) were the children's analysis, it should denote the same thing as (20-23).

(20) The room was Adj[made] and Adj[clean].
(21) The room was Adj[clean] and Adj[made].
(22) The Adj[clean] room was Adj[made].
(23) The Adj[made] room was Adj[clean].

Although children might understand it as resultative if they analyze the passive as in (20) and (23), they could as well analyze it as non-resultative as in (21) and (22), since there is nothing to make them prefer or force the resultative interpretation.

Now the prediction is clear. The resultative reading is forced if children have an NP-trace. If not, we should see both the resultative and non-resultative interpretation of the construction.

4. Experiments

4.1 Experiment I

Two experiments were conducted. The first one involved the small clause construction with the verb make. The subjects were eight three year-olds, five four year-olds, and six five year-olds. A short story was presented with two pictures before each set of

\[1\] The sentence in (23) is ungrammatical in adult grammar, but should be good in children's grammar if made were an adjective.
questions. There were eight sets of questions. Each set consisted of one active sentence, one small clause (SC) active sentence, one passive sentence, and one SC passive sentence. An example is shown below.

(24) Story: Oscar the grouch built a house. He wanted it messy. So his friend Big Bird put the dirt into his house.

Pictures: One with Oscar standing near the house with a hammer, and one with Oscar and Big Bird standing near the house, which has dirt in it.

Questions: 1. Was the house made? (Yes/No) (If yes,) Who did it? 2. Was the house made messy? (Yes/No) (If yes,) Who did it? 3. Who made the house messy? 4. Who made the house?

One three year old, who did not answer correctly to the SC active sentences, is excluded from the discussion below. This indicates that he did not understand the small clause construction in general. The stories used in the experiment are shown in Appendix I.

The results of the experiment were surprising. All the children, except for one four year-old, answered correctly, as shown in Table 1.

<table>
<thead>
<tr>
<th>Construction</th>
<th>Percentage Correct, Experiment I</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 years</td>
<td>4 years</td>
</tr>
<tr>
<td>Passive</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>SC passive</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>Active</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>SC active</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

There was one four year-old, who answered incorrectly the SC passive sentences, while answering correctly the regular passive sentences. One could argue that she is in a stage where the NP-movement of the direct object is possible, but not from inside of a small clause. But then we do not have an explanation for why all the three year-olds answered the SC passive sentences correctly. In fact, none of the three year-olds were confused. They answered very confidently.
Some children's answers suggest that the subject-predicative reading is also available for the SC passive sentences, although it is not available to adults. The sentence, "The house was made messy," is understood in such a way that the adjective messy modifies the subject the house. The paraphrase is "The messy house was made". Two children showed the availability of the subject-predicative reading as well as the resultative reading. Their answer to the question, "Was the house made messy?" was "No. It wasn't messy at first, but it was MADE messy later," with a stress on made. I understand it to be that the child wanted to emphasize the resultative reading by putting a stress on made. These children obviously know the resultative reading.

Thus our prediction is borne out. The fact that the resultative reading is given to the SC passives sentences without exception shows that children do have an NP-trace.

4.2 Experiment II

The second experiment also involves the small clause construction. In adult grammar, (25) is grammatical, but not (26).

(25) John wiped the window clean.
(26) *John wiped the window dirty.

Thus the small clause construction of this type is lexicalized in adult grammar. Randall (1980) notes that children, however, overgenerate this type of sentence. Bowerman (1982) cites many examples of this sort. Some of them are shown below.

(27)a. I pulled it unstapled. (3 yr.; 8 mo.)
   b. I'm patting her wet. (4; 0)
   c. You're combing me baldheaded. (5; 10)
   d. Are you washing me blind? (5; 6)

Thus it seems that this kind of resultative construction is not lexicalized in children's grammar. Children are generating these sentences syntactically. Then, if children understand the passive of these productively-generated sentences with the resultative interpretation, we can argue that it is also syntax, not the lexicon, that is responsible for their understanding of the passive. That is; in syntax, children are positing an NP-trace in the preadjectival
NP position to obtain the resultative reading.

The experiment's subjects were nine three year-olds, nine four year-olds and six five year-olds. All of them are counted in Table 2. The experiment was done by children who passed a pre-test for colors. The experiment's procedure was as follows. A child was shown a set of three pictures and he was asked to point to the picture that he thought was meant by the sentence given by the experimenter. An example is shown below.

(28) 1. A girl dresses the cat black.
2. The cat is dressed black.
3. The black cat is dressed.

Sentence 1 was to see whether a child understands a resultative reading of a SC active sentence. Sentence 2 was to see whether the resultative interpretation is possible with a SC passive sentence. Sentence 3 was to see how strong the influence of inference is for this non-resultative sentence to yield a resultative interpretation. If a child has an NP-trace, he should understand the SC passive Sentence 2 as resultative. That is; when he is given sentence 2, he should choose picture A. If the child is understanding sentence 2 as resultative by inference, or understanding the passive participle as an adjective, he should also obtain the resultative interpretation with the non-resultative sentence 3. That is; given sentence 3, he should choose picture A. Also, if it is by inference that a child is understanding the SC passive sentence 2 as resultative, we would not expect him to be very consistent in obtaining the resultative interpretation when he is given the SC passive sentences. That is; given sentence 2, he might choose any of picture A, B or C.
Notice that the influence of inference, which makes one interpret a non-resultative sentence as resultative is present, but is weak in adults. In other words, it is not impossible to interpret (29) as resultative like (30), but this is not necessarily the interpretation.

(29) The house is made and green now.
(30) The house is made green.

The sentence in (29) in adult grammar does not refer to the cause of the house being green. Maybe the house has become molded after many years, or maybe moss covers the house.

The influence of inference can also be unpredictable. It is easier to interpret (31) as resultative like (32) than to interpret (33) as resultative like (34).

(31) My old porch is bright red now.
(32) My old porch is made/painted bright red.
(33) My old porch is green now.
(34) My old porch is made/painted green.

Thus if the children's answers are by inference, we should not see consistency in their answers.

Let us now review the results of the experiment. The sentences used in the experiment are shown in Appendix II. The results are shown in Table 2.

Table 2
Percentage of Resultative Reading, Experiment II

<table>
<thead>
<tr>
<th>Construction</th>
<th>3 years</th>
<th>4 years</th>
<th>5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC active</td>
<td>88</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>SC passive</td>
<td>84</td>
<td>92</td>
<td>94</td>
</tr>
<tr>
<td>Prenominal</td>
<td>26</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>
Children understand the SC passive sentences as resultative as well as the SC active sentences. The low percentage of children who understand the non-resultative prenominal adjective sentences as resultative shows that they are not understanding sentences 1 and 2 by inference. Thus the results of this experiment also support our claim that children do have an NP-trace in their grammar.

5. Conclusion

We have discussed the "adjective hypothesis" of children's passives and our hypothesis, which predicts that children have an NP-trace present in the small clause construction. We then saw from the results of two experiments that children do have an NP-trace at a very early stage. This result, however, does not exclude the maturation theory. Since the youngest children that we tested are three years old, one could argue that the principle which is required for A-chain formation has already matured by that age.

The results of our experiments present an important question. When a child acquires the various constructions which involve passivization, is it the case that he learns a rule for each construction and in the end he realizes that all the rules involve the same grammatical operation? Or, is it the case that as soon as he learns the passive rule, he can analyze any construction which involves passivization? Let us call the former hypothesis Hypothesis A, and the latter Hypothesis B.

To be more concrete, according to Hypothesis A, a child would learn a structure-specific rule for (35) first, then when he encounters a sentence like (36), he would learn another structure-specific rule for it, and then, when he encounters a sentence like (37), he learns another structure-specific rule for it.

(35) The elephant, was pushed np[ t₁ ].
(36) The elephant, was painted sc[ t₁ yellow].
(37) The elephant, was believed st[ t₁ to be smart].

The sentences in (35-37) have structures different from one another. After learning all the structure-specific rules, the child then realizes that they all involve passivization, and extracts them to one general rule.
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According to Hypothesis B, when a child learns passives, he learns a non-structure-specific rule, something like (38).

(38) Passive Rule (tentative):

Analyze the string $V_X[NP$ and move the NP where $X$ is open.

$(X$ is open where it is not a barrier.$)^2$

This general rule, then, enables a child to analyze (35-37) at the same time.

The fact that even the three year old children understood the SC passive seems to suggest that Hypothesis B is correct. The choice between Hypothesis and Hypothesis B is a crucial issue in how language is acquired. But we will leave the question open for future study.

ACKNOWLEDGEMENTS

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\[2\] For the definition of barriers, see Chomsky(1986).
Stories used in the Experiment I

1. Oscar the grouch built a house. He wanted it messy. So his friend Big Bird came, and put dirt in the house.
2. Miss Piggy made a dress. She wanted it pretty. So Kermit the frog put a lot of flowers on it.
3. Mickey Mouse made soup. He wanted it cold. So a little girl put a lot of ice cubes in it.
4. Kermit the frog made a chocolate milk shake. He wanted it salty. So Oscar the grouch put a lot of salt in it.
5. Big Bird built a house. He wanted it red. So a little girl put red paint on it.
6. Oscar the grouch baked cookies. He wanted them wet. So Big Bird put water on them.
7. Mickey Mouse made a pair of pants. He wanted them yellow. So a little girl put yellow paint on them.
8. Oscar made a trash can. He wanted it dirty. So Miss Piggy put dirt on it.
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APPENDIX II

Sets of Sentences used in the Experiment II
(Order mixed in the actual experiment)

1. A girl wipes the window dirty.
The window is wiped dirty.
The dirty window is wiped.
2. A girl dresses the dog black.
The dog is dressed black.
The black dog is dressed.
3. A girl fries the egg brown.
The egg is fried brown.
The brown egg is fried.
4. A girl colors the bear white.
The bear is colored white.
The white bear is colored white.
5. A boy paints the nail orange.
The nail is painted orange.
The orange nail is painted.
6. A girl decorates the cake yellow.
The cake is decorated yellow.
The yellow cake is decorated.
7. Big Bird paints the toy pink.
The toy is painted pink.
The pink toy is painted.
8. Cookie Monster dresses the baby pink.
The baby is dressed pink.
The pink baby is dressed.
9. Mickey colors the wall red.
The wall is colored red.
The red wall is colored.
10. Curmit decorates the wall yellow.
The wall is decorated yellow.
The yellow wall decorated.
11. An elephant decorates the tree red.
The tree is decorated red.
The red tree is decorated.
12. Donald paints the table red.
The table is painted red.
The red table is painted.
13. A little girl makes the trash can dirty.
The trash can is made dirty.
The dirty trash can is made.
14. A little boy colors the chair pink.
The chair is colored pink.
The pink chair is colored.
15. A little girl dresses the mouse yellow.
The mouse is dressed yellow.
The yellow mouse is dressed.
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