The effect of mistakes in the input on the acquisition of a miniature artificial language (II): Using a subject-paced procedure

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Thirty university students learned a miniature artificial language by watching linguistic inputs consisting of forty example sentences, presented one by one, in a subject-paced procedure where the time each subject spent for each exemplar was measured and recorded. The twenty subjects exposed to the linguistic inputs which contained 20% of mistaken examples acquired the linguistic rules as much as the other ten who were exposed to the correct exemplars only. Twelve of the 20 subjects noticed the presence of mistaken exemplars in their linguistic inputs. They tended to get higher scores on acquisition tests and spent a longer time watching the mistaken exemplars than their counterparts.

Key words: artificial language acquisition, subject-paced procedures, linguistic inputs, mistaken inputs, irregularity.

The preceding study (Mori, 1980) has revealed that acquisition of a miniature artificial language (MAL) is possible even if subjects are provided a linguistic input with a certain number of mistakes (20% of the total samples). The same type of studies with much less grammatical complexities (Smith, 1973; Nagata, 1976) and one (Braine, 1971) which used a fairly complex grammar but with fewer mistakes (7% of the total samples) have shown similar results.

Although the results were consistent, explanations on how subjects overcome irregularities or mistakes in the inputs were not uniform. According to Smith (1973), his subjects seemed to have learned the exemplars which contained irregularities in a different way from the rule-governed exemplars. In Smith's (1973) experiment, a smaller number of irregular exemplars were presented frequently. It seemed plausible that the subjects learned the irregular exemplars by rote while they learned the others by inducing the governing rules. In this way, they could eliminate the irregular exemplars which, otherwise, would have interfered with the rule learning. This process appeared to be very similar to that of the learning of past tense inflection rules of English (cf. Palermo & Howe, 1970).

Braine (1971) proposed another explanation. Since his experiment contained much fewer irregular exemplars, or mistakes, it seemed implausible to assume that subjects learned them by rote. Instead, Braine assumed that these mistaken exemplars were sieved off by "a built-in decay characteristic" of the memory com-

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3 Now at University of Tsukuba.
ponent of his language acquisition model. Braine proposed this model in place of the hypothesis-testing model proposed by Chomsky (1965), Katz (1966) and others.

Braine's model has two principal components: a scanner which receives the input sentences; and a memory component which accumulates the features of sentences noticed by the scanner. The information stored in the memory component can be lost after a period of time unless it is kept restored to accumulate enough and to become a permanent memory. This model explains how a mistake, that is an infrequent irregular exemplar, can be eliminated while a frequent irregular exemplar can be acquired.

It also suggests some interesting matters relevant to irregular exemplars in language acquisition. According to this model, a language learner observes irregular exemplars in the same way as regular ones but does not have to notice the presence of irregular ones. On the other hand, the hypothesis-testing model assumes that a language learner must be able to notice the presence of irregularities and react to irregular and regular ones differently. For example, if he uses the hypothesis-testing strategy, he should spend a much longer time at an irregular exemplar, for he needs to change the hypothesis he has made from preceding regular exemplars.

The author's earlier study (Mori, 1980) failed to discuss how irregularities could be overcome by subjects. The present study was designed to follow it up by using a subject-paced procedure for examining the following two questions: Will subjects notice the irregularities, and if so, when? Will he spend a longer time at an irregular one than at a regular one, if he can look at each exemplar as long as he needs?

**Method**

*Description of the miniature artificial language.* The miniature artificial language (MAL) used in this experiment was exactly the same as that used in the preceding study (Mori, 1980). The MAL consisted of sixteen "words" and a "grammatical structure" described as follows:

\[
egin{align*}
S & \rightarrow AP + BP +(CP) \\
AP & \rightarrow A + (D) \\
BP & \rightarrow \{B_1 \ \\
& \ \\
& \{B_2 + CP \} \\
CP & \rightarrow C + (D) \\
A & \rightarrow \{GAV / FET / KUS / DEP \} \\
B_1 & \rightarrow \{BIF / ZOR \} \\
B_2 & \rightarrow \{PAX / MUL \} \\
C & \rightarrow \{RUD / LIM / NAK / COZ \} \\
D & \rightarrow \{SIV / YOW / NES / FAL \}
\end{align*}
\]

It should be noted that the description above was used because it was simple and unambiguous and not because it was presumed to reflect subjects' perceptions. Each word had its referent represented as a geometric figure. The referents were designed to be incorporated into systematic patterns that would be reflected in the structure of the sentence. (See Fig. 1 in Mori (1980) for an illustration of the words and referents.)

**Experimental conditions.** There were two experimental conditions along with a control condition. For the control condition, forty different sentences were chosen from the total set of sentences generated by the rules and presented to subjects with appropriate referents. For the RM and GM conditions, eight sentences were randomly chosen from every five of the forty sentences and either a referential mistakes (for the RM condition) or a grammatical mistake (for the GM condition) was inserted.

**Apparatus.** The forty sample sentences were presented to each subject one by one in random order by a slide projector. The same order was used for all subjects. The subject was allowed to advance slides at any time he wished by pushing a button in front of him. There was no button for moving slides backwards. A digital timer (Takei Kiki Kogyo) and a digital printer (Takei Kiki Kogyo) were connected to the
Instructions. The instructions given to subjects were the same as those in the preceding study (Mori, 1980). They were also told that they could advance slides at any time they wished by pushing the button but they were not allowed to move slides backwards. After the instructions were given, subjects were allowed to use the forward button several times to see how to change the slides.

Tests. After every ten slides, there was an intermission where a test was given to measure the subject's progress in learning the MAL. The test was the same kind as those used in the former studies (Moeser & Bregman, 1972; Mori, 1980). Subjects were required to choose grammatical sentences between pairs of alternatives. There were four tests identical in form but different in terms of the sentences used. No sentences used in a test had previously been seen by the subjects. Each test consisted of 21 questions.

Questionnaires. After four tests were completed, a questionnaire was given to ask (a) whether or not the subject noticed any mistakes or irregularities, and (b) if so, when he first noticed it. In order to check the credibility of subjects' answers, the same questionnaires were given to subjects in the control group as well as the experimental groups.

Subjects. Subjects were 30 university students, 21 from University of Tsukuba, Japan, and nine from Memorial University of Newfoundland, Canada. Seven Japanese and three Canadians were assigned randomly to each condition. Subjects were tested individually.

Results
No significant differences were produced between the Japanese and Canadian subjects either on test scores \((t(28)=0.84, p<0.05)\) or on total time spent to watch the slides \((t(28)=0.28, 0.7<p<0.8)\). Therefore, the results from both groups were analysed together.

Test scores. The mean correct scores on the tests for each condition are shown in Table 1. There were no significant differences among the three conditions \(F(2,27)=0.87\). Almost the same number of subjects in each condition (4 in the control, 5 in the RM, and 4 in the GM condition) reached the acquisition criterion (18 and more out of 21 on the test-4; statistically higher than the chance at .001 level). These results replicated the preceding study (Mori, 1980).

Time scores. The time each subject spent to watch each slide was measured in seconds and converted into reciprocal num-
Table 3  
Number of subjects acquired the language and noticed the mistakes: The twenty subjects in the RM and GM conditions

<table>
<thead>
<tr>
<th>Presence of mistakes</th>
<th>Noticed</th>
<th>Failed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition criterion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reached</td>
<td>7</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Failed</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>8</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 4  
The mean time scores of the 12 subjects who noticed the mistakes

<table>
<thead>
<tr>
<th></th>
<th>Mistaken-slides</th>
<th>The rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>.124</td>
<td>.162</td>
</tr>
<tr>
<td>SD</td>
<td>.054</td>
<td>.061</td>
</tr>
</tbody>
</table>

numbers after adjusting for sentence length. Then, time scores for the eight slides that contained mistakes and those for the rest of the slides were calculated. For the control condition, the time scores were calculated for the eight slides corresponding to those in the experimental conditions and for the rest of the slides. The mean time scores for mistaken-slides and for the rest in each condition are shown in Table 2. A $2 \times 3$ ANOVA was performed on the time scores. No main effects nor the interaction were significant ($F(2,27)=0.84$, for between conditions; $F(1,27)=1.69$, for mistaken-slides vs. the rest; and $F(2,27)=1.72$, for the interaction).

Questionnaires. Seven out of the ten subjects in the RM condition answered that they had noticed the presence of mistakes or irregularities during the presentation. So did five subjects in the GM condition. Eight of them noticed it between the 21st and 30th slides, and the other four between the 11th and 20th. No subjects answered, "noticed," in the control condition.

Correlation between test scores and questionnaires. The point biserial correlation coefficient ($r_{pb}$) was calculated between the test scores for 20 subjects in the RM and GM conditions and whether or not they noticed the mistakes. This showed that there was a significant correlation ($r_{pb} = .611$, $t(18)=3.28$, $p<.01$). Then the 20 subjects were cross-tabulated with regards to the acquisition of language and the noticing of mistakes (cf. Table 3). Although the acquisition and noticing seemed to go together this does not reach the statistical significance ($p=.157$).

Time scores for those who noticed the mistakes. According to the above analyses, the subjects who noticed the presence of mistakes seemed to do the task differently from the other subjects in the RM and GM conditions. It is quite probable that the time scores of the former should differ from those of the latter. Time scores of the 12 subjects who noticed the mistakes in the RM and GM conditions$^5$ (cf. Table 4) were compared with those of the ten subjects in the control condition. A $2 \times 2$ ANOVA revealed that the two main effects were significant ($F(1,20)=6.23$, $p<.05$, for between the control and the RM-GM conditions; $F(1,20)=6.28$, $p<.05$, for mistaken-slides vs. the rest). The interaction was also highly significant ($F(1,20)=9.74$, $p<.01$). These results showed that subjects in the RM and GM conditions who noticed the presence of mistakes tended to spend longer watching the mistaken-slides.

Discussion

How mistakes could be overcome by the MAL learning subjects. The results from the present experiment were not readily explained by either Smith’s or Braine’s model. Unlike Smith’s (1973) experiment, learning the mistaken exemplars by rote did not seem to work to eliminate them in the Mori

$^5$ There were no considerable differences between those subjects in the RM and GM conditions ($F<1$, both on test scores and on time scores). Therefore, they were analysed together.
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(1980) experiment. On the other hand, Braine’s (1971) model appeared to be more suitable. Braine’s assumption that mistaken exemplars would be sieved off by a built-in decay characteristic of memory might well explain the reason why the mistakes had little negative effects on the MAL learning. But further examinations on subjects’ performance in the MAL learning have revealed that the acquisition tended to be correlated with noticing mistakes and that subjects spent a longer time looking at mistaken slides. Accordingly, the model should be revised in these respects or else alternative models should be developed. The present study did not aim to offer a model. But it tends to suggest that further studies on this topic should aim to reveal the internal learning process of each subject rather than his achievement. Mori (1980) and the present study had the same results in terms of subjects’ achievements but the present study contributed considerably more to this topic by measuring the time each subject spent watching each exemplar. In order to find a satisfactory explanation for this problem it is necessary to conduct further studies, especially those which put more focus on subjects’ introspective reports.

References


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