Effects of Grammar Instruction and Fluency Training on the Learning of *the* and *a* by Native Speakers of Japanese

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In a computer-assisted sentence completion task, the effects of grammar instruction and fluency training on learning the use of the definite and indefinite articles of English were examined. Forty-eight native Japanese-speaking students were assigned to four groups: with grammar/accuracy (G/A), without grammar/accuracy (N/A), with grammar/fluency (G/F), and without grammar/fluency (N/F). In the G/A and N/A groups, training continued until performance reached 100% accuracy (accuracy criterion). In the G/F and N/F groups, training continued until 100% accuracy was reached and the correct responses were made at a high speed (fluency criterion). Grammar instruction was given to participants in the G/A and G/F groups but not to those in the N/A and N/F groups. Generalization to new sentences was tested immediately after reaching the required criterion. High levels of generalization occurred, regardless of the type of mastery criterion and whether the grammar instruction was given. Retention tests were conducted 4, 6, and 8 weeks after training. Fluency training effectively improved retention of the performance attained without the grammar instruction. This effect was diminished when grammar instruction was given during training. Learning grammatical rules was not necessary for the generalized use of appropriate definite and indefinite articles or for the maintenance of the performance attained through fluency training.

For native speakers of Japanese, the article system is one of the most difficult aspects of English to learn. Because there are no definite and indefinite articles in Japanese, some researchers attribute this learning difficulty to the difference in the grammatical structure between the two languages (Lane, 1981; Master, 1990; Tomiyama, 1980). In general, the research conducted in such fields as English as a second language

or teaching English for students of other languages has a cognitive orientation, where structural rather than functional aspects of language are studied, and hypothetical constructs such as information-processing models are proposed (e.g., see Fotos, 1994; Fotos & Ellis, 1991). Although there are a variety of such models, a strong unifying theory is lacking, which, according to Schlinger (1995), is necessary for developing effective teaching strategies.

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Behavior analysis has a strong unifying theory of reinforcement built from laboratory experiments, but its extension and application to the study of language has been slow (see *The Analysis of Verbal Behavior*, 1998, for critical reviews). Skinner (1957) analyzed some aspects of English articles as "quantifying autoclitics" (p. 327). The mand "Give me *the* book" has a specific effect on the listener's choice

in complying with the mand, whereas "Give me *a* book" does not. However, there has been little empirical research on how such response classes are acquired by native speakers of English, or on the processes involved in the learning of English as a second language. Skinner (1957) also proposed that the second-language learner may become a good listener first, which would then automatically reinforce his or her verbal behavior as a speaker (p. 381). He also made a list of useful responses for "self-editing," such as echoics, grammatical taggings and ordering, and rhetorical ordering, for situations in which appropriate responses are not strong enough (p. 381). This list of variables is certainly applicable to the verbal behavior of the second-language learner. However, to date, these ideas have not been investigated empirically.

The concepts of contingency-shaped and rule-governed behavior (Skinner, 1957, 1974) may be two of the few exceptions. Both empirical (see Catania, Shimoff, & Matthews, 1989) and theoretical (Cerutti, 1989; Schlinger, 1993) analyses of these concepts abound. Regarding the role of rules in learning concepts, Shimamune and Malott (1994) proposed "definition-based concept control," in which the statement of the definition of a concept controls the learner's responses, such as the discrimination of examples of the concept from nonexamples. They also proposed the idea of a transition from definition-based control to simple concept control, in which the properties of examples and nonexamples directly control the behavior of the learner without intermediate verbal responses.

It is conceivable that the second-language learner's response is first under the supplemental control of grammatical rules. For instance, talking to a friend, I might say to myself, "I have to use *a* for a singular noun when the noun appears first time in the context," and tell him, "I saw *a* funny-looking dog the other day." But this is a rather

time-consuming process. In conversation, there is not enough time for stating rules. Also, once appropriate responses are emitted and reinforced by the listener, the context of the conversation and other parts of the sentence would become discriminative stimuli, which then directly control this type of autoclitic response. The role of grammatical rules in the process of transition from rule to contingency control seems to be worthy of investigation.

In a previous study, Shimamune and Ho (1995) examined the effects of grammatical rules on the learning of the English article by native speakers of other languages. The participants were international undergraduate students who had been in the United States for 4 months or longer. Their first language was Japanese, Chinese, Malay, or Arabic. The participants volunteered to work on a drill-type computer task, in which they had to choose either *a* (or *an*), *the*, or "nothing" to complete English sentences. Subjects received immediate feedback about the correctness of their responses. Half of the participants received instructions on the grammatical rules that could be applied to complete the sentences. The participants who received the instructions (i.e., rule-governed practice) reached mastery faster than the participants who received no such instructions (i.e., contingency-shaped practice). However, a high degree of generalization to new sentences was observed in both groups; grammar instruction reduced the amount of practice, but it was not necessary for generalization.

In the present study, we extend the findings of the previous study (Shimamune & Ho, 1995) by focusing on the effects of fluency training on retention and its interaction with grammatical rule control. The mastery criterion used in the previous study was defined in terms of accuracy. It has often been shown, however, that performance based on an accuracy criterion is short-lived (see Johnson & Layng, 1992, 1994). On the other hand, a mastery

criterion in terms of fluency that requires both high accuracy and speed has been shown to improve academic skills such as reading, spelling, mathematics, and problem solving, and to maintain those skills over a long period of time (Alper & White, 1971; Binder, 1988, 1996; Johnson & Layng, 1992, 1996; Lindsley, 1992; Potts, Eshleman, & Cooper, 1993). Because fluency training requires faster responding, it may facilitate transition from definition-based rule control to simple contingency control, and as a result, the autoclitic response may come under the stimulus control of the sentence itself and persist longer. We used a similar computer-assisted drill-type task with native Japanese-speaking undergraduate students. Immediately after training, a generalization test to new sentences was carried out, with a retention test conducted 4, 6, or 8 weeks later. In an effort to clarify the effects of rule control, the participants' verbal descriptions of grammatical rules were also collected.

METHOD

Participants

Sixty-one undergraduate students, all native speakers of Japanese, volunteered to participate in the study. In order to exclude those who could already use English articles appropriately, we ranked the scores of a pretest, which we will describe below, and selected 48 students (21 male, 27 female) with the lowest scores to be participants.

Materials

Two grammatical rules for the definite article (*the*) and two grammatical rules for the indefinite article (*a* or *an*) were selected as the target of training. From a preliminary experiment, we had found that these four rules were among the most difficult for Japanese speakers to learn. Eight pairs of sentences for each rule were generated, with one member of each pair being an

instance in which the rule applied (example) and the other being an instance where the rule did not apply (nonexample). In the paired sentences, the same noun appeared after a blank in which either *a*, *an*, *the*, or nothing (no articles) should be placed. For example, "He donated () million dollars" was an example of the rule "Use the article *a* or *an* if the following noun is plural and modified by a numerical measure unit." The paired nonexample was "He is () millions of dollars in debt," in which no articles should be placed. Half of the nonexamples were completed with the other article (*a* or *the*) based on grammatical rules other than the four target rules. The rest of the nonexamples were completed with "nothing." See the Appendix for the total of 64 sentences.

The incomplete sentences were divided into two sets. The assignment of the sets was counterbalanced among the participants. In other words, half of the participants used Set 1 for the pretest and training and Set 2 for the generalization test. The other half of the participants did vice versa. No significant difference was found between the scores on the two sets of sentences, $t(46) = 0.64$, $p = .52$. We therefore combined data in the results.

Design

Two primary between-group variables were examined. The first variable was the type of instruction, specifically whether the participants were provided with instructions on grammatical rules. The second variable was the type of mastery criterion, specifically whether the participants were trained to an accuracy or a fluency criterion. A 2×2 factorial design generated four experimental groups, referred to as with grammar/accuracy (G/A), with grammar/fluency (G/F), without grammar/accuracy (N/A), and without grammar/fluency (N/F).

Grammar Instruction

The four grammatical rules and a pair of example and nonexample sen-

tences for each rule were printed on a sheet of paper as grammar instruction. The participants in the G/A and G/F groups were asked to read this instruction at the beginning of each session. Moreover, during training, they had to identify the rule applicable to complete the sentence, as explained below. No grammatical instruction was given to the participants in the N/A and N/F groups.

Mastery Criteria

For the G/A and N/A groups, training continued until the participants showed 100% accuracy in two consecutive blocks of 32 trials. For the G/F and N/F groups, training continued until the participants reached 100% accuracy and the correct responses were made at the rate of 50 responses per minute or faster in two consecutive blocks. This fluency criterion was determined through a preliminary experiment, in which well-trained students performed the same task as rapidly and accurately as possible. At the beginning of training, all participants were instructed about the mastery criterion they had to meet. In particular, the participants in the G/F and N/F groups were instructed that they would work toward accuracy first and then toward fluency.

Procedure

Pretest. A set of 32 incomplete sentences was printed on a sheet of paper. The 61 students were asked to complete the sentences, as accurately as possible, by placing *a*, *an*, *the*, or “nothing” in the blanks.

Training. The 48 students selected as participants were assigned to the four experimental groups, so that the mean pretest scores in each group were as evenly matched as possible (a matched-pair procedure).

Each participant was instructed to work on the sentence completion task using a drill-type, computer-assisted training software program (Platinum, Sun System, 1993). Each session con-

sisted of blocks of 32 trials using a sentence set. The sentence set consisted of 16 examples (eight for *a* and eight for *the*) and 16 nonexamples (four for *a*, four for *the*, and eight for “nothing”). Trials began with the presentation of an incomplete sentence and alternatives from which to choose the answer. In the N/A and N/F groups, the participants were asked to hit a numeric key 1, 2, or 3, each of which corresponded to *a* or *an*, *the*, and “nothing.” In the G/A and G/F groups, the participants were required to identify the appropriate grammatical rule and choose articles based on the rule. Thus, there were seven alternatives: *a* or *an* because of Rule 1, *a* or *an* because of Rule 2, *a* or *an* because of other rules that you know, *the* because of Rule 3, *the* because of Rule 4, *the* because of other rules that you know, and “nothing.” The answers corresponded to numeric keys 1, 2, 3, 4, 5, 6, and 7, respectively. The combination of the answers and the numeric keys was consistent throughout the experiment and was shown on the display. The incomplete sentence and alternatives remained on the display until the participant responded. When the participant made the correct response, an audible beep and a visible green circle were presented for 0.75 s, and the next trial began. When the participant made an incorrect response, a buzzer and a red cross were presented together with the correct answer, and the same trial was repeated with the correct answer remaining on the display (serving as a correction procedure). The next trial was not presented until the participant made the correct response. Only the first responses on each trial were counted. Each of 32 incomplete sentences appeared once in a block. The presentation order of sentences was randomized in each block.

A session continued until either the participant reached the mastery criterion or 90 min had passed. If the mastery criterion was not met within this time limit, an additional session was scheduled for a later day.

Generalization test. Immediately after reaching the required criterion, the participants received the other sentence set: 32 new sentences with the same composite of example and nonexample sentences as the first set. To make a fair comparison between the four experimental groups, there were only three alternatives (*a* or *an*, *the*, and “nothing”) even for the G/A and G/F groups in the generalization and retention tests. The same procedure was employed as in training except that no feedback stimuli were presented with regard to the correctness of responses. All the participants were asked to perform as accurately as possible. No instruction was given to the N/F and G/F groups with regard to speed.

Retention test. Each participant received a retention test 4, 6, or 8 weeks after the training had been completed. The participants in each group were assigned to one of the retention intervals, so that the mean number of blocks required to achieve the mastery criterion during training was, as closely as possible, matched across the three retention intervals. Each of the 64 sentences used during the training and generalization test was presented once, in a mixed order. Feedback stimuli were not given.

Grammar test. For each participant, a grammar test was carried out on three occasions: immediately after the pretest, immediately after the generalization test, and immediately after the retention test. A pair of example and nonexample sentences for each of the four target rules were generated and printed on a sheet of paper in a random order. The participant was asked to complete the sentences and to write down the grammatical rules on which his or her answers were based.

RESULTS

Table 1 lists the names of the variables statistically examined in this section. Throughout the statistical analyses, an alpha level of .05 was used.

Table 1

The variables examined in statistical analyses.

Variables	Comparison
Instruction	No grammar instruction vs. grammar instruction
Criterion	Accuracy vs. fluency
Training	Pretest vs. generalization test
Retention interval	2 vs. 4 vs. 8 weeks
Sentence type	Examples vs. nonexamples

Pretest

The participants produced lower pretest scores on example sentences than on nonexample sentences. Table 2 shows the percentage of correct responses for each experimental group. An analysis of variance (ANOVA) revealed that sentence type had a significant effect on correctness, $F(1, 22) = 89.16$, $p < .0001$, confirming that the four target rules we used were in fact difficult for the participants, because mathematically the chance level for examples and nonexamples is the same (.33). Also, because no significant difference was found among the four experimental groups, $F(3, 69) = 1.40$, $p = .24$, the validity of the matched-pair procedure was confirmed.

Training

Although the fluency criterion was used in the N/F and G/F groups, we also counted the number of blocks needed by the participants in these groups to reach the accuracy criterion (Table 2). More blocks were necessary to reach the accuracy criterion with the fluency requirement than with the accuracy requirement alone. An ANOVA was performed with two between-group variables (instruction and criterion). A significant effect was found for criterion, $F(1, 44) = 22.30$, $p < .0001$. This is similar to the so-called

Table 2

Pretest, generalization, and retention test scores and mean number of training blocks.

Condition	Pretest		Training	Generalization		Retention ^a	
	EX	NX	BLK	EX	NX	EX	NX
G/A	39.7	71.5	9.8	91.3	75.2	76.1	74.2
G/F	39.5	64.2	19.6	88.6	76.5	77.8	76.4
N/A	36.7	68.9	10.8	89.3	79.0	66.2	72.8
N/F	49.1	67.8	18.1	86.6	79.3	80.5	82.2

Note. EX = example sentences; NX = nonexample sentences; BLK = number of blocks to reach criterion.

^a 4, 6, and 8 weeks combined.

“speed-accuracy tradeoff” (e.g., Fitts, 1966), and is interesting because the N/F and G/F groups were instructed to work toward accuracy first.

No significant effect was observed for instruction with regard to the number of blocks needed to reach accuracy criterion, $F(1, 44) = .026$, $p = .87$. Training for the G/F and N/F groups continued until the participants reached the fluency criterion. The total number of blocks required to meet the fluency criterion was 41.3 in the N/F group and 40.3 in the G/F group, and were not significantly different, $t(22) = .13$, $p = .90$. Contrary to our previous study

(Shimamune & Ho, 1995), grammar instruction failed to reduce the amount of practice.

Generalization Test

Figure 1 shows comparisons between the pretest and generalization test scores. Generalization occurred with both types of sentences, and the degree of improvement from the pretest was larger for the example than for the nonexample sentences. A three-way ANOVA was conducted separately for each type of sentence, with two between-group variables (instruction

Fig. 1. Percentage of correct responses on pretests and generalization tests for each group. The left panel shows the scores on the example sentences, and the right panel shows the scores on the nonexample sentences. (G/F = with grammar/fluency group; G/A = with grammar/accuracy group; N/F = without grammar/fluency group; N/A = without grammar/accuracy group.)

Table 3

Analysis of variance for generalization test.

		<i>F</i>	
	<i>df</i>	EX	NX
Between groups			
Instruction (I)	1	0.82	0.54
Criterion (C)	1	0.56	0.43
I × C	1	1.94	0.26
Subject within-group error	44	(122.22)	(160.23)
Within group			
Training (T)	1	329.33**	29.05**
T × I	1	1.01	0.61
T × C	1	2.84	2.11
T × I × C	1	1.43	1.10
T × subject within-group error	44	(166.01)	(72.30)

Note. Values in parentheses represent mean square errors. EX = example sentences; NX = nonexample sentences.

** $p < .01$.

and criterion) and a within-group variable (training). The results are summarized in Table 3. In both types of sentences, a significant effect was found only for training. In other words, generalization occurred regardless of whether or not the grammar instruction was given or the type of mastery criterion.

Retention Test

Figure 2 shows the percentage of correct responses for each group at three retention intervals (4, 6, and 8 weeks). Because no significant difference was found between the scores on example and nonexample sentences, $F(1, 94) = .267$, $p = .61$, combined scores were used for the following analyses. Compared to the final performance in training (100%) and generalization test ($M = 83.2\%$), performance on the retention test had deteriorated ($M = 75.8\%$). However, it was still above the pretest scores ($M = 54.7\%$).

An ANOVA was conducted with three between-group variables (retention interval, instruction, and criterion). The results are shown in Table 4.

Retention interval and criterion both showed significant differences. Although instruction alone was not significant, its interaction with criterion was significant. Figure 3 displays this interactive effect by pooling the data on different retention intervals. The fluency criterion led to better retention than the accuracy criterion, but only when grammar instruction was not given. Grammar instruction improved retention only when the accuracy criterion was used. The combination of the grammar instruction and the fluency criterion did not result in the best performance on the retention test.

Grammar Test

There were four example sentences in the grammar test, and each grammatical rule described by the participant was scored either correct or incorrect. Table 5 presents the mean number of correct descriptions for each group for each test occasion. An ANOVA was conducted with two between-group variables (instruction and criterion) and a within-group variable (training). The results are shown in Table 6. Instruction and its interaction

Fig. 2. Percentage of correct responses at different retention intervals (4, 6, and 8 weeks) for each group. Data are averaged among the participants assigned to each retention-interval condition. The percentages of correct responses on pretests were 55.7%, 51.9%, 52.8%, and 58.4% for G/A, G/F, N/A, and N/F groups, respectively.

Table 4

Analysis of variance for retention test.

	<i>df</i>	<i>F</i>
Retention interval (R)	2	3.39*
Instruction (I)	1	0.10
R × I	2	1.95
Criterion (C)	1	9.65**
R × C	2	0.65
I × C	1	4.95*
R × I × C	2	3.00
Error	84	(118.25)

Note. Values in parentheses represent mean square errors.

* $p < .05$.

** $p < .01$.

with training were significant; however, criterion was not significant. Not surprisingly, more accurate descriptions of grammatical rules were produced with grammar instruction than without it.

Figure 4 shows the numbers of correct grammar descriptions obtained at three different retention intervals in each group. At the 4-week interval, the G/F and G/A groups still showed relatively higher scores than the N/F and N/A groups, but the performance in the former groups had dropped to the levels of the latter groups at the 8-week interval. An ANOVA with two between-group variables (criterion and retention interval) was conducted separately for the groups with grammar instruction (G/A, G/F) and the groups without grammar instruction (N/A, N/F). The results are shown in Table 7.

Fig. 3. Percentage of correct responses at the retention test. Retention performance is shown separately for the groups trained with grammar instruction (circles) and for the groups trained without grammar instruction (squares). Data are averaged across the 4-, 6-, and 8-week retention-interval conditions in each group. (G/F = with grammar/fluency group; G/A = with grammar/accuracy group; N/F = without grammar/fluency group; N/A = without grammar/accuracy group.)

Criterion and its interaction with retention interval were significant only in the groups with grammar instruction. In other words, when the participants were provided with grammar instruction, the fluency criterion was effective in leading to the retention of an accurate description of rules at relatively short intervals (4 to 6 weeks).

As demonstrated in our previous

Table 6

Analysis of variance for grammar tests.

	<i>df</i>	<i>F</i>
Between groups		
Instruction (I)	1	27.67**
Criterion (C)	1	0.14
I × C	1	0.02
Subject within-group error	44	(0.70)
Within group		
Training (T)	1	111.23**
T × I	1	17.55**
T × C	1	0.52
T × I × C	1	0.02
T × subject within-group error	44	(0.50)

Note. Values in parentheses represent mean square errors.

** $p < .01$.

study (Shimamune & Ho, 1995), no consistent relationship was observed between generalization test performance and performance on the grammar test (cf. Tables 2 and 5). Even though the grammar test scores of the N/F and N/A groups were low, their generalization test scores still matched those of the G/F and G/A groups. Neither did we find a consistent relationship between retention performance (Figure 2) and grammar test performance (Figure 4). The Pearson prod-

Table 5

Mean number and standard deviation of correct descriptions of grammatical rules.

Condition	Pretest		Generalization test		Retention test					
					4 weeks		6 weeks		8 weeks	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
G/F	1.50	0.80	3.50	0.52	3.75	0.50	3.25	0.50	2.75	0.50
G/A	1.42	0.90	3.67	0.49	3.25	0.50	3.25	0.50	2.50	0.58
N/F	1.17	0.58	2.00	1.04	2.75	1.26	2.76	0.96	2.25	0.96
N/A	1.17	0.72	2.17	0.94	2.50	0.58	1.50	1.00	2.75	0.96

Fig. 4. Number of correct descriptions of grammatical rules at different retention intervals (4, 6, and 8 weeks) for each group. Data are averaged among the participants assigned to each retention-interval condition.

uct-moment correlation between the retention test scores on the example sentences and the grammar test scores was

weak, $n = 48$, $r = -.03$, and was not significant, $p = .87$.

DISCUSSION

The present study examined the effects of grammatical instructions and fluency training on the learning of certain aspects of the use of English articles. To summarize the results: (a) Grammar instruction did not effectively reduce the amount of practice required to reach the accuracy criterion. (b) Generalization to new example sentences reached high levels irrespective of the type of mastery criterion or whether grammar instruction was given. (c) Fluency training facilitated retention of the performance attained without grammar instruction, whereas this fluency effect was not observed when grammar instruction was given during training. (d) Grammar instruction facilitated main-

Table 7

Analysis of variance for generalization test.

	<i>df</i>	<i>F</i>	
		G/A, G/F	N/A, N/F
Criterion (C)	1	9.00**	0.00
Retention interval (R)	2	8.33**	0.40
C × R	2	0.33	2.52
Error	18	(0.38)	(0.94)

Note. Values in parentheses represent mean square errors.

** $p < .01$.

tenance of the performance learned through accuracy training. (e) Training with grammar instruction enhanced the ability to describe grammatical rules, but this effect diminished gradually. Finally, (f) there was no consistent relationship between accuracy in describing grammatical rules and accuracy in selecting appropriate articles.

Grammar instruction failed to reduce the amount of practice required to achieve either the accuracy or fluency criterion. This is inconsistent with our previous study (Shimamune & Ho, 1995) and might have been caused by a procedural difference. In the present study, the participants in the G/A and G/F groups had seven alternative answers to choose from, whereas there were only three alternatives in the previous study. We modified the procedure to ensure that the participants in these groups would state grammatical rules, at least covertly, each time they completed a sentence. However, this procedural change may have required more effort for responding (seven keys instead of three keys to choose from) and increased the likelihood of errors.

Our results indicated that grammar instruction was not necessary for training the participant's appropriate choice of articles. Grammar instruction did not reduce the amount of training required, and the participants showed a high level of generalization without it. This is consistent with the previous study and our everyday experience that native speakers often cannot state the grammatical rules of their language. The present study also found a similar result in performance during retention probes. The best retention performance was observed by subjects in the N/F group, whose scores on the grammar test were low. These results indicate that the drill-type sentence-completion task used in this study with the fluency criterion was effective enough to establish contingency control over the participants' autoclitic responses.

Without fluency training, however, long-lasting performance was not established, as shown by the poor reten-

tion performance of the N/A group. It should be noted, however, that grammar instruction was comparatively effective with accuracy training, as seen by the better retention of the G/A group compared to the N/A group. These results may indicate that supplemental control by grammatical rules is useful when contingency control is not established. But, in general, we failed to find a consistent relationship between the statement of the grammatical rules and the selection of appropriate articles. Further studies are required.

The combination of grammar instruction and fluency criterion did not result in the best retention performance. We naively expected that fluency training would facilitate the transition from rule-based to contingency control. But it was almost as if grammar instruction interfered with the effectiveness of the fluency training. This result may be seen as an instance of blocking. The blocking effect has been studied in a wide variety of conditioning paradigms, such as conditioned suppression in rats (e.g., Kamin, 1969) and operant conditioning in mentally handicapped children (e.g., Singh & Solman, 1990). It is possible that the participant's intermediate verbal responses, such as stating grammatical rules, blocked the acquisition of stimulus control of the other parts of the sentence over the autoclitic response.

Johnson and Layng (1996) maintained that a fluency criterion based on average students' performance (a norm-referenced approach) does not guarantee fluent performance. They claim that fluent performance should be functionally defined as follows: (a) maintenance—performance must be maintained after a significant period of no practice; (b) endurance—performance must be demonstrated with a longer period of duration than practice; (c) stability—performance must not be distracted easily; (d) application—performance can be used in more complicated tasks; and (e) problem solving—performance can be used to solve new problems. This study dealt with main-

tenance, and only one condition—fluency training without grammar—met the criterion (better than 80% correct after 8 weeks of no practice). Setting a norm-referenced criterion of 50 correct responses per minute or faster did not result in fluent performance with the grammatical instruction. Binder (1996) summarized factors that prevent building fluency, one of which is “emphasis on preventing errors during learning” (p. 189). Grammatical instruction can be seen as an aid to prevent errors. Making errors and being exposed to punishment contingencies (e.g., a buzzer, a red cross on the screen, and correction procedure) may also be an important factor in the transition from rule to contingency control.

It has been pointed out that English teachers in Japan rely heavily on grammatical rules to teach English in their classrooms (e.g., Dinsmore, 1985), which often causes students to lose interest (Azuma, 1992). More recently, an increasing number of teachers are trying to introduce a communicative approach in their classroom. This approach places less emphasis on grammatical rules and more emphasis on conversation (Ando et al., 1992; Helgesen, 1991). The present study suggests a specific case in which teaching grammatical rules may not be necessary if fluency training is provided. Grammatical instruction may even prevent the transition from rule-based control to contingency control.

Further research will be necessary to assess the generality of the present findings. First, the participants in the present study were all undergraduate students who had already learned English grammar to a certain degree. Studies with beginners and more advanced learners are needed. Second, participants were trained only in the use of definite and indefinite articles in a sentence-completion task. Other grammatical rules (e.g., singular-plural) and other tasks (e.g., reading comprehension, speaking, and writing) should be examined. Third, although the present study employed a between-group de-

sign and statistical analyses, a within-subject design (such as a repeated measures design) would be more beneficial to identify variables that are responsible for individual differences. Such data would allow us to make more general conclusions. Further studies in teaching and learning of second languages may help to clarify the interactive relations between rule and contingency control, and provide useful information to improve fluency in the long term.

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APPENDIX

Reviewers kindly pointed out some grammatical errors in the sentences. However, we did not correct them because those were the exact sentences used in this experiment.

Rule 1

Use the article *a* or *an* if the following noun is plural and modified by a numerical measure unit.

Example Sentences

1. It happened () hundred years ago.
2. The game started only () few minutes ago.
3. () thousand questions were asked at the meeting.
4. () billion mosquitoes hatched this summer.
5. He donated () million dollars.
6. I have () hundred things to do.
7. This television costs () thousand dollars.
8. The bread is () few days old.

Nonexample Sentences

1. It happened () hundreds of years ago.
2. We have () few minute left. We have to go now.
3. We had to answer () thousands of questions they asked us.
4. Do you know how many of () billion mosquitoes hatched this summer will survive?
5. He is () millions of dollars in debt.
6. I have completed () hundreds of things that I had listed last year.
7. We will never get back () thousands of dollars we spent in Las Vegas.
8. We will have () few day in London to stay.

Rule 2

Use the article *a* or *an* if the following noun is a product of the manufacturer or artist referred to.

Example Sentences

1. His car was () Ford.
2. The painting on the wall is () Picasso.
3. Tom's father has bought () new Cadillac.
4. That statue over there is () Rodin.
5. They showed () Honda to the President.
6. This car is () Nissan.
7. This sonata is () Mozart.
8. This museum has () Gogh.

Nonexample Sentences

1. () Ford we used to have was in a bad shape.
2. () Picasso is an artist of France.
3. I have driven his () new Cadillac.
4. () Rodin's statue we just saw is very famous.
5. There are () Honda dealers in this town too.
6. He works for () Nissan factory that received a well-known prize for its quality.
7. () Mozart was a musical composer in Austria.
8. Please show me () Gogh's picture you were talking about.

Rule 3

Use the article *the* if the following noun represents the whole class of things or species.

Example Sentences

1. () tiger and () cat belong to the same family of animals.
2. Did you hear that news over () radio this morning?
3. () automobile has changed our life a great deal.
4. She plays () piano well.
5. She played () violin for us.

6. () owl has large eyes.
7. I love to live in () city.
8. I spoke to him about it on () telephone.

Nonexample Sentences

1. Tom has () Tiger and () cat in his yard.
2. There was () radio in the box.
3. I wish to visit several () automobile factories in Toyota city.
4. They came to ask if they can borrow my () piano.
5. She has many () violins.
6. We saw () owls living in the forests.
7. There was () city across the river.
8. He doesn't have () telephone.

Rule 4

Use the article *the* if the blank is preceded by *by* and the following noun represents a measure unit.

Example Sentences

1. The workers get paid by () week.
2. I rent this house by () year.
3. We buy tea by () pound.
4. We borrow the car by () day.
5. McDonald pays their employees by () hour.
6. Water is sold by () liter.
7. My salary is about ¥250,000 by () month.
8. International phone calls to the U.S. cost about ¥100 by () minute.

Nonexample Sentences

1. Mary takes piano lessons once () week.
2. He has bought the house last () year.
3. The beef cost me twenty dollars () pound.
4. It is getting colder day by () day.
5. The bullet train runs 230 kilometers () hour.
6. This bottle can hold three () liters of water.
7. We get bonus every six () months.
8. Could you wait for () minute?