LEARNING SIMPLE AND COMPLEX SECOND LANGUAGE RULES UNDER IMPLICIT, INCIDENTAL, RULE-SEARCH, AND INSTRUCTED CONDITIONS

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This study examines the generalizability of claims by Reber (1989, 1993) about the implicit learning of artificial grammars to the context of adult second language acquisition (SLA). In the field of SLA Krashen (1981, 1982, 1985, 1994) has made claims parallel to those of Reber regarding the differential effectiveness of conscious learning of rules and unconscious incidental acquisition of rules. Specifically addressed are Reber’s and Krashen’s claims that (a) implicit learning is more effective than explicit learning when the stimulus domain is complex, and (b) explicit learning of simple and complex stimulus domains is possible if the underlying rules are made salient. One hundred four adult learners of English as a second language were randomly assigned to implicit, incidental, rule-search, or instructed computerized training conditions. Speed and accuracy of judgments of novel tokens of easy and hard rule sentence types presented during training were used as dependent measures. Results do not support the first of Reber’s and Krashen’s claims but do support the second. Implicit learners do not outperform other learners on complex rules, but instructed learners outperform all others in learning simple rules. Analyses of the effect

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of sentence type and grammaticality on learning suggest a transfer-appropriate processing account of the relationship among consciousness, rule awareness, training, and transfer task performance.

A number of SLA researchers have argued that drawing attention to certain forms by making them salient in the input can be beneficial to the rate of second language (L2) learning (e.g., Doughty, 1991; R. Ellis, 1993, 1994, 1995; Long, 1988, 1991, in press; Sharwood Smith, 1991, 1993), and Schmidt (1990, 1993, 1994a, 1995) has claimed that conscious awareness of the form of input at the level of "noticing" is a necessary condition for L2 development to occur (for discussion, see Robinson, 1995b, in press; Tomlin & Villa, 1994). In contrast, Krashen (1979, 1981, 1982, 1985, 1994) argues that two distinct processes operate in L2 development: a conscious process of deduction based on rule application, which results in a "learned" system, and an unconscious process of induction, which results in an "acquired" system. The latter system is claimed to be responsible for most L2 production, as the conditions under which the learned system can operate successfully seldom arise. In addition, the development of the learned system is restricted to a relatively small number of simple rules. Claims similar to those of Krashen have been made by Reber (1989, 1993). Reber's claims are based on experimental evidence of the learning that takes place during exposure to letter strings generated by artificial grammars. Like Krashen, Reber argues that learning can be both conscious and unconscious and that what can be learned by unconscious "implicit" learning processes exceeds what can be learned by "explicit" conscious processes. Like Krashen, Reber claims that complex rules can only be learned implicitly: Conscious explicit learning is only effective where the rules are simple and the structural pattern of covariance they describe is salient to the learner. The present study addresses two issues raised by Krashen's and Reber's claims.

The Generalizability Issue

The generalizability issue concerns the extent to which it is possible to generalize findings from Reber's studies to the context of adult SLA. To address this issue, the present study compared learning under the unconscious learning conditions operationalized in Reber's (1967, 1969, 1989, 1993) experimental studies (an implicit instructed to remember condition) and implied by Krashen's (1982, 1985) descriptions of the conditions leading to acquisition (an incidental focus on meaning condition). The present study also compared the conscious learning conditions operationalized in Reber's studies (a condition in which subjects were instructed to search for rules) and implied by Krashen's descriptions of the conditions under which learning takes place (an instructed condition). If Reber's claims about implicit and explicit learning are generalizable to adult SLA, then learning under implicit and incidental conditions should be equivalent, and learning under rule-search and in-
structed conditions should be equivalent. These claims are formalized in Hypothesis 1 of this study.

The Complexity Issue

The complexity issue concerns Reber's and Krashen's claims that complex rules can only be learned unconsciously, whereas it is possible to learn simple rules via conscious rule-search and instruction. In the present study, sentences illustrating a simple and a complex pedagogic rule of English were presented to learners during training under all conditions. The complexity difference of these pedagogic rules was empirically established following procedures described later and was subsequently confirmed by the results of this experiment. If Reber's and Krashen's claims regarding the relationship among rule complexity, learning, and consciousness are correct, then implicit and incidental learning should be superior to rule-search and instructed learning in the case of the complex rule but not the simple rule. These claims are formalized in Hypothesis 2 of this study.

RULE COMPLEXITY, CONSCIOUSNESS, AND LEARNING

The relationship between consciousness and induction is a growing topic of debate in cognitive psychology (Crick, 1995; Searle, 1990, 1992; Shanks & St. John, 1994; Vokey & Brooks, 1992). Reber (1967, 1969, 1989, 1993) approaches the issue of the relation among rule complexity, consciousness, and learning from a tradition of using artificial grammars to study the effects of different degrees of rule awareness on learning. In the training phase of these experiments, subjects are presented with strings of letters generated by an artificial, Markovian, left-to-right finite-state grammar (see Reber, 1993, p. 26). In the testing, or transfer, phase of experiments, subjects are presented with new examples of strings generated by the grammar and are asked to judge which of them are well formed. Subjects have been found to perform differently as a function of the different conditions under which training takes place. Training can be under implicit conditions, following instructions simply to memorize, or under explicit rule-search conditions, following instructions to attend in order to identify underlying rules. Explicit conditions can also include a preteaching component in which subjects are shown the grammar and are instructed to relate it to letter strings viewed during training.

Reber claims that these experiments produce evidence of the unconscious nature of implicit learning, as subjects trained under the memorization condition are often able to classify the strings into grammatical or ungrammatical at levels significantly better than chance yet are unable to articulate the rules of the grammar that produced the acceptable strings. Based on this evidence, Reber makes claims about the product and process of implicit learning: (a) The product is an abstract knowledge of the rules of the grammar, and (b) the process whereby this knowledge is accumulated is inaccessible to consciousness. Reber has also claimed that implicit learning is superior to explicit learning because on many occasions subjects trained under the
memorization condition perform better on the grammaticality judgment transfer task than those trained under the rule-search condition. However, Reber (1993, p. 49) does concede that if the stimulus domain is simple and the relevant structural properties are made salient, then explicit learning can be effective. A necessary precondition for the operation of implicit processes, Reber argues, is that the stimulus domain be complex. In this situation explicit attempts to learn will be relatively ineffective. Some SLA research has adopted Reber’s methodology for studying implicit and explicit learning, including the use of artificial finite state grammars (Nation & McLaughlin, 1986; Nayak, Hansen, Kreuger, & McLaughlin, 1990), although the generalizability of research using artificial grammars to the field of SLA has been questioned (Carr & Curran, 1994; McLaughlin, 1980; Schmidt, 1994b).

In the field of SLA, Krashen (1982, 1985, 1994) has made very similar claims to those of Reber. Krashen asserts that only “easy” rules are consciously learnable; “hard” rules must be induced via the unconscious processes that lead to acquisition.

The rules that we can learn and carry around in our heads for use as a Monitor are not those that are the earliest acquired, nor are they those that are important for communication. Rather, they are the simple rules, rules that are easiest to describe and remember. (Krashen, 1982, p. 97)

Krashen (1982, pp. 97–98) distinguishes between formal and functional dimensions of complexity. Wh-question formation, requiring extensive permutations of word order, is claimed to be a formally complex rule, in contrast to the suppliance of the morpheme for third person agreement, which is formally simple. The use of plural forms is functionally simple, whereas choice between definite and indefinite articles is functionally complex (cf. R. Ellis, 1990, p. 167).

Second Language Rule Complexity

The relevance of the distinction between levels of complexity of the rules to be learned under explicit and implicit conditions has been acknowledged by other SLA researchers, but no clear criteria for distinguishing the complexity of L2 rules have emerged from this debate (see Hulstijn, 1995; Robinson, in press). Tarone (1985) followed Krashen (1982) in distinguishing the simple rule for third person -s from the complex rule for article use. Tarone also included the rule for direct object pronoun occurrence along with third person -s as an example of a simple rule. However, Preston (1989) disagreed: “Object pronoun occurrence and article use are more subtle morpho-syntactic and semantic processes. Neither can have its rule for use stated easily” (p. 259). Bardovi-Harlig (1987) cited salience, meaning frequency in the input, as the criterion distinguishing wh-questions with preposition pied-pipping (e.g., To whom did John give the book?) from wh-questions with preposition stranding (e.g., Who did John give the book to?). The latter form, she argued, may be easier to learn because the structures are more frequent in the input. Salience could also be operationalized in perceptual terms to explain her results, as the relationship between the wh-word and the preposition that is crucial to understanding this form
of \textit{wh}-question formation is visually and acoustically more salient in preposition stranding than in pied-piping because in preposition stranding the \textit{wh}-word and the preposition occupy positions at the beginning and at the end of the structures. Perceptual salience may therefore relate to the ease with which structural elements of rules can be noticed and so learned (cf. Slobin, 1985).\footnote{Bialystok (1979) asked English-speaking high school learners of French to complete a grammaticality judgment task and to identify and explain the errors in sentences judged ungrammatical. She found that adjective errors were easier to detect than pronoun errors, which in turn were easier than verb errors. Bialystok explained this in terms of the difficulty of the rules with which the errors were associated: “Rules pertaining to single lexical items were easiest and those to general structures were most difficult” (p. 100). An example of the former is “Color adjectives always come before the noun.” An example of the latter is “To form the passé composé use the correct form of \textit{avoir} or \textit{être} plus the past participle of the verb” (p. 101).

Green and Hecht (1992) also asked their subjects, school-age German-speaking learners of ESL, to complete a grammaticality judgment test and to identify and explain any errors. When learners were able to do the former, but not the latter, they claimed they were displaying “implicit” knowledge. The rules that were most consistently correctly articulated they termed “easy” rules. These included “those that (1) referred to easily recognized categories; (2) could be applied mechanically; (3) were not dependent on large contexts: for example the morphological dichotomies like \textit{a/an}, \textit{who/which}, straightforward cases of \textit{some/any}, and simple word order” (p. 179). Hard rules, which were rarely identified or articulated, involved permutations and additions and deletions that were applied over larger structural contexts and invoked semantically opaque principles. These included those that involve aspect, such as the use of the continuous form or the perfect tense. . . . These are semantic distinctions that express a speaker’s perspective on a situation. . . . They do not allow of simple exhaustive descriptions and they are not always governed by features of the immediate linguistic context. (p. 180)

Linguistic Rules and Pedagogic Rules

Although researchers frequently invoke the notion of rule to describe what is learned during the process of instructed or naturalistic SLA, there are two senses of the term \textit{rule} that need to be distinguished (see Corder, 1988; Westney, 1994). The first sense of \textit{rule} implies a claim about the form in which knowledge of language is represented in the learner’s mind. However, current linguistic theories such as Universal Grammar (UG) (Chomsky, 1986), Lexical Functional Grammar (Bresnan, 1982), and Generalized Phrase Structure Grammar (Gazdar, Klein, Pullum, & Sag, 1985), for example, offer competing formalizations of linguistic rules, and there is no consensus over which is to be preferred as a basis for characterizing the representational development that occurs during SLA, although a great deal of recent research has been directed at exploring the predictions of UG for SLA (e.g., Cook, 1994;
Robinson, 1994c; White, 1992). In fact, the need to posit any rules of the type traditionally invoked by linguists as part of language representation (e.g., Pinker, 1991) is questioned by physicalist philosophers of mind (Crick, 1995; Searle, 1992) and by production systems and connectionist models of cognition (Holland, Holyoak, Nisbett, & Thagard, 1986; McClelland & Elman, 1986). Pedagogic rules, in contrast, are traditionally presented as simplified versions of linguistic rules that necessarily fall short of exhaustive treatment and avoid the theoretical characterization typical of linguistic rules (Faerch, 1986). This is necessary for pedagogic reasons because an exhaustive theoretical explanation of linguistic rules is an unsuitable means of presenting L2 information to learners. Given their limited scope and level of detail, how is it possible for pedagogic rules to be used to develop L2 competence?

The Effectiveness of Pedagogic Rules. The theoretical claims regarding the effectiveness of pedagogic rules can be grouped as follows: (a) the nonisomorphy, noninterface position, which claims that implicit knowledge, or competence, and explicit knowledge of pedagogic rules are different in kind and noninterfaced (Krashen, 1985; Prabhu, 1987); (b) the attention-focusing position, which claims that pedagogic rules are useful as devices for focusing attention on selected aspects of the structures to be learned, which are then noticed and subsequently learned as a consequence of inductive processes that are not accessible to consciousness (Seliger, 1979; Sharwood Smith, 1993); and (c) the understanding position, which claims that learning and applying pedagogic rules can lead to a conscious understanding of the structural regularities the rule applies to (Schmidt, 1990, 1993; Schmidt & Frota, 1986).

The “attention-focusing” and “understanding” positions are related to Schmidt’s (1990) claims that consciousness at the level of noticing the form of input is necessary to subsequent L2 learning, and that consciousness at the level of rule understanding is strongly facilitative of later learning. To this extent, pedagogic rule formats may be argued to facilitate learning because either (a) they simply cause learners to notice salient aspects of the structures or examples that the pedagogic rule is explaining or (b) comprehending the rule explanation itself, in conjunction with noticing examples, leads to an understanding of the structural regularities upon which the rule is based. It is possible that complexity affects structural noticing and rule understanding in the same way. Simply noticing the structures presented as examples is unlikely to be facilitative of learning if the structures themselves are too complex and the salient features of the structures that the rule regulates are consequently not obvious. Similarly, the more complex the explanation of a rule is, the less likely it is to lead to understanding, and the more likely it is to be ignored in favor of simpler rules of thumb, as in Schmidt’s (1990) choice of rules for learning the aspect of past tense Portuguese verbs: “I believed that I used two rules of thumb for aspectual choice—use imperfect for used to and for making excuses.... I was told some more complex rules for aspectual choice in class, but I ignored them” (p. 147).

These two components of pedagogic rules, the structures given as examples and the rule explanations, must be well matched if the possibilities of noticing and
Learning Simple and Complex Second Language Rules

Structure
+ simple

Explanation + brief
1 2

+ detailed
3 4

+ complex

Figure 1. Elements of pedagogic rules.

understanding are to be maximized for the learner, as illustrated in Figure 1. Effective simple and complex pedagogic rules, in which the level of detail of the explanation matches the extent of the covariance of the structures regulated by the rule, occupy quadrants 1 and 4. Less effective rules occupy quadrants 2 (a simple pattern of structural covariance explained in a complicated, overly detailed way) and 3 (a complex pattern of structural covariance explained in a brief, oversimplified form).

**Empirically Motivating the Easy–Hard Rule Distinction.** Given the lack of any clear agreement among SLA researchers about the objective criteria to apply in distinguishing the complexity of pedagogic rules, the present study used the expert judgment of experienced L2 teachers to identify the rules by seeking to establish consensus about rule complexity based on the subjective criteria underlying their shared expertise. The use of expert informants to rate the complexity of problem formats, in the absence of any accepted a priori criteria for determining complexity, is a standard one in experimental studies of problem-solving (Reed, Ackinclose, & Voss, 1990) and was felt to have the following advantages: (a) It provided empirical support for an easy-hard rule distinction; (b) it is replicable; (c) it has high face validity, as experienced ESL teachers are the group most qualified to make expert decisions about the factors influencing the complexity of pedagogic rule formats; (d) it was expected that teachers would use predominantly information-processing load criteria similar to those used by Krashen (i.e., ease of description and memorability) and it was the comparability of claims by Krashen and Reber regarding rule complexity and learning condition that the study sought to address; and (e) it allowed judgments about the linguistic and psycholinguistic complexity of the structures described by the rules to influence the final selection once a number of easy and hard pedagogic rule formats had been identified by the teachers' judgments.

The following steps were followed in identifying the easy and hard rules:
1. A grammaticality judgment test of structures that were estimated to range in degree of complexity and potential familiarity was given to a group of subjects comparable to the intended subjects for the present study in age, proficiency level, native language, and length of exposure to English.4
2. Items consistently and incorrectly rated ungrammatical were selected.
3. Pedagogic rules based on these structures were written by the researcher by analyzing the elements of the constructions.
4. These rules were given to 15 experienced ESL teachers to rate for complexity using a 7-point rating scale.5
5. After a delay of a week, the teachers were asked to rate the complexity of structures described by the rules using a Q-sort of cards illustrating the structures.6
6. The results were examined to see whether their rating of the complexity of the rules corresponded with the results of the Q-sort of the relevant structures.7
7. The rules identified were then examined to see whether a plausible explanation could be found confirming the easy–hard rule distinction.

This procedure clearly identified two rules and their corresponding structures as differing in complexity: a rule for describing how to form pseudoclefts of location, that is, Where Mary and John live is in Chicago not in New York (the hard rule), and a rule describing the fact that subject–verb (SV) inversion is allowed in sentences where adverbials of movement or location are fronted, that is, Into the house John ran/ran John (the easy rule).8 Adverbial conditioned constraints on SV inversion similar to those described in the easy rule have been observed in languages other than English (Bresnan & Kanerva, 1989), and it is possible to reduce this to a simple rule of thumb: If adverbials of location are fronted, SV inversion is possible; if adverbials of time are fronted, it is not.9 In contrast, pseudoclefts occur much less commonly in other languages and may be specific to English (see Baker, 1989, pp. 367–371; Celce-Murcia & Larsen-Freeman, 1983, pp. 404–408; McCawley, 1988, pp. 59–61). Pseudoclefts are also difficult to process in the L1 (Fletcher, 1980) and characterize written rather than spoken discourse (Prince, 1978), and it seems likely that the extensive additions and deletions necessary to form pseudoclefts from locational phrases would add to the difficulty of rules describing them for learners (see Appendix A).

METHOD
Design
The following factors are included in the present study: (a) Condition, with four levels—implicit, incidental, rule-search, and instructed—a between-subjects factor; (b) Rules, with two levels—simple versus complex—a within-subject factor; and (c) dependent measures, Speed and Accuracy of response to sentences presented in a grammaticality judgment posttest following training.

Research Hypotheses

Hypothesis 1. The implicit and incidental conditions will pattern together in all comparisons, and the explicit rule-search and explicit instructed conditions will pattern together in all comparisons.
Hypothesis 2. Performance on complex structures in the transfer session will be faster and more accurate for subjects trained under implicit and incidental conditions than for subjects trained under explicit rule-search and explicit instructed conditions.

Hypothesis 3. Performance on simple rules will be superior to performance on complex rules under all conditions, as measured by speed and accuracy of response.

Hypothesis 4. In all conditions, subjects will attest to being more aware of simple rules than of complex rules during the debriefing sessions.

Rationales for the Research Hypotheses

Hypothesis 1 relates Reber's implicit and explicit rule-search conditions to the incidental and explicit instructed conditions described by SLA researchers. The implicit and incidental conditions are alike in not requiring a conscious focus on the grammatical form of the stimuli presented during training. In the implicit condition the task instruction is to memorize sentences, whereas in the incidental condition the task instruction is to read the sentences to understand their meaning. Paradis (1994) suggests that implicit learning and incidental learning result in identical knowledge bases: “Implicit competence refers to the knowledge inferred from individuals' performance. [It is] acquired incidentally [and] stored implicitly” (p. 395). In contrast, the rule-search and instructed conditions involve a conscious focus on grammatical rules. Instructed learners must apply a previously learned rule to sentences during training, whereas rule-search learners must search for the rules. Krashen (1981) and Reber (1993) both claim that a conscious focus on grammatical rules will produce inferior learning relative to learning in implicit conditions (in the case of Reber) and incidental conditions (in the case of Krashen). This difference will be most pronounced if the stimulus domain is complex.

Hypothesis 2 is derived from Reber's statement that “implicit processing of complex materials has an advantage over explicit processing” (1989, p. 223) and from Krashen's that “only ‘easy' rules are learnable” (1982, p. 98). No specific claims are made for performance on the easy rule, in part because of Reber's claim that instruction can sometimes affect learning negatively because it “imposes a formalization of a structure that is . . . discoordinate with the tacit system [of existing knowledge]” (1993, p. 51), although some of Reber's findings (1993, pp. 50–53) show that instruction, if followed by exposure to relevant exemplars, can lead to superior learning for the instructed groups. Hypothesis 3 follows from the easy-hard classification of the rules and structures made by teachers. Hypothesis 4 follows from Reber's claim that even in the implicit condition subjects will become aware of rules if they are salient and that salience will be induced by the simplicity of the stimulus domain:

A rich and complex stimulus domain is a prerequisite for the occurrence of implicit learning. If the system in use is too simple, or if the code can be broken by conscious effort, then one will not see implicit processes. (1989, p. 220)

Similarly, in the rule-search condition, Reber claims that subjects will only become aware of simple rules. Complex rules can only be learned implicitly and will not be
accessible to awareness. Incidental learners are also more likely to become aware of simple rules, and instructed learners are more likely to forget, or imperfectly recollect, complex rules relative to simple rules.¹⁰

Subjects

Subjects for the study were 104 nonnative speakers of English (94 Japanese, 5 Korean, and 5 Mandarin Chinese), aged 19–34 years and enrolled in intermediate-level ESL courses in Hawai‘i. All subjects reported themselves to have received between 6 and 8 years of formal schooling in English. They were offered $10 in return for their participation in the study.

Data Collection Procedures

Pretesting. Subjects first completed a pretest consisting of the first 30 items of the grammaticality judgment test used in the pilot study to identify unfamiliar structures. Those who circled “ungrammatical” for the sentences corresponding to the simple and complex rules were selected for the study. The items were Into the house ran John and Where the cheese is is in the basket not in the bag. More extensive testing of their knowledge of these rules was avoided because drawing attention during the pretest to the structures to be learned during the treatment would have threatened the validity of the study, as both the implicit and incidental conditions required that subjects should not be aware of, or looking for, grammatical rules during the training sessions.

The Training Phase. After completing the pretest, subjects were randomly assigned to one of the four conditions. All conditions consisted of a training and a transfer phase. The training phase consisted of a familiarization task, in which the demands of training conditions were explained on a computer screen. The explanations of training tasks for all conditions consisted of the same example sentences in the same order. This was followed by two training sessions during which subjects in all conditions saw 40 sentences, presented in a fixed random order and timed to appear for 10 seconds. Twenty sentences were generated by the simple rule, and 20 sentences were generated by the complex rule.

The implicit condition was explained to subjects as a memory test. Subjects viewed sentences conforming to the two rules and were instructed to remember them. To ensure delivery of the memorization condition, follow-up questions requiring “yes” or “no” responses appeared after each sentence. These asked whether a particular sequence of two words had occurred (e.g., “Did the words Mary and fall occur next to each other in the sentence?”). Word pairs were randomly selected for follow-up sentences. Subjects responded using the key c for correct, or yes, or m for mistake, or no. They were given feedback in the form of a “correct” or “incorrect” message after each response.

The incidental condition was explained to subjects as an exercise in reading for meaning. Subjects completed a “yes” or “no” comprehension question about the
Learning Simple and Complex Second Language Rules

propositional content of each sentence they viewed (Appendix B). They responded with c for correct, or yes, or m for mistake, or no, and were also given “correct” or “incorrect” feedback after each response.

The rule-search condition was explained as an exercise in identifying the rules illustrated by sentences. Subjects answered questions requiring a “yes” or “no” response (e.g., “Have you identified the rules yet? Are you still looking for the rules?”) using the key c for correct, or yes, or m for mistake, or no. Because questions were open-ended, no feedback was given, and the next stimulus appeared on the screen immediately following the response keystroke.

In the instructed condition, subjects read through the rules that were the focus of the study. The rule formats were the same as those given to teachers to rate for complexity (Appendix A). Four key points of the explanations of these rules were rehearsed during the familiarization phase. These related to violations of the grammaticality of sentences that were constitutive of the ungrammatical types presented during the transfer phase (Appendix C). Subjects consulted written versions of these rules during the computerized training sessions. During each session, subjects saw sentences and then were asked metalinguistic questions relating the sentences to the explanation of the rule given in the familiarization phase (e.g., “Did the verbs used agree in tense? Did the subject of the sentence come after the verb?”). Each question required a “yes” or “no” response. As in the implicit and incidental conditions, subjects received “correct” or “incorrect” feedback to each response, which remained on the screen until they responded to the “Press any key to continue” prompt.

The Transfer Phase. After completing the two training sessions, subjects were asked to complete a grammaticality judgment task on the computer. They were instructed to respond as quickly as they could to each sentence by pressing c if it was grammatical or m if it was ungrammatical. Subjects completed a familiarization task and then saw a randomized set of 20 grammatical and 20 ungrammatical sentences. Accuracy and speed of response, in milliseconds, were recorded. After finishing, subjects were given a set of five questions and asked to write answers in their native language.

Materials

Training and transfer sessions were completed on Macintosh SE, SEIi, and Ilsi computers with standard qwerty keyboards. Sentences were presented in black, on a white background, in Geneva 12-point font. The training and transfer programs were written using Mindlab software (Meike, 1988).

Training Set Sentences. The training set sentences consisted of 20 grammatical structures illustrating the simple rule and 20 grammatical structures illustrating the complex rule (Appendix E). The sentences illustrating the simple rule were made up of four tokens of five types. These types were the same as the types used in the explanation of the rule given to teachers to rate for complexity and given to subjects
to study in the instructed condition. Type 1 sentences were in the order subject + verb + location phrase (e.g., Paul drove across the city). Type 2 sentences were in the order location phrase + verb + subject (e.g., Up the road came Eric). Type 3 sentences were in the order location phrase + subject + verb (e.g., Round the track Bill raced). Type 4 sentences were in the order subject + verb + time phrase (e.g., Lori ate at five o’clock). Type 5 sentences were in the order time phrase + subject + verb (e.g., In the afternoon Elaine arrived).

The grammatical sentences illustrating the complex rule were also made up of four tokens of five types. These types were also motivated by the description of the complex rule presented to teachers to rate for complexity. Type 1 sentences contained two conjoined clauses that contrasted the locations of two things (e.g., The girl plays in the park and the boy plays in the yard). Type 2 sentences had singular subjects and two forms of the verb be (e.g., Where Sue is is in the car not on the boat). Type 3 sentences had plural subjects, requiring agreement with a plural form of the main verb be (e.g., Where Jim and Amy are is in the kitchen not in the garden). Type 4 sentences had singular subjects and lexical main verbs (e.g., Where the President lives is in Washington not in Chicago). Type 5 sentences contained plural subjects and lexical main verbs (e.g., Where Steve and Mark swim is in the pool not in the ocean). Additionally, two of the four tokens illustrating the complex type 2, 3, 4, and 5 sentences consisted of the optional phrase beginning with not, described at the end of the complex rule. Only simple vocabulary and common English names were used in each sentence.\(^\text{13}\)

Transfer Set Sentences. The transfer set sentences were made up of 10 grammatical easy rule sentences, 10 grammatical hard rule sentences, 10 ungrammatical easy rule sentences, and 10 ungrammatical hard rule sentences (Appendix F). The grammatical sentences were two new tokens of each of the 10 types presented during the training sessions. The ungrammatical sentences were systematic violations of these grammatical types, as described in the rules presented to teachers to rate for complexity and to subjects to study in the instructed condition (see Table 1).

Debriefing Questionnaire. The debriefing questions were written in Japanese for Japanese subjects and in English for other subjects. Space was left beneath each question for subjects to write answers (Appendix D).

Analyses

To address Hypothesis 1, repeated-measure analyses of variance (ANOVAs) of accuracy and reaction time of responses to all transfer set sentences were performed. Planned comparisons were made between implicit versus incidental and rule-search versus instructed conditions and between the joint performance of the implicit and incidental versus the rule-search and instructed conditions. These were followed by pairwise post-hoc comparisons of all conditions. To address Hypothesis 2, the factor Rule was removed from the ANOVAs and separate analyses were made of easy and hard rule performance. These were followed by the series of planned and post-hoc comparisons used to address Hypothesis 1. For Hypothesis 3, the factor Condition
Learning Simple and Complex Second Language Rules

Table 1. Summary of the transfer set sentence types

| Easy rule grammatical types | Type 1 (S + V + location)—e.g., Lisa fell onto the grass. |
| Type 2 (location + V + S)—e.g., Across the street raced Tom. |
| Type 3 (location + S + V)—e.g., Through the window Maria stared. |
| Type 4 (S + V + time)—e.g., Peter woke at eight o’clock. |
| Type 5 (time + S + V)—e.g., On her birthday Gabi sang. |

| Easy rule ungrammatical types | Type 1 (time + V + S—no inversion without location first)—e.g., On Saturday night danced Charlie. |
| Type 2 (V + S + time—no inversion without location first)—e.g., Golled Debbie in the morning. |

| Hard rule grammatical types | Type 1 (S + V + location and S + V + location)—e.g., The pen is in the box and the pencil is in the drawer. |
| Type 2 (S singular + be)—e.g., Where the car is is in the driveway. |
| Type 3 (S plural + be)—e.g., Where the apples are is in the bowl. |
| Type 4 (S singular + lexical verb)—e.g., Where Judy teaches is at the university. |
| Type 5 (S plural + lexical verb)—e.g., Where Mary and Joe relax is by the pool. |

| Hard rule ungrammatical types | Type 1 (no inversion with “where”)—e.g., Where is Bill is in the country. |
| Type 2 (invariant singular “be”)—e.g., Where Carl writes are at a desk. |
| Type 3 (required tense agreement)—e.g., Where the bird is was in the sky. |
| Type 4 (required “where”)—e.g., What the King lives is in a palace. |
| Type 5 (required “not” for contrasting locations)—e.g., Where Mark works is in America in Japan. |

was removed and ANOVAs for each condition were performed separately to identify whether the factor Rule was significant. For Hypothesis 4, a chi-square analysis of subjects’ responses to the debriefing questionnaire was performed. Given the large number of comparisons made in the present study, the alpha level was set at $p < .01$.

RESULTS

Hypothesis 1

The repeated-measure ANOVA for Accuracy shows significant main effects for Condition ($F(3, 100) = 6.799$, $p < .01$) and Rule ($F(1, 100) = 70.566$, $p < .01$) (see Table 2 and Figure 2). There is no significant main effect for Grammaticality and no significant interaction between Rule and Condition. There is an almost significant interaction of Grammaticality and Condition ($F(3, 100) = 3.953$, $p = .0104$) and a significant interaction of Rule and Grammaticality ($F(1, 100) = 9.253$, $p < .01$). The planned comparisons show a significant difference only between the rule-search and instructed conditions ($F(1, 50) = 15.465$, $p < .01$). Scheffé post-hoc comparisons show the instructed condition to be significantly more accurate than the implicit and rule-search conditions ($p < .01$) and an almost significant difference between the instructed and incidental conditions ($p = .0185$).
Table 2. ANOVA table for accuracy to transfer set sentences

| Source                                      | df | F Value | p Value |
|---------------------------------------------|----|---------|---------|
| C                                           | 3  | 6.799   | .0003   |
| Subject (Group)                             | 100| 70.566  | .0001   |
| R                                           | 1  | 3.300   | .0235   |
| R*C                                         | 3  | 5.232   | .0243   |
| R*Subject (Group)                           | 100| 3.953   | .0104   |
| G                                           | 1  | 14.706  | .0001   |
| G*C                                         | 3  | 1.334   | .1200   |
| G*Subject (Group)                           | 900| 9.253   | .0030   |
| S                                           | 9  | 1.255   | .2940   |
| S*C                                         | 27 | 9.044   | .5480   |
| S*Subject (Group)                           | 900| 6.911   | .0001   |
| R*G                                         | 1  | 2.584   | .0104   |
| R*G*C                                       | 3  | 9.308   | .0001   |
| R*G*Subject (Group)                         | 27 | 1.268   | .1641   |
| R*G*S                                       | 27 | 0.944   | .5480   |

Dependent: Accuracy

Note: C = Condition (implicit, incidental, rule-search, instructed); G = Grammaticality (grammatical, ungrammatical); R = Rule (easy rule, hard rule); S = sentence token.

Figure 2. Mean accuracy on easy and hard rules.
Learning Simple and Complex Second Language Rules

Table 3. ANOVA table for reaction time to transfer set sentences

| Source | df | F Value | p Value |
|--------|----|---------|---------|
| C      | 3  | 3.502   | .0182   |
| R      | 1  | 84.053  | .0001   |
| R*C    | 3  | 0.531   | .6618   |
| R*Subject (Group) | 100 | 1.995 | .1609 |
| G      | 1  | 0.515   | .6727   |
| G*C    | 3  | 2.171   | .0001   |
| G*Subject (Group) | 100 | 1.198 | .2243 |
| S      | 9  | 22.171  | .0001   |
| S*C    | 27 | 1.198   | .2243   |
| S*Subject (Group) | 900 | 3.142 | .0793 |
| R*G    | 1  | 2.413   | .0711   |
| R*G*C  | 3  | 11.986  | .0001   |
| R*G*Subject (Group) | 100 | 1.466 | .0598 |
| R*S    | 9  | 17.319  | .0001   |
| R*S*C  | 27 | 1.022   | .4340   |
| R*S*Subject (Group) | 900 | 9.581 | .0001 |
| G*S    | 9  | 0.640   | .9218   |
| G*S*C  | 27 | 0.463   | .6402   |
| G*S*Subject (Group) | 900 | 3.502 | .0182 |

Dependent: Reaction time

Note: C = Condition (implicit, incidental, rule-search, instructed); G = Grammaticality (grammatical, ungrammatical); R = Rule (easy rule, hard rule); S = sentence token.

The repeated-measure ANOVA for Reaction Time shows a main effect for Condition that approaches significance \(F(3, 100) = 3.502, p = .0182\) and a significant main effect for Rule \(F(1, 100) = 84.053, p < .01\) (see Table 3 and Figure 3). Mean reaction time for the rule-search condition is lower than for all other conditions and mean reaction time to the easy rule is lower than to the hard rule. There are no significant interactions. The planned comparisons show only an effect approaching significance for a difference between rule-search and instructed learners \(F(1, 50) = 5.835, p = .0175\).

**Summary of the Evidence for Hypothesis 1.** There is no difference in accuracy or reaction time between the implicit and incidental conditions, and they therefore pattern together, partially confirming Hypothesis 1. However, the instructed condition is significantly more accurate than the rule-search condition. There is also a trend supporting the superior speed of the rule-search condition relative to other conditions and an almost significant effect for a difference in speed between the rule-search and instructed conditions \(p = .0175\). These results, therefore, lend only partial support to Hypothesis 1.
Figure 3. Mean reaction time on easy and hard rules.

Figure 4. Mean accuracy on grammatical and ungrammatical hard rule sentences.

Hypothesis 2

The repeated-measure ANOVA for complex rule Accuracy shows a significant main effect for Grammaticality ($F(1, 100) = 11.308, p < .01$) and an almost significant interaction between Grammaticality and Condition ($F(3, 100) = 3.722, p = .0139$) (see Figure 4). All subjects are more accurate in judging grammatical sentences than they are in judging ungrammatical sentences, with this difference being most
Learning Simple and Complex Second Language Rules

Figure 5. Mean accuracy on grammatical and ungrammatical easy rule sentences.

pronounced for instructed subjects. Planned comparisons ($F(1, 50) = 8.517, p < .01$) and Scheffé post-hoc comparisons show instructed learners to be more accurate than rule-search learners.

The repeated-measure ANOVA for simple rule Accuracy shows a significant main effect for Condition ($F(3, 100) = 7.494, p < .01$) but no significant main effect for Grammaticality or interaction of Grammaticality and Condition (see Figure 5). The planned comparisons show a significant difference between the rule-search and instructed conditions ($F(1, 50) = 13.246, p < .01$) and between the combined implicit and incidental versus the instructed and rule-search conditions ($F(1, 100) = 7.142, p < .01$). Scheffé post-hoc comparisons show a significant difference between instructed learners and implicit and rule-search learners and an almost significant difference between instructed and incidental learners ($p = .03$).

The repeated-measure ANOVA for complex rule Reaction Time shows that the main effect for Condition approaches significance ($F(3, 100) = 3.508, p = .0181$) (see Figure 6). Planned comparisons show an almost significant difference between the rule-search and instructed learners ($F(1, 50) = 5.019, p = .0273$).

The repeated-measure ANOVA for simple rule Reaction Time shows no significant main effects or interactions, and no significant differences are revealed by the planned comparisons (see Figure 7).

Summary of the Evidence for Hypothesis 2. Hypothesis 2 is not supported. The implicit and incidental conditions are not superior to the rule-search and instructed conditions in accuracy or speed of performance on the hard rule. Although the implicit and incidental conditions perform similarly, the instructed condition is more accurate than the rule-search condition on both rules, and there is an almost
Figure 6. Mean reaction time on grammatical and ungrammatical hard rule sentences.

Figure 7. Mean reaction time on grammatical and ungrammatical easy rule sentences.
significant difference in speed between the rule-search and instructed conditions on hard rule sentences. There is also a significant difference between the instructed and implicit conditions in accuracy on easy rule sentences and an almost significant difference between instructed and incidental conditions.

**Hypothesis 3**

The repeated-measure ANOVAs for simple and complex rule Accuracy for each condition show that only for subjects in the implicit condition is there no significant difference between easy and hard rules ($F(1, 25) = 3.779, p = .0632$). For subjects in the incidental ($F(1, 25) = 14.818, p < .01$), rule-search ($F(1, 25) = 23.736, p < .01$), and instructed conditions ($F(1, 25) = 38.670, p < .01$), there is significantly more accurate performance on easy rules. Only for the instructed condition is there a significant main effect for Grammaticality ($F(1, 25) = 32.529, p < .01$) and an interaction of Rule and Grammaticality ($F(1, 25) = 10.740, p < .01$).

The repeated-measure ANOVAs for simple and complex rule Reaction Time reveal a significant difference between reaction times to easy and hard rule sentences for subjects in the implicit ($F(1, 25) = 30.254, p < .01$), incidental ($F(1, 25) = 28.696, p < .01$), rule-search ($F(1, 25) = 18.813, p < .01$), and instructed conditions ($F(1, 25) = 12.489, p < .01$). In all cases, performance on easy rule sentences is fastest. There are no significant main effects for Grammaticality for subjects in any condition and a significant interaction of Rule and Grammaticality only for the instructed condition ($F(1, 25) = 7.714, p = .0102$).

**Summary of the Evidence for Hypothesis 3.** Hypothesis 3 is supported. Responses to easy rule sentences are significantly faster than responses to hard rule sentences for subjects in all conditions and significantly more accurate for all subjects except those in the implicit condition. For implicit learners, mean accuracy for easy rule sentences is higher than mean accuracy for hard rule sentences and the difference approaches significance ($p = .0632$). However, there is a main effect of Grammaticality and a significant interaction of Rule and Grammaticality for the instructed condition. Instructed subjects perform less accurately on ungrammatical compared to grammatical sentences, particularly in the case of the hard rule.

**Hypothesis 4**

The awareness data is based on coded responses to only one of the debriefing questions (Appendix D), "Can you say what the rules were?" Answers to this question were used to distinguish subjects in terms of their ability to verbalize the easy and hard rules presented during training (see Robinson 1994b, 1995a, for results of analyses of answers to the other debriefing questions). Complete rule explanations were not required. If subjects described any elements of the easy and hard rules presented during training either by a structural description or by presenting and commenting upon an example of an easy or hard rule sentence, subjects were coded as able to verbalize. Coding also included information about which rule was
Table 4. Frequencies of subjects verbalizing one rule and both rules

|            | Implicit | Incidental | Rule-Search | Instructed | Total |
|------------|----------|------------|-------------|------------|-------|
| Easy rule  | 1        | 1          | 1           | 6          | 9     |
| Hard rule  | 5        | 4          | 2           | 0          | 11    |
| Both rules | 0        | 2          | 4           | 8          | 14    |

verbalized. Frequencies of subjects verbalizing only the easy rule, and verbalizing both rules are displayed in Table 4. Only subjects who verbalized one rule were included in the analysis for Hypothesis 4. A one-way chi-square was performed on the total frequencies for subjects verbalizing only the easy rule and only the hard rule.

Of those subjects verbalizing only one rule, there is only a small difference between those verbalizing the easy rule (9 subjects) and the hard rule (11 subjects). The results of the chi-square with Yates' correction are not significant ($\chi^2 = .200, p > .01$). As Table 4 shows, instructed subjects verbalizing one rule all reported the easy rule, with a trend toward reporting the hard rule for subjects in other conditions. A chi-square of the frequency of easy and hard rule verbalizability by those in the combined implicit and incidental group, with Yates' correction, was also not significant ($\chi^2 = 3.36, p > .01$). Pairwise comparisons of easy and hard rule verbalization for the instructed versus implicit, incidental, and rule-search conditions, however, are all significant (instructed vs. implicit $\chi^2 = 11.66, p < .01$; instructed vs. incidental $\chi^2 = 8.67, p < .01$; instructed vs. rule-search $\chi^2 = 8.53, p < .01$).

Summary of the Evidence for Hypothesis 4. Hypothesis 4 is not supported. Few subjects verbalized either of the rules, and there is no significant difference between those verbalizing the easy rule and those verbalizing the hard rule. There are, however, significant differences between instructed subjects and all other subjects in this respect, with those instructed subjects verbalizing the easy rule and subjects in other conditions tending to verbalize the hard rule.

DISCUSSION

The Generalizability and Complexity Issues

Results of the main analyses provide partial support for the claim that findings from Reber's research are generalizable to the domain of SLA but do not support Reber's and Krashen's claims that rules regulating complex stimulus domains are most effectively learned under unconscious conditions. The analyses for Hypotheses 1 and 2 support the claim for comparability of performance by those in the implicit and incidental conditions, but not by those in the rule-search and instructed conditions. There are no significant differences between implicit and incidental learners in speed and accuracy of performance on transfer set exemplars of the easy and hard rules (see Figure 2). However, instructed learners are significantly more accurate than rule-search learners in performance on both rules, and there is an effect approaching
significance for the greater speed of the rule-search learners relative to the instructed learners (see Figure 3). These results are in line with the findings reported by Reber, Kassim, Lewis, and Cantor (1980) that explicit instruction, accompanied by structured exposure to relevant examples, has advantages over rule-search and implicit learning and also with N. Ellis's (1993) finding for superior learning of a second language rule of morphophonology by those in a structured exposure condition, relative to those in an implicit learning condition. They also suggest that, despite their similarity with respect to consciousness, a more important difference between the instructed and rule-search conditions lies in the deductive versus inductive learning processes they facilitate (see DeKeyser, 1994, 1995; Seliger, 1975).

Comparing the accuracy of transfer test performance for Reber's implicit and rule-search conditions does reveal findings similar to those reported by Reber, as implicit learners are more accurate on hard rule sentences than rule-search learners, whereas rule-search learners are more accurate on easy rule sentences (see Figure 2). However, the main analyses were performed using measures of accuracy and reaction time to all easy and hard rule sentences in the transfer set. Further analyses of accuracy on individual sentence types (see Table 5) show that implicit learners perform better than any other condition on hard rule sentences, using measures of chance and above-chance performance. Rule-search learners are worst, being accurate and above chance only on three of the hard rule sentence types confirming Reber's claim that conscious rule-search can be effective if the stimulus domain is simple but will be less effective than implicit learning if the domain is complex.

A comparison of the relative effectiveness of incidental and instructed conditions on easy and hard rules does not support Krashen's claims. The results of the main analyses performed to address Hypothesis 2 show that instructed learners are significantly more accurate than incidental learners on easy rules. Analyses of chance and above-chance performance on hard rule sentence types summarized in Table 5 also reveal superior learning of the hard rule by instructed learners, because their responses are above chance and accurate on 7 of the 10 types, compared to above-chance and accurate performance on only five hard rule sentence types by incidental learners.

The Effect of Grammaticality and Type on Learning

While the factor Grammaticality only influenced the performance of instructed subjects on hard rule sentences (see Figure 4), further analyses, not motivated by the main hypothesis of the study, showed that there were differences across all conditions with respect to performance on individual types of sentences using measures of chance and non-chance performance (see Table 5). These show the significant interaction of Rule and Grammaticality in measures of accuracy for the instructed condition to be attributable to above-chance inaccurate performance on two ungrammatical hard rule sentence types. Subjects trained in the instructed condition performed at chance on a third ungrammatical hard rule sentence type. Subjects trained in the rule-search and incidental conditions performed at chance on four of the hard rule ungrammatical sentence types. However, subjects trained in the im-
Table 5. Percentage of correct responses to easy and hard rule sentence types presented in the transfer set

| Sentence Type                                      | % Correct |
|---------------------------------------------------|-----------|
|                                                   | Imp      | Inc      | Rule-s  | Inst     |
| Easy rule grammatical types                       |          |          |         |          |
| Type 1 (S + V + location)                         | 86.5  | 82.7  | 84.6  | 92.3          |
| Type 2 (location + V + S)                         | 36.5* | 36.5* | 28.8* | 78.8          |
| Type 3 (location + S + V)                         | 65.4  | 73.1  | 61.5  | 96.2          |
| Type 4 (S + V + time)                             | 67.3  | 73.1  | 90.4  | 88.5          |
| Type 5 (time + S + V)                             | 69.2  | 76.9  | 76.9  | 92.3          |
| Easy rule ungrammatical types                     |          |          |         |          |
| Type 1 (time + V + S)                             | 64.6  | 73.8  | 67.7  | 84.6          |
| Type 2 (V + S + time)                             | 70.8  | 78.5  | 73.8  | 74.6          |
| Hard rule grammatical types                       |          |          |         |          |
| Type 1 (S + V + location and S + V + location)    | 71.2  | 71.2  | 80.8  | 80.8          |
| Type 2 (S singular + be)                          | 65.4  | 75    | 40.4* | 88.5          |
| Type 3 (S plural + be)                            | 63.5  | 61.5  | 51.9* | 88.5          |
| Type 4 (S singular + lexical verb)                | 50*   | 61.5  | 61.5  | 84.6          |
| Type 5 (S plural + lexical verb)                  | 61.5  | 55.8* | 57.7* | 76.9          |
| Hard rule ungrammatical types                     |          |          |         |          |
| Type 1 (no inversion with Where)                  | 61.5  | 53.8* | 53.8* | 71.2          |
| Type 2 (invariant singular be)                    | 59.6  | 44.2* | 53.8* | 34.6?         |
| Type 3 (required tense agreement)                 | 63.5  | 38.5* | 48.1* | 53.8*         |
| Type 4 (required Where)                           | 48.1* | 48.1* | 55.8* | 23.1?         |
| Type 5 (required not for contrasting locations)   | 69.2  | 76.9  | 65.4  | 67.3          |

Note: * = performance at chance; ? = performance above chance but inaccurate; Imp = implicit condition; Inc = incidental condition; Rule-s = rule-search condition; Inst = instructed condition.

Implicit condition performed above chance on four of the hard rule ungrammatical types and to this extent performed better on the hard rule than subjects trained in any other condition.

Learning Effects and Transfer of Training Task Demands

Explanations of results of implicit learning studies have either argued that the results of such learning are evidence for abstraction of rule-based knowledge (Reber, 1989) or knowledge based on memory for fragmentary instances encountered during training (Dulany, Carlson, & Dewey, 1984; Perruchet & Pacteau, 1990; Vokey & Brooks, 1992), whereas others have argued that the effects of implicit learning are attributable to a synergy of both forms of knowledge (Matthews et al., 1989). Shanks and St. John (1994) and Whittlesea and Dorken (1993) have argued that there is no reason, a priori, to associate the products of learning under any condition with a knowledge base composed of either entirely rule-based or entirely memory-based knowledge and that the processing demands of tasks are likely to encourage the development of a knowledge base composed of a blend of these two sources of knowledge. However, task conditions will predispose learners to rely more heavily on one than
Learning in the Instructed Condition. Subjects in the instructed condition were accurate at above-chance levels on all types apart from three hard ungrammatical types. Performance on type 3 sentences was at chance, and performance on types 2 and 4 was above chance but inaccurate. Why should performance on these ungrammatical types be poorer in the instructed condition than performance on ungrammatical easy rule sentence types, which was significantly above chance and accurate?

One explanation lies in the additional processing and reasoning demands imposed by making judgments using knowledge of the hard rule relative to making judgments based on knowledge of the easy rule. To make a grammaticality judgment, one can either scan a sentence to find evidence confirming the hypothesis that it is grammatical or scan a sentence to find evidence of ungrammaticality that would disconfirm the hypothesis. The latter is the proper procedure, as transfer set sentences in the present study always contained a number of correctly applied grammatical subrules that could have been mistakenly taken as confirming evidence of grammaticality in cases where the sentence also contained a grammaticality violation. In the case of the easy rule, it is relatively easy to check disconfirming evidence: If there is subject–verb inversion, check to see whether adverbials of location are at the front; if they are not, only then is it ungrammatical. Of course, instructed subjects were made aware of this rule during training. It is difficult to discover it through rule-search or to otherwise induce it, as the poor accuracy of subjects in the other conditions demonstrates.

To correctly judge an ungrammatical hard rule sentence, however, subjects must scan the sentence in order to identify whether any of the five possible violations occur. This may be done serially, by checking to see whether each of the possible violations has occurred, or in parallel. There is no simple rule of thumb to guide this search. Here the search for disconfirming evidence is potentially more effortful than in the ungrammatical easy rule sentences, as on occasion it may be the last of the five violations checked that leads to disconfirmation of the hypothesis of grammaticality. Given the effortfulness of this task, the results for poor performance on hard rule ungrammatical sentences may reflect “confirmation bias” in the instructed group, that is, the tendency to seek confirmation of a hypothesis by looking for confirming examples rather than by looking for disconfirming examples (Evans, Newstead, & Byrne, 1993; Klayman & Ha, 1989; Wason, 1960). In this case, noticing that the first or second, or most salient, of the possible hard rule grammaticality violations has not been made could lead subjects to wrongly assume that none of the others had been made.

The difference in the confirmation–disconfirmation bias could explain the difference in accuracy of responses to ungrammatical easy rule and ungrammatical hard rule sentences for subjects trained in the instructed condition. The above-chance
performance on type 1 and type 5 hard ungrammatical violations suggests that the violations contained in these sentences were checked first. If they were not violated, the sentence was wrongly judged grammatical. This suggests a depth of search of two grammaticality violations for subjects in the instructed condition. Violations in type 2 and type 3 hard rule ungrammatical sentences, which contain a potentially confusing combination of verb tense agreement and number agreement violations, do not appear to have been consistently checked by instructed learners.16 Neither were type 4 hard ungrammatical violations, which posed problems across all conditions, consistently checked, due possibly to the fact that knowledge of the acceptability of sentence-initial wh-words such as what led learners to overgeneralize the rule.

**Learning in the Implicit Condition.** In contrast to the instructed condition, the major task demand in the implicit condition is that subjects remember which words co-occur. Noticing allowable co-occurrences of words that relate to specific hard rule violations may thus have facilitated performance by implicit subjects. This could account for superior performance on hard ungrammatical type 2 and 3 sentences, which are ungrammatical by virtue of the constraints on the allowable co-occurrence of verbs that differ in tense and of verbs that differ in number marking. A similar explanation could be given for accurate above-chance performance on hard ungrammatical type 1 sentences, as in these sentences the two verbs are separated by a subject nominal. The co-occurrences of verb forms in hard ungrammatical sentence types 1, 2, and 3 therefore contradict the bigram and trigram knowledge picked up during the memorization task. Like all other subjects, implicit learners were accurate and above chance on type 5 sentences. Type 5 sentences are noticeably semantically ill-formed, and possibly they are rejected on this basis alone. They were only at chance on type 4 sentences. Type 4 sentences violate no bigram knowledge that could have been picked up during training; they could have been wrongly accepted for the same reason given for subjects in the instructed condition. Alternatively, and in line with the explanation given for above-chance performance on types 1, 2, and 3, these sentences could have been wrongly accepted by implicit learners because the bigram is in, which these sentences contain, does occur in the grammatical sentences, and subjects could have wrongly based their judgment of grammaticality on this knowledge.

Although this explanation of performance in the implicit condition is similar to that of Hayes and Broadbent (1988), who describe implicit learning as the "passive aggregation of information about the co-occurrence of environmental events and features" (p. 251), an important modification is necessary for the purposes of explaining implicit learning of the data in the present study. Unlike many of the artificial grammar experiments reported by Reber (1993), in which letters occurred in the same bigram pairings in the training and transfer phase, in this experiment the same words did not co-occur in the sentences viewed during the training and transfer tasks. Transfer sentences were novel examples of the same type presented during training. Whereas the verb is and its forms, which are critical to identifying the violations in type 1, 2, and 3 hard rule ungrammatical sentences, were necessarily repeated, the other lexical verbs were not repeated, nor were the subjects of senten-
ces that separate the verbs in type 1 violations. Thus, memory for the pairs of co-occurring verbs presented in training would need to be accessed together with knowledge of differences in plural and singular forms and past and present tense forms that moderated their relationship in the training set sentences in order to make the judgment of ungrammaticality on transfer set sentences of types 1, 2, and 3. Activation of prior knowledge of grammatical subrules therefore likely played a part in the decisions about grammaticality made in the implicit condition, which were, however, triggered by noticing restrictions on co-occurring words, rather than by a search for more global rules. Although subjects in the implicit condition did perform at above-chance levels on more ungrammatical hard rule sentence types than the instructed subjects, the mean performance for accuracy on all hard ungrammatical sentences for this group is still low, about 60%. While implicit learning could have occurred in the preceding manner, it is likely to have resulted in piecemeal associative knowledge of allowable co-occurrences of words, supported by access to knowledge of plurality and tense. To this extent, the memorization strategies resulting in this knowledge base are likely to have been insufficient for the acquisition of knowledge of the allowable discontinuities in word order that characterize the easy rule grammatical type 2 structures, as these take place over a wider window of associative learning and attention than two or three words. Correctly judging the acceptability of easy rule grammatical type 2 sentences involves distinguishing adverbials of location, which allow subject-verb inversion when fronted, from adverbials of time, which do not. Noticing this type of information is unlikely to result from the memorization strategy, and so this constraint was not learned in the implicit condition.

CONCLUSION

Effect of instruction studies examining the relationship between instruction, attention to form, and learning have typically been conducted under classroom conditions (e.g., Harley, 1993; Spada & Lightbown, 1993). Given the nature of such research, it is unclear what learning processes result from instruction and what the significant interactions of learning conditions, as distinct from instructional treatment and the formal characteristics of language are. Experimental studies of the effect of instruction are necessary to identify such processes and to thereby address Krashen's claim that the aggregate advantages of instruction summarized by Long (1988) were due not to conscious attention to form but to the fact that instructional treatments created acquisition-rich environments in which comprehensible input was available in sufficient quantities to promote incidental learning or acquisition. Given, also, that much of the debate about the effectiveness of formal instruction has revolved around the question of whether to teach grammar rules (Krashen, 1985, 1992; Lightbown & Pienemann, 1993; Odlin, 1986; Rutherford & Sharwood Smith, 1988), it is particularly necessary to supplement quasi-experimental demonstrations of the effectiveness of instruction in pedagogic rules (e.g., Eckman, Bell, & Nelson, 1988; Gass, 1982; Lightbown & Spada, 1990) with evidence from studies using full experimental designs. In the present study, I have explained learning under the implicit and
instructed conditions in functional terms, arguing that they are fundamentally similar because both occur as a consequence of consciously held processing strategies adopted in response to specific training task demands. Task demands led to differences in learning, not differential access to conscious and unconscious systems (cf. Blaxton, 1989; Robinson, 1995a, 1995b; Stadler, 1995).

The limitations of the present study, such as the limited generalizability of the experimental conditions, and the limitations of the procedure for selecting the easy and hard pedagogic rules must be acknowledged. Findings from studies adopting theory-driven approaches to distinguishing rule complexity are needed to supplement those of the present study (cf. DeKeyser, 1995; Hulstijn, 1995; Hulstijn & De Graaff, 1994). Longer periods of exposure to greater quantities of input may also have improved implicit and incidental learning, particularly given Krashen's characterization of acquisition as a process that takes more time than instructed learning, requiring massive exposure to comprehensible input (cf. N. Ellis, 1993). There is also a need to accompany the grammaticality judgment measures of learning used here with measures of ability for productive use. Future experimental studies of SLA, correcting for these limitations, may help give substance to those frequently invoked theoretical constructs, implicit and explicit L2 knowledge (R. Ellis, 1993; Odlin, 1986; Robinson, 1994a, in press), and help establish a firmer empirical footing for current speculation about the relative contributions of implicit learning and explicit instruction to classroom-based L2 development.

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NOTES

1. However, although one of Slobin's operating principles—pay attention to the beginnings and ends of strings—can be invoked to support the claim that preposition stranding is more salient than pied-piping, and therefore more easily noticed and so learned, it is also true that another of Slobin's principles—avoid discontinuities—makes the reverse prediction about learnability. Preposition stranding who-to is a discontinuous structure, in contrast to the continuous to whom.

2. Clearly pedagogic or instructional rules have a representational function in that they aim to develop competence, but it is unclear how to characterize competence representationally, and there is considerable debate over this. Reber (1993) has speculated that connectionist networks “may well be able to provide a formal foundation for examining the underlying processes that we have long felt lies at the core of implicit learning” (p. 106). Like many contemporary philosophers of mind (see also Crick, 1995; Humphrey, 1992), Searle (1992) also favors a connectionist framework for language representation, arguing that knowledge of language is properly characterized not as unconscious rules of the type formalized in UG but as association patterns that are not produced by mental representations that in some way reflect those patterns, but are produced by neurophysiological structures that need have no resemblance to the patterns at all. The hardware produces patterns of association . . . but the patterns of association play no causal role in the production of patterns of behavior—they just are those patterns of behavior. (p. 344)

In contrast, Zobl (1995), in a reinterpretation of Krashen's acquisition-learning distinction, has suggested that acquired L2 knowledge is the result of access to innately specified deep unconscious linguistic rules of the symbol-processing kind characterized by UG.

3. Evidence from studies of expert judgment in other areas of the curriculum indicates that consistency of judgment in problem classification tasks can be achieved as a result of formal training in a knowledge domain like physics (see Chi, Glaser, & Rees, 1982). However, experience in applying that knowledge domain to practical problems in everyday life can also be drawn on to establish consistency of judgment, and there is some evidence indicating that the knowledge base established by experience is superior to that established
Learning Simple and Complex Second Language Rules

by purely formal academic training (see Ceci & Liker, 1986; Voss, 1986). These studies lend support to the decision to ask experienced teachers of ESL to provide the estimate of rule complexity.

4. This was a group of 20 Japanese junior college students, aged 19–20 years, who were in Hawai‘i studying conversational English. All had received 7 years of formal English instruction in Japan and had been placed into intermediate-level language programs at the University of Hawai‘i.

5. The 15 ESL teachers who completed the rating scale judgments of rule complexity and the Q-sort of the structures were all native English speakers with at least 4 years of ESL teaching experience. Mean length of teaching experience was 11 years. All had postgraduate qualifications, and many had M.A.s in ESL or TEFL. They participated in this study voluntarily.

6. A Q-sort is a procedure for ranking items such as the sentences used in this study in order of difficulty. Each card in the Q-sort illustrated the key structure that exemplified the rule to be learned by subjects. This structure had been the focus of the rule explanations that the teachers had earlier rated for complexity. Teachers were given the cards and asked to rank them in terms of the difficulty of the sentences they contained for L2 learners, with most difficult at the top, least difficult at the bottom. Equivalent items could be indicated by clipping cards together.

7. With regard to the way in which the easy or hard distinction was represented to teachers, I asked them to complete a questionnaire that read, "Please look through the following eight rules of English. Rate them in terms of their difficulty for a second language learner of English using the following rating scales." I was not specific about the L2 learners’ LI background, although I did say the learners were at an intermediate level.

8. The rating scale results were converted from a -3 (easy) to +3 (hard) scale to a score from 1 to 7 for each rule format. Mean rating for the hard pseudocleft rule was 5.93 (SD = 1.1) and for the easy word order rule 3.6 (SD = 1.45). Fourteen of the 15 teachers rated them as distinct in complexity in this direction. Only one teacher rated them as equivalent at +1, a difficulty score of 5. The Q-sort results were converted to a score from 1 to 8, with 8 given to the structure placed on top of the stack, indicating that it was most difficult, and 1 given to the structure at the bottom, indicating that it was the easiest. Mean score for the hard structure was 7.55 (SD = 0.64), and for the easy structure was 3.86 (SD = 1.59). All teachers agreed with this difference in structural complexity.

9. It is true that the characterization of this easy rule, as offered to teachers to rate for complexity and as presented to learners in the instructed condition, does not take account of differences in the acceptability of inverted sentences that are attributable to such factors as definitiveness or choice of tense and aspect. As one anonymous reviewer points out, the inversion in the following sentence may be thought to improve with indefiniteness: Into the wall crashed the/this man. It is also true that continuous aspect and future tense forms with will make the inversion unacceptable, as in the following example: Into the wall is crashing/will crash the man. However, the pedagogic rule presented here was a simplified version of the linguistic facts, not an exhaustive description. As such, some teachers may well choose to follow up exposure to the rule as described in this paper with examples of the preceding sort, thus further developing learner awareness of the constraints on the generalization captured by the pedagogic rule format. That is, the easy pedagogic rule described here is typical of many pedagogic rules that abstract away from the complexity of linguistic details in order to identify regularities for learners (see Robinson & Ha, 1993, p. 433). It was for this reason that alternations in the definiteness of noun phrase referents or of the choice of aspect were avoided in presenting examples to learners, as characterizing this additional information would have no doubt added to the complexity of the rule for learners.

10. Verbalizability was used as a way of operationalizing awareness and of identifying the objects of awareness. Although it is true that one can be aware of something without being able to put it into words, for the present study it was necessary to identify precisely which of the rules subjects were aware of, and so answers to the debriefing question to verbalize rules were used in the initial analyses. Further analyses of the awareness data are described in Robinson (1994b, 1995a).

11. The delivery of the incidental condition required not only that the subjects read for meaning but also that the input be comprehensible. This was found to be so, as the mean accuracy of response to the 40 comprehension questions asked during the second trial of training for incidental subjects was at 92.4% and ranged from 78% to 100% for all subjects. It was therefore felt that the input presented to learners in the incidental condition met the requirement that it be comprehensible.

12. I reminded each subject of the grammaticality judgment pretest that they had done and the procedure followed there for distinguishing grammatical from ungrammatical sentences. The transfer task familiarization phase also included an exercise in which subjects had to rate the grammaticality of two sentences before they proceeded, and I monitored this to ensure they understood the task.

13. It must be noted that the sentences based on the complex rule are, on average, longer than those based on the simple rule. This is a consequence of the difference in structural complexity of the sentences generated by these two rules, as the complex rule requires learners to understand and apply a greater
number of additions and deletions to the possible form of the sentence than is the case with the simple rule. Whereas this difference in length probably directly affected the differences in reaction time to easy and hard rule sentences in the transfer task, it did so equally for all conditions, enabling valid comparisons between performance in each condition to be made.

14. In the transfer task, 26 subjects in each condition made responses to 20 grammatical items and 20 ungrammatical items, forming a total of 40 responses to sentence tokens. These were divided between easy and hard rules, so there were 10 hard rule ungrammatical sentences, 10 hard rule grammatical sentences, 10 easy rule ungrammatical sentences, and 10 easy rule grammatical sentences. Using the chi-square statistic to calculate the probability of the distribution of accurate and inaccurate responses to, for example, the 10 easy rule grammatical sentences for the 26 subjects in each condition gives a ratio of 151–109 as significantly above chance at the \( p < .01 \) level of significance (\( \chi^2(151) - \chi^2(130) = 21 \times 21/130 = 3.39 + 2 = 6.7 \)). This means those scoring over 58% accurate or below 42% accurate are performing above chance.

15. The explanation of the effects of learning under the different conditions given here is compatible with similar accounts given by Blaxton (1989), Roediger, Weldon, and Challis (1989), and Graf and Ryan (1990) of the effects observed during performance on implicit memory tests, and it differs from separate systems accounts of the effects of learning under implicit conditions such as those of Krashen (1982) and Paradis (1994) (see Robinson 1995a, 1995b).

16. As one anonymous reviewer notes, it is possible that this evidence of subrule ordering in checking the grammaticality of hard rule sentences resulted from a perceived temporal constraint, in the sense that subjects felt pressure to be fast in the transfer grammaticality judgment test and thus made decisions on the basis of the occurrence of those violations that were easiest to check quickly.

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APPENDIX A:
THE EASY AND HARD RULE FORMATS

THE EASY RULE
Some sentences contain a subject a verb and a location phrase or a time phrase. Here are some examples:

Joan (subject) crashed (verb) into the wall. (location phrase)
John (subject) slept (verb) in the morning. (time phrase)

Location and time phrases can be moved to the front of the sentence:

Into the wall Joan crashed.
On Tuesday morning John slept.

The verb can also come before the subject, but only when location phrases are at the front of the sentence:

Into the wall (location phrase) crashed (verb) Joan, (subject)
*On Tuesday morning (time phrase) slept (verb) John.

The * means this sentence is ungrammatical.

THE HARD RULE
Some sentences tell about the locations of two things:

e.g., Alice stands on the right and Judy stands on the left.

We can change this sentence to focus on one of the locations:

e.g., Where Alice stands is on the right.

To make sentences like these, first choose the subject whose location you want to emphasize, ‘Alice,’ then place ‘where’ in front of it:

Where Alice

Next, follow the subject with the verb, ‘stands’:

Where Alice (subject) stands (verb)

Note that the verb cannot come before the subject:

*Where stands (verb) Alice (subject)

The * means this sentence is ungrammatical.
Next add a singular form of the verb 'be' which agrees in tense followed by the phrase describing the location of the subject:

Where Alice stands is on the right.
Where Alice stood was on the right.

If the verb does not agree in tense, the sentence is ungrammatical:

*Where Alice stands was on the right.

The second location can also be contrasted with the focus location by joining them using 'not.' This 'not' is required. Without it the sentence is ungrammatical.

Where Alice stands is on the right not on the left.
*Where Alice stands is on the right the left.
APPENDIX B:
QUESTIONS PRESENTED TO
SUBJECTS IN THE INCIDENTAL
CONDITION TRAINING PHASE

S = stimulus sentence; Q = follow-up question.

S. Paul drove across the city.
Q. Was Paul travelling by sea?

S. Mary sank under the sea.
Q. Was Mary at home?

S. Jill walked over the bridge.
Q. Was Jill taking a walk?

S. John ran into the house.
Q. Was John driving a car?

S. Up the road came Eric.
Q. Was Eric travelling by plane?

S. Off the horse fell Amy.
Q. Was Amy riding a camel?

S. Down the hill slid Jack.
Q. Was Jack in the classroom?

S. Onto the boat jumped Sue.
Q. Did Sue get onto the boat?

S. Round the track Bill raced.
Q. Was Bill studying at home?

S. Through the forest Jane went.
Q. Was Jane watching a movie?

S. Past the river Helen rode.
Q. Did Helen fall into the river?

S. Out of the shop Jim rushed.
Q. Was Jim in a hurry?

S. Lori ate at five o'clock.
Q. Was Lori eating her lunch?

S. Ron left on Thursday night.
Q. Did Ron stay until Friday?

S. Roland returned at midnight.
Q. Was Roland asleep by midnight?

S. Peggy slept on Tuesday morning.
Q. Was Peggy tired?

S. In the afternoon Elaine arrived.
Q. Did Elaine arrive at night?
S. At the weekend Randy exercised.
Q. Did Randy exercise every day?
S. On Christmas day Lily phoned.
Q. Did Lily forget to call on Christmas day?
S. In the morning Claire jogged.
Q. Did Claire exercise in the morning?
S. The girl plays in the park and the boy plays in the yard.
Q. Were the boy and girl playing together?
S. The letter is in the bag and the book is on the chair.
Q. Is the letter on the chair?
S. John works in the shop and Mary works in the hospital.
Q. Is John a doctor?
S. The milk is in the glass and the coffee is in the jar.
Q. Is there any coffee left?
S. Where Helen is is in New York.
Q. Is Helen in Honolulu?
S. Where the phone is is in the bedroom.
Q. Is there a phone in the bedroom?
S. Where Sue is is in the car not in the boat.
Q. Is Sue in the boat?
S. Where the cheese is is on the plate not in the basket.
Q. Is the cheese in the basket?
S. Where the children are is on the beach.
Q. Are the children in bed?
S. Where Eric and Jill are is at home.
Q. Is Eric alone in the house?
S. Where Jim and Amy are is in the kitchen not in the garden.
Q. Are Jim and Amy swimming?
S. Where the people are is in the park not in the church.
Q. Are there any people in the park?
S. Where the cat sleeps is on the floor.
Q. Does the cat sleep on the floor?
S. Where Bill eats is at the table.
Q. Does Bill eat off the floor?
S. Where the President lives is in Washington not in Boston.
Q. Does the President live in New York?
S. Where Jane sits is on the sofa not on the stool.
Q. Does Jane sit on the sofa?
S. Where the birds nest is in the tree.
Q. Do the birds nest in the garage?
S. Where Paul and Jack surf is at Waikiki.
Q. Do Paul and Jack surf at Ala Moana?
S. Where Steve and Mark swim is in the pool not in the ocean.
Q. Does Steve swim in the pool?
S. Where the students meet is in the library not in the restaurant.
Q. Do the students meet in the restaurant?
APPENDIX C:
KEY POINTS OF THE EASY AND HARD RULES REHEARSED DURING THE INSTRUCTED CONDITION TRAINING PHASE

EASY RULE

Into the wall crashed Joan.

Study these questions and understand the answers.

1. Was a location phrase used in the sentence?
   (answer c, yes)
2. Did the subject of the sentence come after the verb?
   (answer c, yes)
3. Was the phrase of time or location at the front of the sentence?
   (answer c, yes)
4. Was a time phrase used in the sentence?
   (answer m, no)

HARD RULE

Where Alice stands is on the right not on the left.

Study these questions and understand the answers.

1. Was a contrasting location introduced by not used?
   (answer c, yes)
2. Did the subject of the sentence come after the verb?
   (answer m, no)
3. Was the verb 'to be' in the singular form?
   (answer c, yes)
4. Did the verbs used agree in tense?
   (answer c, yes)
APPENDIX D: JAPANESE VERSION OF THE DEBRIEFING QUESTIONNAIRE

次の質問に日本語で答えてください。

1. この実験をするのは、楽しかったですか？

2. この実験は、やさしかったですか、むずかしかったですか？

3. 最初の2つの実験をしている時に、文法の規則に気づきましたか？

4. 最初の2つの実験をしている時に、文法の規則をみつけようとしましたか？

5. どのような規則が言えますか？
APPENDIX E:
THE TRAINING SET SENTENCES

EASY RULE SENTENCES

Easy Grammatical Type 1

i. Paul drove across the city.
ii. Mary sank under the sea.
iii. Jill walked over the bridge.
iv. John ran into the house.

Easy Grammatical Type 2

i. Up the road came Eric.
ii. Off the horse fell Amy.
iii. Down the hill slid Jack.
iv. Onto the boat jumped Sue.

Easy Grammatical Type 3

i. Round the track Bill raced.
ii. Through the forest Jane went.
iii. Past the river Helen rode.
iv. Out of the shop Jim rushed.

Easy Grammatical Type 4

i. Lori ate at five o'clock.
ii. Ron left on Thursday night.
iii. Roland returned at midnight.
iv. Peggy slept on Tuesday morning.

Easy Grammatical Type 5

i. In the afternoon Elaine arrived.
ii. At the weekend Randy exercised.
iii. On Christmas day Lily phoned.
iv. In the morning Claire jogged.

HARD RULE SENTENCES

Hard Grammatical Type 1

i. The girl plays in the park and the boy plays in the yard.
ii. The letter is in the bag and the book is on the chair.
iii. John works in the shop and Mary works in the hospital.
iv. The milk is in the glass and the coffee is in the jar.
Hard Grammatical Type 2

i. Where Helen is is in New York.
ii. Where the phone is is in the bedroom.
iii. Where Sue is is in the car not in the boat.
iv. Where the cheese is is on the plate not in the basket.

Hard Grammatical Type 3

i. Where the children are is on the beach.
ii. Where Eric and Jill are is at home.
iii. Where Jim and Amy are is in the kitchen not in the garden.
iv. Where the people are is in the park not in the church.

Hard Grammatical Type 4

i. Where the cat sleeps is on the floor.
ii. Where Bill eats is at the table.
iii. Where the President lives is in Washington not in Boston.
iv. Where Jane sits is on the sofa not on the stool.

Hard Grammatical Type 5

i. Where the birds nest is in the tree.
ii. Where Paula and Jack surf is at Waikiki.
iii. Where Steve and Mark swim is in the pool not in the ocean.
iv. Where the students meet is in the library not in the restaurant.
APPENDIX F:  
THE TRANSFER SET SENTENCES

EASY RULE SENTENCES

Easy Grammatical Type 1
i. Craig walked into the room.
ii. Lisa fell onto the grass.

Easy Grammatical Type 2
i. Across the street raced Tom.
ii. Out of the door ran Kate.

Easy Grammatical Type 3
i. Through the window Maria stared.
ii. Over the town Lucy flew.

Easy Grammatical Type 4
i. Peter woke at eight o’clock.
ii. Wendy started on Monday morning.

Easy Grammatical Type 5
i. On her birthday Gabi sang.
ii. In the evening Dick studied.

Easy Ungrammatical Type 1
i. On Saturday night danced Charlie.
ii. At nine thirty left Robert.
iii. In the afternoon spoke Ian.
iv. On Sunday painted Graham.
v. At night ate Judy.

Easy Ungrammatical Type 2
i. Golfed Debbie in the morning.
ii. Died Stan on Friday night.
iii. Departed Fred at nine thirty.
iv. Crawled Mick through the tunnel.
v. Slipped Maggy off the roof.

HARD RULE SENTENCES

Hard Grammatical Type 1
i. The pen is in the box and the pencil is in the drawer.
ii. Lisa reads in the bedroom and Mick reads in the study.
Hard Grammatical Type 2

i. Where L.A. is is in California.
ii. Where the car is is in the driveway not in the road.

Hard Grammatical Type 3

i. Where the apples are is in the bowl.
ii. Where Ann and Ian are is at the movies not at the zoo.

Hard Grammatical Type 4

i. Where Judy teaches is at the university.
ii. Where Peter waits is by the stairs not in the cafe.

Hard Grammatical Type 5

i. Where my parents vacation is in Europe.
ii. Where Maria and Joe relax is by the pool not on the beach.

Hard Ungrammatical Type 1

i. Where is Bill is in the country not in the city.
ii. Where cooks Jim is in the kitchen not in the bathroom.

Hard Ungrammatical Type 2

i. Where Carl writes are at a desk not on the floor.
ii. Where the soldiers fight are in Europe not in Hawaii.

Hard Ungrammatical Type 3

i. Where the bird is was in the sky not in the sea.
ii. Where the plane lands was in the airport not at the dock.

Hard Ungrammatical Type 4

i. What the King lives is in a palace not in an apartment.
ii. What the dog is is in the yard not in the house.

Hard Ungrammatical Type 5

i. Where the horse stands is in the field in the barn.
ii. Where Mark works is in America in Japan.