

# CONSCIOUSNESS AND FOREIGN LANGUAGE LEARNING: A TUTORIAL ON THE ROLE OF ATTENTION AND AWARENESS IN LEARNING

---

## ABSTRACT

A number of issues concerning the role of consciousness in foreign language learning are identified, defined, and shown to be essentially the same as issues that have been much discussed and investigated in psychology. The psychological literature is reviewed (together with the available literature on foreign language learning) to find answers to the following questions: Is attention necessary for learning? Is awareness at the level of "noticing" required for learning? Is awareness at higher levels, such as awareness of abstract rules or principles, required for learning? The first conclusion to be drawn is that not all learning is deliberate or intentional (for example, it is clearly possible to learn vocabulary through extensive reading, without a clear intention to learn new words), but all learning does require attention (if readers do not pay attention to new words when they encounter them, they will not learn them). It is logically impossible to ever prove this claim, but it should be quite possible to falsify it. One convincing demonstration of learning without attention would be enough, but so far there have not been any. Several studies purporting to demonstrate learning without attention are shown to really have demonstrated only a low level of learning associated with a low level of attention. The question of whether subjective awareness is necessary (or even helpful) for learning is more controversial, and the evidence leads to less clear-cut conclusions. A low level of awareness, called here "noticing," is nearly isomorphic with attention, and seems to be associated with all learning. A higher level of awareness ("understanding") is involved in contrasts between explicit learning (learning on the basis of conscious knowledge, insights, and hypotheses) and implicit learning (learning based on unconscious processes of generalization and abstraction). It can be shown that many claims of unconscious learning in this sense follow either from over-estimation of

what has been learned (abstract rules are claimed to exist unconsciously without adequate justification) or from under-estimation of what learners know consciously (often they are not even asked). Not all cases of this sort can be conclusively settled, however, so implicit learning remains a possibility with interesting theoretical and practical implications.

## INTRODUCTION: THE PROBLEM OF CONSCIOUSNESS

Some questions that are important for foreign language pedagogy are not very interesting theoretically. Similarly, many teachers believe that theory and research in the field of foreign language learning or second language acquisition (SLA) are often irrelevant to their concerns (Pica, 1994). It seems to me that questions concerning the role of consciousness in learning, however difficult to answer, are important to all. These are issues that capture the attention of philosophers, psychologists, linguists, psycholinguists, and second and foreign language learning theorists. These issues are also of concern to language teachers, who have their own beliefs and positions with respect to these matters and for whom there are pedagogical consequences.

There are three major points of view represented in the foreign language teaching community. The first is the most traditional, and stresses the importance of conscious understanding and study for success in learning foreign languages. In this view, mistakes in a foreign language are the result of either not knowing the rules, forgetting them, or not paying attention. Generally speaking, the view is that knowledge comes first, followed by practice in applying what has been taught. For classroom practice, the traditional view leads to explicit discussion of the rules and regularities of the foreign language, comparisons with the native language, practice, and error correction. The value of communicative practice is seldom denied, but this sometimes takes second place to decontextualized explanation and drill. At the institutional level, there is likely to be lots of discussion about which structures should be included in the syllabus for the first semester, the second semester, and so on.

The second major point of view is that language learning (or “acquisition”) is unconscious or subconscious (no one seems to make a distinction between the two terms). Language learning in natural settings (both L1 and L2) takes place through interaction and the processing of input. Successful language learning in schools also results from understanding and participating in social interaction with classmates and the teacher about topics that matter. Students can achieve a high level of proficiency, including a high level of grammatical accuracy, without any explicit focus on the language itself (Faltis and Hudelson, 1994, provide a recent clear expression of this view). If this view is correct, it follows that there should be little or no concern with a structural syllabus for language learning (since learners learn at their own pace and according to a natural, built-in syllabus), pedagogy should be meaning-oriented rather than form-oriented, and there should be little or no direct explanation of grammar, focused practice, or error correction (Krashen, 1982, 1993; Krashen and Terrell, 1983; Prabhu, 1987). Many who hold this view consider themselves progressive or modern, although the tension between the focus-on-language school and the focus-on-meaning school might be better viewed as a series of wide pendulum swings over the past century, rather than a straightforward progression. Those in the “communication” camp often view their more traditional colleagues as Neanderthals, and those who think language learning is hard work and requires considerable conscious effort may scoff at those who delude themselves into thinking that “chatting” is an effective way to learn a foreign language.

A third, intermediate view is clearly emerging in the foreign language profession. In this view, communicative, meaning-focused instruction is essential, but not all language features can be acquired when learners’ attention is focused exclusively on meaning. A focus on form appears to be necessary and desirable, especially if provided within a communicative context (Lightbown and Spada, 1994). While input and interaction are important to establish a secure level of communicative proficiency, this is not because language learning is unconscious, but because input and interaction, attention, and awareness are all crucial for learning, and when understanding and application are poorly synchronized, there will be problems: fluency but premature stabilization in the case of completely meaning-focused learning, abstract knowledge but limited ability to perform in the case

of overly conscious learners or those have been instructed with an excessive focus on form. In this view, explicit instruction does not lead directly to automatic, productive use, but direct instruction, consciousness-raising, and a focus on form are valuable to the extent that they help learners bring order to the input they encounter, facilitate understanding, and boost or support natural acquisition processes (DeKeyser, 1994; Doughty, 1991; N. Ellis, 1993, 1994a; R. Ellis, 1990, 1993; 1994; Fotos, 1993; Fotos and Ellis, 1991; Harley, 1994; Hulstijn, this volume; Hulstijn and de Graaff, 1994; Larsen-Freeman and Long, 1991; Lightbown and Pienemann, 1993; Long, 1988, 1991, in press; Loschky and Bley-Vroman, 1990; Rutherford, 1987; Skehan, 1992; VanPatten, 1993; White, Spada, Lightbown, and Ranta, 1991; Sharwood Smith, 1991, 1992; Terrell, 1991).

The purpose of this chapter is to examine the theoretical foundation for these views about pedagogy, through a review of the literature on consciousness and learning. It must be noted, however, that there are many in the scientific community who are skeptical of the possibility of integrating notions of consciousness into theory. Hardcastle (1993) provides a succinct summary of these objections:

- Theory cannot capture a first person perspective.
- Consciousness is causally inert with respect to explaining cognition.
- The notion “consciousness” is too vague to be a natural kind term.

The third objection, that “consciousness” is too vague to be a natural term, has been expressed in the foreign language field by McLaughlin (1990), who argues that the folk term is too ambiguous to be of any use. Sometimes when we say that we have done something consciously, we mean that we have done it deliberately, with intention and with effort, and when we say that we have done something unconsciously, we mean that we did it without meaning to or without effort. Other times, we might say that we learned something unconsciously, without paying attention to it or without noticing it. On other occasions, we talk of conscious knowledge,

usually meaning knowledge (either deliberately sought or serendipitously found) that we are able to articulate, in contrast to knowledge that is intuitive and inexpressible. Such a range of partly distinct and partly overlapping meanings is not very helpful, so in this chapter I will deal separately with what I think are the main issues in the conscious/unconscious controversy in foreign language learning:

- Can there be learning without intention?
- Can there be learning without attention?
- Can there be learning without noticing?
- Can there be learning without understanding?

In response to Hardcastle's first objection to integrating consciousness into any theory, that theory cannot accommodate a first person perspective, I recognize the difficulties in this, but it should be tried. Consciousness is essentially a private, subjective phenomenon, perhaps inaccessible to precise measurement. Perhaps it would be better if we could leave it out of our theories, but it seems to me that if we require this we deny by fiat any role for the private, subjective experiences of learners as they grapple with language. In the 1970's, there was a movement to focus the emerging SLA field away from what teachers do and more towards what goes on inside the heads of language learners. Yet this orientation has seldom been realized, in the sense that learners are almost never asked about their learning or their accounts incorporated into theories of learning. This dismissal of what learners might have to say about their own learning is related to Hardcastle's third objection to incorporating consciousness into scientific description: it doesn't matter, because consciousness is epiphenomenal and plays no causal role in learning or any other aspect of life. In this chapter, I will argue against this epiphenomenalist position.

Even if the notion of consciousness is put aside to deal with more specific and precise aspects of what we mean by that term, there are many thorny methodological problem in trying to decide whether learning is intentional or incidental, attended or unattended, explicit

or implicit. One solution to this problem is to adopt the “implicit stance” (Reber, 1993, p. 9). Assuming the primacy of the implicit, the role of unconscious processes is taken as axiomatic and the unconscious is assumed to be the default mode of learning. A second solution to the problem is to put the burden of proof on those who claim that particular processes are unconscious or that a particular knowledge base is tacit. In this paper I will adopt this second stance and will try to see the extent to which it is possible to defend the radical proposition that there is no such thing as unconscious learning. If there is no unconscious learning, it cannot be primary.

## CAN THERE BE LEARNING WITHOUT INTENTION?

There is one sense in which much learning, including language learning, can be said to be unconscious and no one will argue. Both intentional and incidental (unintended) learning are common and easy to demonstrate experimentally. In many experimental tasks, it doesn't matter at all whether someone intends to learn or not or what part of the task they intend to master. What matters is how the task forces the material to be processed (Anderson, 1985; Eysenck, 1982). However, when a task does not focus attention on what needs to be learned, then intentional learning is superior if the motivation to learn leads to the exercise of effective cognitive and metacognitive strategies (Pintrich, 1989).

Elley (1991) summarized studies of the effects of book floods on students' acquisition of a second language in elementary schools, reporting that children who are exposed to high-interest story books are consistently found to learn the target language more quickly than students learning by means of structured (audio-lingual) programs. Krashen (1989) has reviewed the evidence that extensive reading is effective for spelling and vocabulary acquisition, incidental learning in the sense that in trying to do one thing (comprehend meaning in reading), something unintended (vocabulary acquisition) occurs.

Theories of SLA recognize that intentions do not cause learning by themselves. Gardner, whose well-known model of the role of motivation in second language learning in classroom settings stresses the importance of integrative motivation, argues that the desire to learn a second language is useless by itself and that motivated learners achieve more than unmotivated learners only because they are more active learners (Gardner, 1985, 1989). Crookes and Schmidt (1991) argue that motivation and intentions are important only when learners have choices. In foreign language learning, these choices often include whether to take classes or not, whether to pay attention in class or not, and so on. What is crucial to learning is attention, and the intention to learn may support this but it is not the only source.

Returning to the example of vocabulary learning, it seems reasonable to assume that one reason we learn words through reading is that when reading we pay attention to them. As N. Ellis (1994c) points out:

... people are strategic, active processors of information. Contra Krashen (1989), it does not follow that vocabulary has been subconsciously acquired from the fact that we have not been taught the vast majority of the words that we know. That we have not been taught vocabulary does not entail that we have not taught ourselves. An explicit vocabulary learning hypothesis would hold that there is some benefit to vocabulary acquisition from the learner noticing novel vocabulary, selectively attending to it, and using a variety of strategies to try to infer its meaning from the context. (p. 219)

One key issue in theories of incidental learning is whether or not the knowledge gained through incidental learning is represented mentally in a different fashion from knowledge gained through intentional approaches to learning. Following Lamendella (1977), who proposed that meaning oriented acquisition involves subcortical structures, in particular those parts of the limbic system responsible for drives and desires, Paradis (1994) argues that knowledge acquired incidentally leads to an implicit competence that is available for automatic use, while deliberate learning leads only to explicit knowledge, differently represented in the brain and not available for automatic use. However, evidence from psychological experiments generally does not support the idea that the incidental vs. intentional distinction results in different knowledge types (Dienes, Broadbent, and Berry, 1991; McLaughlin, 1990).

In summary, there can indeed be learning without intention, but this does not imply the existence of unconscious learning in any other sense.



## CAN THERE BE LEARNING WITHOUT ATTENTION?

The orthodox position in psychology and cognitive science is that there is no learning without attention (Carlson and Dulany, 1985; Fisk and Schneider, 1984; Kihlstrom, 1984; Logan, 1988; Moray, 1959; Nissen and Bullemer, 1987; Posner, 1992; Shiffrin and Schneider, 1977; Velmans, 1991; Wolford and Morrison, 1980). This claim is often related to models of memory; it is argued that unattended stimuli persist in immediate short-term memory for only a few seconds at best, and attention is the necessary and sufficient condition for long-term memory storage to occur. In SLA as well, the claim has been made frequently that attention to input is necessary for input to become intake that is available for further mental processing (Carr and Curran, 1994; Scovel, 1991; Tomlin and Villa, 1994; van Lier, 1991, 1994). A number of researchers and theorists have further argued that there may be two types of learning (e.g., declarative and procedural, or explicit and implicit, or rule-based and instance-based) that differ in their reliance on awareness, but both depend on attention (Carr and Curran, 1994; Nissen and Bullemer, 1987; Tomlin and Villa, 1994).

Many experiments have provided support for the position that attention is necessary for encoding in long-term memory, predominantly using two experimental research paradigms: selective attention and divided attention. In selective attention studies, subjects are asked to pay attention to one source of information while ignoring another. There is plenty of evidence that adults are able to do this (though the ability develops slowly in children; for review and discussion, see Bialystok, 1990, 1993, 1994a, 1994b; Forest-Pressley, MacKinnon and Waller, 1985). An every-day example is the "cocktail party phenomenon," in which it is possible to eavesdrop on an intriguing conversation going on some feet away or even across a room while ignoring talk which is closer and louder. Well-known experimental variants of the selective attention paradigm are dichotic listening studies, in which different messages are presented to the left and right ears through headphones and subjects are told to listen to

only one channel, and shadowing experiments, in which subjects hear two messages and try to say one of them right along with the speaker. Early results from such studies provided clear results in support of the need for attention for storage: recall and recognition tests administered after such experiments showed that only the information in the attended channel was remembered (Bowers, 1984; Cherry, 1953; Glucksberg and Cowan, 1970; Moray, 1959; Norman, 1969).

There are a few results from selective attention studies that show some later recognition of unattended information and suggest that selective attention may not be absolutely necessary for long-term storage (Allport, Antonis, and Reynolds, 1972), but interpreting these results runs afoul of a serious methodological difficulty: demonstrating that remembered stimuli are truly unattended (in spite of instructions) is very difficult to establish. For this reason, most researchers in the field prefer to work instead with the divided attention paradigm, in which subjects are told to carry out two tasks simultaneously, one of which is so demanding that it depletes all attentional resources, preventing subjects from attending to other stimuli.

Findings from divided attention studies also generally support the view that attention is essential for learning. For example, Nissen and Bullemer (1987) used a serial reaction time task in which on each trial a light appeared in one of four locations and subjects were instructed to press keys to indicate the presence of the light. In a single task learning experiment, one group of subjects was exposed to a repeating sequence of 10 positions, while another group was exposed to a random non-repeating sequence. Across eight blocks of trials, the group exposed to random sequencing improved their performance somewhat (indicating a practice effect), but not by much. Those exposed to the repeating sequence improved their reaction time significantly, indicating that they had learned the sequence and could anticipate where the next light would appear. Next, in a dual-task condition, some subjects were instructed to track the appearance of lights simultaneously with a tone counting task. A tone that was either high or low in pitch occurred at the beginning of each trial, and subjects were told to count the number of times the low tone occurred. The dual-task group revealed no convincing evidence of sequence learning, and the most impressive result from a series of experiments was that subjects who were trained under the dual-task

condition were no better at responding to the position of lights in a subsequent single task situation than subjects who had no experience at all with any of the tasks (Nissen and Bullemer, 1987: 21).

Once again, however, a few studies using the divided attention paradigm have provided conflicting results. Kellogg (1980) showed that subjects who performed complex mental multiplication while faces were presented as secondary stimuli performed better than chance on a recognition test for the faces. In a widely cited recent study, Curran and Keele (1993) reported evidence for unattended learning using a variant of the Nissen and Bullemer serial reaction time task combined with tone-counting and comparing single-task with dual-task performance. Although few in number, these studies are worthy of careful scrutiny, because they purport to show at least the possibility of unattended learning.

Again the nagging question remains: was the learning in these experiments truly unattended? In the case of Kellogg's experiment, it seems very likely that it was not, because it is widely believed that although attentional capacity is limited, it is not completely fixed and is expanded when information is presented through different modalities such as the visual channel and the aural channel (Allport, Antonis, and Reynolds, 1972). Kellogg was aware of this problem and tried to control for it by asking subjects to visualize the aurally presented digits in the multiplication task in order to deplete both aural and visual attention, but it is not at all clear that subjects followed this instruction, and a moment's reflection should convince readers that visualizing arithmetic problems is not an easy task at all.

Curran and Keele's interpretation of their results is subject to a somewhat more complicated objection. In the Nissen and Bullemer version of the repeating sequence task (which showed no learning in the dual-task condition), each sequence presented to subjects was ambiguous, i.e., there was no event that was always followed by a predictable second event. Instead, a long sequence was used. Using letters to indicate screen positions, the sequence was: D-B-C-A-C-B-D-C-B-A. Note that D can be followed by either B or C; B can be followed by C or A; etc. In single-task learning, subjects exhibited slower responses for certain ambiguous serial positions (e.g., B or C

appearing after D), which Nissen and Bullemer interpreted as evidence that subjects chunked the longer sequence into shorter sequences (e.g., D-B-C-A and D-C-B-A). The slow responses by subjects to the unpredictable element immediately following D in the two sets was interpreted as reflecting their uncertainty regarding which chunk was presented; there was no uncertainty as to what the last two elements of the chunk were (C-A in the D-B-C-A chunk and B-A in the D-C-B-A chunk) and their responses to those elements were faster.

Cohen, Ivry, and Keele (1990) found that if a repeating pattern had at least one unique stimulus position, subjects showed some learning in the dual task condition, and Curran and Keele (whose experiments showed some learning in the dual task position) also used patterns that had unique elements. Six different patterns were used, distributed randomly across subjects. Using numbers to indicate screen positions, the repeating sequences were:

- Sequence 1: 1-2-3-2-4-3
- Sequence 2: 1-2-3-1-3-4
- Sequence 3: 1-4-3-1-3-2
- Sequence 4: 1-4-2-3-1-2
- Sequence 5: 1-3-2-4-1-2
- Sequence 6: 4-2-3-2-1-3

In the six patterns above, there are numerous invariant relations. For example, in Sequence 1, an element in position 1 can only be followed by one in position 2, and an element in position 4 can only be followed by one in position 3. In Sequence 2, an element in position 2 can only be followed by one in position 3, and an element in position 4 can only be followed by one in position 1 (as the sequence repeats). Other sequences are not invariant but not all combinations are possible, and all of these sequences are different from randomly generated sequences in one simple but important respect: no element presented on the screen is ever followed by one in the same position.

The theory that attention is required for all learning (and that more complex learning requires more attention) predicts that there will be

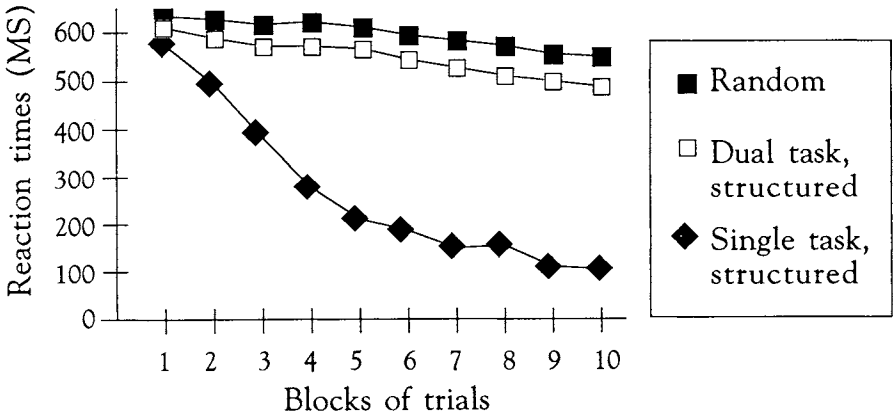
differences in learning depending on what kind of stimulus array is used. The type of stimulus array used by Nissen and Bullemer demands that subjects divide a longer sequence into parts and learn orders within parts. This requires a considerable allocation of attention to a long sequence and should be blocked easily by completing attentional demands, just what Nissen and Bullemer found. The type of stimulus array used by Curran and Keele should be partly learnable with much less attention, because some learning can be accomplished through simple item-item associations — and Curran and Keele did find some learning in the dual task condition.

Do Curran and Keele's experiments show *some* learning with *no* attention, however? Once again, this seems unlikely. In fact, Curran and Keele concede that "When we refer to one form of learning as nonattentional, we do not wish to imply that no attention whatsoever is used on the primary task ... [since] undoubtedly, subjects must in some sense attend to a visual stimulus to make a response" (1993:190). It is reasonable to assume, given Nissen and Bullemer's results, that attention to a six element sequence is indeed blocked by the competing tone-counting task, but not reasonable to assume that attention to simple two element sequences is similarly blocked. Curran and Keele argue that whether or not attention is completely blocked is not crucial to their concerns, but for the claim that learning without attention is possible, this distinction is crucial. The alternative explanation, that learning under the dual-task condition is not learning without attention but simple learning with a correspondingly small amount of attention (to small pieces of a longer sequence), seems entirely reasonable.

While the zero-point question (whether there can be learning with no attention) is theoretically interesting, the debate over this issue should not obscure a larger and much more secure finding, that the more one attends, the more one learns (Baars, 1988). Figure 1 shows a schematic representation of typical results from studies such as those reported by Curran and Keele, Nissen and Bullemer, and many others who have used dual-task learning with reaction time as the dependent variable. What is most striking about Figure 1 is the small (sometimes nonexistent) difference between performance on random sequences and performance on structured sequences under conditions of degraded attention, compared to the very large differences observed

between both of those and the learning of structured sequences with focused attention. All seem to agree on the point that focal attention is essential for robust memory. Kellogg and Dare (1989), who argue that both attended and unattended encoding in memory are possible, emphasize that while their conclusion that attention is not necessary for very poor memory is of theoretical interest, this “does not imply that unattended encoding has any practical value ... [since] the degree of elaboration resulting from unattended encoding appears to be too limited to have any substantive influence on human cognition or behavior” (1989: 412).

**Figure 1: Schematic representation of learning structured sequences under single task (focal attention) and dual task (degraded attention) conditions, compared to performance on random sequences**



What does this mean for foreign language learning? Can we generalize from studies of reaction time on simple, controlled non-linguistic tasks to the much more complex (and far less controlled) domain of language learning, where accuracy rather than speed is the usual indicator of learning (except with respect to fluency concerns)? There are limits to the validity of such generalizations, but one possible implication from these studies is that while all aspects of language learning require some degree of focal attention, different aspects may require more or less of it. Following this line of thinking, the learning of individual words, collocations and short, fixed expressions (e.g., *pick*

*it up, see you later* in English; *c'est la vie* in French, *arigato gozaimasu* in Japanese) would require attention to be learned, but not nearly as much as longer, ambiguous sequences of language. Carr and Curran (1994) have observed that the complex sequences generated by syntax are highly ambiguous (almost every word can be preceded and followed by many different words, often from different syntactic classes), and are unlikely to be learned without focal attention. Because communicative interaction is always a divided attention task (requiring attention to literal, figurative, pragmatic, and interactional meaning in addition to linguistic form at all levels for full comprehension), this would predict that naturalistic, uninstructed language learners should be relatively better at acquiring vocabulary and formulaic expressions than at acquiring complex syntax, which seems to be generally the case. It also suggests that within instructional approaches that are primarily communicative, learning some aspects of language probably either requires or at least will benefit from some degree of decontextualization, whereas others may not.<sup>1</sup>

---

<sup>1</sup> Inflectional morphology falls somewhere in between lexicon and syntax with respect to attentional needs. In the case of bound morphemes, it could be argued that since these are short sequences, they can be learned associatively with minimal attention. However, the choice of which morpheme to produce in a particular context also requires attention to neighboring elements (e.g., to a nearby noun for gender and number agreement on adjectives) or not so neighboring elements (e.g., a more distant noun) or even to invisible aspects of the communicative context (e.g., to nouns that are understood from context but not overtly expressed, in the case of gender and number, or to speaker or hearer "perspective" in the case of article choice in English or aspectual choice in Romance languages). One would predict that more focal attention is required both to detect and to produce correctly inflected forms when the governing element is distant than when it is nearby and that getting things right when key elements are not overtly expressed will be most difficult. Zalewski (1993) has made a different prediction, arguing that inflectional morphology that is locally determined will be less likely to be attended to than more globally determined morphology, because the former is usually redundant and the latter more crucial for communication. Zalewski suggests that presenting morphology in global contexts will be more instructionally effective, because this will render them more cognitively salient, and the mental effort involved in processing them should also lead to better retention.

The best known attempts to apply models of attention and the divided attention paradigm to foreign language learning have been those of VanPatten (1990, 1993, 1994). Arguing that anyone can process input for meaning or for form, VanPatten suggests that the critical questions are whether learners can attend to form while simultaneously attending to meaning and, if so, what kind of form and under what conditions this is possible (VanPatten, 1994). VanPatten hypothesizes that when involved in communicative exchanges, learners process input for meaning before anything else, that they prefer processing lexical items to grammatical items, that they prefer processing "more meaningful" morphology before "less or non-meaningful" morphology (these concepts are not well-defined), and that before learners can process less meaningful morphology, they must be able to process communicative content at little or no cost to attention. This can be interpreted fatalistically (learners are not going to acquire less meaningful morphology until they are reasonably competent communicatively and then they will, so don't worry about it) or as a reason to include a focus on form within an instructional program. VanPatten argues for an interventionist approach to instruction, but argues strongly for structured, focused input processing activities, rather than traditional explanation plus output exercises. In one example of such input processing activities, learners of Spanish were instructed to focus attention on word order and clitic pronouns and practice correct form-meaning mappings when processing input strings. When compared to a group receiving more traditional (output oriented) instruction, both gained in production ability, but only those given the input processing treatment gained in both comprehension and production abilities (VanPatten and Cadierno, 1993).

A further extension of the hypothesis that attention is required for all learning is that what must be attended to is not just input from one channel as opposed to another or stimuli important to one task as opposed to another, but also different features of "the same" input (Schmidt, 1993b). This question has been less researched in psychology, but what evidence there is supports the idea. Hanson and Hirst (1988) point out that an event may be thought of as a cluster of attributes and report experiments supporting the hypothesis that attention to specific stimulus attributes is necessary in order to encode information about them. The only information for which there is



evidence of automatic (unattended) encoding is the frequency of a stimulus event (Hasher and Zacks, 1979, 1984), but the frequency with which something occurs is not an attribute of an individual event itself. If true, the hypothesis that no learning of correlated stimulus attributes occurs without attention means that in order to acquire phonology, one must attend to phonology; in order to acquire pragmatics, one must attend to both linguistic forms and the relevant contextual features; and so forth. Nothing is free.

## CAN THERE BE LEARNING WITHOUT NOTICING?

It is difficult to distinguish between paying attention to something and noticing or being aware of it. As Carr and Curran (1994) point out, these are often treated as synonyms: "If you are conscious of something, then you are attending to it ... and if you are attending to something, then you are conscious of it" (1994: 219). The view that attention and awareness at the level of noticing are flip sides of the same coin is also embodied in many classical definitions of attention, such as that of William James, who defined attention as "the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought ... focalization, concentration, consciousness are of its essence ... it implies withdrawal from some things in order to deal more effectively with others" (1890: 403–404). Most modern psychologists make a distinction between attention and its correlated subjective experience, however, viewing attention as one of the basic mechanisms in an information processing system or "computational mind," while relating subjective experiences such as noticing what one attends to, remarking upon it, being aware of it, and so forth as features of "phenomenological mind" (Jackendoff, 1987). And here we run into several classical philosophical problems, generally referred to as the mind-body problem (Harnad, 1990, 1991; Nagle, 1974, 1993). How can the physical brain give rise to the non-physical experiences of consciousness? How could the subjective, non-material experiences of phenomenological mind ever affect the physical (neurologically grounded), computational mind? Could there be organisms (or machines) who were functionally exactly like us but felt or experienced nothing at all (the "absent qualia hypothesis"), and if so, would we be justified in calling them conscious?

Popular psychology tends to emphasize the influence of the mind on the body, but both mainstream psychology and many philosophers are firmly on the other side of the argument, giving the following responses to these questions: (1) no one knows quite how the physical brain and computational mind give rise to consciousness, but they do

(Gazzaniga, 1993; O'Keefe, 1985); (2) the direction of causality is one way: computational mind causes phenomenal mind but phenomenal mind has no causal efficacy (Jackendoff, 1987); and (3) if there were persons or machines who were functionally the same as us except that they experienced nothing, we might as well call them conscious, since internal mental events cannot be the data of science and the subjective side of things just does not matter (Dennett 1987, 1991). This is the essential epiphenomenalist argument.

To pursue these questions adequately would take us far beyond the scope of this chapter, but interested readers are referred to the work of Jackendoff (1987) in psychology and linguistics and Dennett (1987, 1991; Dennett and Kinsbourne, 1992) in philosophy, both of whose works are very interesting reading. The questions that need to be discussed here are more limited: can attention and noticing be independently defined in ways that are useful for understanding foreign language learning, and is there evidence for their dissociation, that is, learning with attention but without noticing?

Attention *can* be defined independently of its subjective correlates, and a very useful description of current theories of attention is provided by Tomlin and Villa (1994), which draws heavily on the work of Posner (1992; Posner and Petersen, 1990; Posner and Rothbart, 1991) and which can be summarized as follows:

- Attention is a limited capacity system.
- Automatic activities which require little or no attention do not interfere with each other.
- Controlled processes require attention and interfere with other control processes.
- Attention can be viewed as three separate but interrelated networks: alertness, orientation, and detection.
- Alertness represents a general readiness to deal with incoming stimuli.

- Orientation refers to a specific aligning of attention (e.g., to language form or to meaning).
- Detection is the cognitive registration of sensory stimuli.
- Detected information is available for other cognitive processing.
- Attention (specifically, detection) is not awareness.

The last of these points is the most relevant to this discussion. Tomlin and Villa argue, as have many others, that detection and further processing of stimuli can be dissociated from awareness of what is attended to, and that detection (not awareness) is what is important. Velmans (1991) has made this point most strongly, arguing that consciousness only *appears* to be necessary in a variety of tasks because they require focal-attentive processing. If consciousness is absent, focal-attentive processing is normally absent, but there are cases in which focal-attentive processing takes place and is effective without consciousness also being present. In a number of publications, I have argued the opposite point of view: that focal attention and awareness are essentially isomorphic, and that a causal role for subjective experience in learning cannot be ruled out (Schmidt, 1990, 1993a, 1993b, 1994a, 1994b). The “noticing hypothesis” states that what learners notice in input is what becomes intake for learning.

In several recent publications, claims that attention and awareness (at the level of noticing) are dissociated and that there is learning without awareness have been based on several of the same experiments dealing with reaction time in sequence learning referred to in the last section. For example, Carr and Curran (1994) refer to experiments by Nissen and Bullemer (1987), among others, as evidence for their assertion that there is little relationship between responses to a questionnaire assessing subject awareness and whether structural learning is shown in serial reaction time tasks. Tomlin and Villa (1994) cite Curran and Keele (1993) as evidence that “subjects can learn a repeating sequence but not be aware of that sequence” (1994: 193).

While both Carr and Curran (1994) and Tomlin and Villa (1994) are excellent review articles with much of great value for understanding the role of attention in foreign language learning, I find it surprising that these reviewers drew these conclusions based on the articles they cite. Since the Nissen and Bullemer and Curran and Keele articles have been discussed in some detail already in this paper, it seems appropriate to return to them to see the extent to which such claims are supported by the evidence. Considering the Nissen and Bullemer article, those authors did not say themselves that there was little relationship between awareness as assessed by a questionnaire and performance on the primary task. What they said was that in the single task repeating pattern (where learning was good) virtually all subjects reported noticing a sequence (1987: 9, 14) and that in the dual task condition (where no learning occurred) virtually no subjects reported noticing a repeating sequence (1997: 14, 29). One subject in the single task condition was not counted as aware because the experimenter forgot to elicit the information, and one subject in the dual task condition thought that there might have been a sequence in some trials but that it went away later. In other words, there was a *very* strong relationship between awareness and learning in these experiments. Nissen and Bullemer's claim that awareness of the existence of a pattern is not required for learning was based on other evidence, the fact that patients with Korsakoff's syndrome learned the sequence, to which I will turn momentarily.

Nissen and her colleagues have reported other experiments, however, in which they have presented evidence for learning patterns without awareness. Hartman, Knopman, and Nissen (1989) reported unaware learning of verbal associations in four experiments. The stimuli in these experiments were repeating 10-word sequences, such as MUSIC – RULER – LADY – OCEAN – LADY – RULER – MUSIC – LADY – RULER – OCEAN. (Once again, notice that some elements in the string are “ambiguous,” but the pattern can be learned if the sequence is broken into chunks.) Learning was assessed by reaction time, and subjects were classified as “aware” or “unaware” on the basis on their ability to indicate any patterns they could report having noticed. In Experiment 1, there was a clear relationship between awareness and performance: aware subjects performed well, while unaware subjects showed no improvement beyond a practice effect shown by control subjects exposed to a completely random word sequence. In Experiments 2 and

3, aware subjects performed much better than the unaware group, but the latter nevertheless showed evidence of a significant, albeit small, amount of learning. In Experiment 4, both aware and unaware subjects gave clear evidence of learning across four blocks of trials. It would seem, therefore, that these experiments (especially Experiment 4) do provide evidence of sequence learning without awareness, were it not for one serious flaw. Not all of the subjects classified as “unaware” were truly unaware. For reasons that are hard to understand, Hartman et al. decided to classify all subjects who could not correctly report more than three consecutive words from the 10-word sequence as unaware. These subjects were, however, partly aware rather than unaware. (Unfortunately, Hartman et al. do not report the number of such partially aware subjects except for Experiment 1, in which 2 of 10 called unaware were partially aware.) Moreover, any three word sequence from the longer string should have had some effect on performance: a subject who has noticed the sequence MUSIC – RULER – LADY would respond rapidly to LADY; a subject who noticed the sequence RULER – LADY – OCEAN would respond rapidly to OCEAN; etc. The conclusion I draw, therefore, is that these experiments do not show learning without noticing, but rather more learning with more noticing and less learning with less noticing.

As for Curran and Keele (1993), those authors did not claim that unaware subjects learned a repeating sequence. What they reported was that subjects were classified as “more aware” and “less aware” (not “unaware”) on the basis of questionnaire responses, and that all results from single task learning conditions clearly demonstrated that subjects who expressed less awareness showed less learning than those who expressed more awareness, who showed less learning in turn than subjects who had been explicitly instructed on the repeating sequence to which they were exposed (1994: 192). The dual task learning group was classified as “predominantly unaware” (1994: 194), and this group showed some learning, but not much. Curran and Keele reported that they were not really concerned with the problem of needing to establish complete absence of awareness and conceded that many subjects probably were partially aware. They made no claim that the small amount of learning observed under the dual task learning condition was learning without awareness. Their major claim instead was that “variations in single-task learning, caused by awareness differences, were not transferred to dual-task conditions” (1993: 192).

More and less aware subjects trained under the single task condition (on which their performance varied) did not vary when an attention demanding distracter task was added following the initial training. This is an important and interesting finding, suggesting that in foreign language learning the benefits of awareness in learning may not be of much immediate help in performance when many different tasks need to be attended to simultaneously. Asserting the irrelevance of awareness for automatic performance (Krashen 1985, 1994) is not the only theoretical solution to this dilemma, however, since there are models of controlled and automatic processing in which automatization is viewed as a gradual transition (with practice) through a number of stages from fully controlled processing (most demanding of attention and awareness) to controlled assist of mostly automatic processing to fully automatic processing (Schneider and Detweiler, 1988; Schmidt, 1992).

Four other sources of evidence have been cited in the literature as support for the claim that there is learning without awareness at the level of noticing: studies of subliminal perception, the phenomenon of blind-sight, studies of implicit memory, and sequence learning by amnesics. Each of these areas of research will be dealt with very briefly, to assess whether any of them show clear evidence of learning without awareness.

### SUBLIMINAL PERCEPTION

Subliminal perception is, by definition, detection without awareness ("perception" means that stimuli are registered by the information processing system; "subliminal" means that this happens below the level of subjective awareness). There are two questions to be asked: does subliminal perception happen?, and does subliminal perception lead to learning? The answer to the first question is yes. Although the mere possibility of subliminal perception was controversial for a long time, there have been a large number of experiments in which subjects are presented with brief or low intensity stimuli which they do not detect (although they do fully attend). These experiments show subtle effects of such stimuli on behavior, and there is no doubt that subliminal perception exists as both a cognitive phenomenon (Schmidt, 1990, 1993a, 1993b) and as a social psychological

phenomenon (Wyer and Srull, 1994). However, the power of such subliminal perception is nothing like the popular view of it, which is largely based on myth. For example, although many people “know” that in the 1950’s clever advertisers used subliminal messages intersplined with cinematic frames to stimulate lobby sales of soft drinks, this is in fact a purely apocryphal story (Merikle, 1988; Moore, 1988). The answer to the second question, whether subliminal perception can lead to learning, seems to be no. Subliminal effects are shown only when very familiar stimuli are presented, activating already established mental structures. For example, Joordens and Merikle (1992) and many others have demonstrated effects for the subliminal presentation of English words, but none of these experiments have shown anything like the learning of new words. To date, psychologists have been unable to establish whether *any* of these effects constitute learning in the sense of establishing new concepts or mental structures. Reviewing the recent literature, Shanks and St. John (1994) conclude that although a few studies reporting subliminal learning have appeared, these are offset by a much more substantial body of negative evidence. Until it is shown that new mental concepts can be acquired in this way, subliminal perception is evidence for detection without awareness but not for learning without awareness. The practical consequence of this is that it would be foolish in the extreme to expect to learn any aspect at all of a foreign language through subliminal audio tapes (Greenwald, Spangeberg, Pratkanis, and Eskenazi, 1991). Sleep learning is equally unlikely to produce any detectable learning (Bootzin, Kihlstrom, and Schachter, 1990).

## BLINDSIGHT

Blindsight (Dennett, 1991; Tye, 1993; Weiskrantz, 1986, 1990) is a condition in which certain patients have large blind areas in their visual fields due to brain damage to the occipital cortex. What is fascinating about such cases is that blindsighted people can, under some circumstances, accurately report what is in the “blind” visual field, without any experiential conscious going on. Blindsighted patients report that they cannot see anything; when they are asked to report what might be in the blind area, they are very reluctant to “guess” and typically do not believe what they are forced to say; and



yet when they do guess, they are often accurate. Blindsightedness therefore constitutes a quite spectacular example of detection without awareness, of absent qualia. But we must ask the second question: does detection without awareness in blindsightedness constitute learning? The answer is no. The degree of detection in the “blind” area turns out, after all, to be very limited. Simple shapes (e.g., circles or triangles) can be recognized, together with familiar objects (e.g., a toothbrush), and even these not consistently. No attempts have been made to teach anything new to blindsighted patients by presenting new shapes (or words, for example) in the blind area, and no reason to think that this would be successful. As in the case of subliminal perception, a demonstration of detection without awareness does not stand up as a case for learning without both attention (detection) and awareness.

## IMPLICIT MEMORY

Past learning experiences affect current behavior, even when we do not consciously recall the relevant prior events. This phenomenon is generally called *implicit memory*, in contrast to *explicit memory* (in which prior exposure is consciously recalled), and there is a huge literature on the differences between the two (for review, see N. Ellis, 1994b, 1994c; Robinson, this volume, in press; Schachter, 1987). Researchers have found that performance differs between direct memory tasks (e.g., recognition and recall tests) requiring conscious retrieval of material presented during the study phase of an experiment and indirect tests (e.g., lexical decision and word stem completion tests) that facilitate retrieval of the material without conscious attempts to recall (Robinson, in press). Many studies of implicit memory have involved word study, both with monolinguals and bilinguals (Ellis, 1994b), and implicit memory is clearly relevant to understanding foreign language learning. Suppose that a second year foreign language student is given a long list of words, some of which appeared in the first year instructional materials and some of which did not, and asked to say whether or not he or she had seen them before, and, if so, when. What we would expect is that such a student would be able to give quite specific details when and how some words were learned. This is called *episodic memory*. In other cases, the learner would be able to say that a word had been

encountered before (there would be some incorrect reports as well), but not give details. Recognition memory of this kind is explicit memory but not episodic memory. There would be many other cases where the learner would not be able to recall whether or not a word had been encountered before, but if we asked learners to go through the list rapidly and indicate which of all the words on the list were real words in the foreign language, we should find that both accuracy and speed (response latency) are much better for the previously encountered words, that is, evidence for implicit memory. (This would be an interesting and useful classroom research study.)

The key question is whether evidence for implicit memory is evidence for learning without awareness and evidence against the noticing hypothesis. In my opinion, the whole area of implicit memory is simply irrelevant for the noticing hypothesis. The noticing hypothesis claims that learning requires awareness *at the time of learning*. It does not require that memory of that event be preserved, much less recalled each time the learned material is encountered.

## LEARNING BY AMNESICS

In fiction, the most commonly represented form of amnesia is retrograde amnesia, when because of a blow to the head or psychological trauma people are unable to remember their past. In psychology, the most commonly studied form of amnesia is anterograde amnesia, in which (because of chronic alcoholism or brain damage) patients are unable to form new memories. An extreme case, that of "H. M." has been widely discussed in the literature (Ellis, 1994b). After surgery for treatment of epilepsy, H. M. had normal recall of events that occurred before his brain damage, but no memory for episodes that occurred after the operation. In these cases, however, there is a dissociation between implicit and explicit memory: "amnesics are severely impaired on the recall and recognition tests which involve a conscious recollection of the prior episode, but they show normal practice effects as a result of prior exposure" (Ellis, 1994b: 229). Numerous studies have shown that such amnesics can learn. Generally speaking, amnesics show zero acquisition of declarative knowledge, but fairly good (though subnormal) acquisition of procedural knowledge. They can acquire implicit knowledge of

vocabulary form (the shape of words), but do not learn new words or form new word associations (Ellis, 1994b, 1994c). They demonstrate some learning of structural sequences generated by miniature artificial grammars, to be discussed in the next section (Knowlton, Ramus, and Squire, 1992). And in the Nissen and Bullemer (1987) experiment discussed in the previous section of this chapter, amnesics with Korsakoff's syndrome demonstrated sequence learning, even though they were completely unaware that they had practiced the task. Referring to anterograde amnesia as the "gold standard" of implicit learning, Carr and Curran (1994) conclude that these demonstrations of learning conclusively demonstrate the dissociation of attention and awareness in learning. Poldrack and Cohen (1994) similarly conclude that such learning is *prima facie* evidence of implicit learning.

I disagree. Demonstrations of implicit memory in anterograde amnesia are even less relevant for the question of implicit learning than are demonstrations of implicit memory in normal persons, for reasons that have been articulately expressed by Shanks and St. John (1994). The noticing hypothesis claims that awareness at the point of learning (Time 1) is required for all learning. Yet for various reasons, including the fact that concurrent reports of awareness during the process of learning are likely to bias the learning itself towards a more conscious mode, awareness must be assessed at some later time (Time 2). In all implicit learning studies, an inference must be made from no evidence of awareness at Time 2 to a lack of awareness at Time 1. For this inference to be valid at all, there must be high confidence that lack of awareness at Time 2 also reflects a lack of awareness at Time 1. In the case of normal subjects, this can perhaps be achieved. But in the case of anterograde amnesics, their essential problem is that they remember nothing of what they were aware of minutes before!

In summary, studies of subliminal perception and blindsight provide evidence for a dissociation between detection and awareness, but not between learning and awareness. Implicit memory studies and studies of learning by amnesics provide evidence for a dissociation between what one is aware of during on-line processing and what one is aware of later, but no evidence for learning without awareness at the point of learning. I conclude that there is no compelling evidence of any learning without awareness at the level of noticing. Subjective experience and information processing appear to be isomorphic.

This does not, I will admit, dispose of the epiphenomenalist position. I argued in the previous section that while it is in principle impossible to prove that attention is required for all learning, it should be possible to disprove that hypothesis (though no disproof has been found). I am not so sanguine that the noticing hypothesis can be either proved or disproved. It cannot be proved because subjective awareness is fleeting and cannot be completely recorded. It cannot be falsified for the same reason; reports of learning without awareness will always founder on the impossibility of demonstrating beyond doubt that a given test of awareness is exhaustive (Merikle, 1994).

Even if learning and awareness are perfectly correlated, this can probably be accounted for by a model of computational mind that does not mention subjective phenomena. Robinson (in press) suggests that the noticing hypothesis can be captured in a model of attention and learning that specifies a need not only for detection (which may be brief, with no permanent effect) but detection plus rehearsal in short-term memory. In such a model, detection plus rehearsal gives rise to awareness, but awareness is not needed as an explanatory concept. I would argue that the correlation between information processing and subjective experience is too high to be coincidental. Assuming that consciousness is a late evolutionary development, there must be some reason for its evolution, and all the evidence points to the fact that what consciousness is good for is learning. But those who maintain that the human brain is an information processing machine that does no more than other (insensate) machines will not be dissuaded from their position that conscious thoughts are irrelevant, or that we are any more than helpless spectators of our own existence. A hundred years of research in psychology and centuries of argumentation in philosophy have not resolved the issue, and I cannot resolve it here.

## CAN THERE BE LEARNING WITHOUT UNDERSTANDING?

Throughout the previous section, I referred repeatedly to the notion of *awareness at the level of noticing*, without attempting to define the expression, which I must now do in order to deal with the question of whether there is learning without *understanding*, a higher level of awareness. I use “noticing” to mean conscious registration of the occurrence of some event, whereas “understanding,” as I am using the term, implies recognition of a general principle, rule or pattern. Noticing refers to surface level phenomena and item learning, while understanding refers to deeper level of abstraction related to (semantic, syntactic, or communicative) meaning, system learning (Slobin, 1985). Since I restrict the usage of these terms for technical purposes and do not use them with their full range of meanings in everyday language, some examples of the intended distinction may be helpful.

- In forensics, noticing has to do with collecting the evidence, understanding with creating a theory of the crime.
- In sequence learning, experiments that require subjects to learn a fixed sequence of specific items or positions, such as ABBC or DCBA, are related to noticing only. But an experiment that requires subjects to generalize from a sequence such as ABBC to one that is related at a more abstract level (e.g., XYYZ) entails the higher level of awareness that I call understanding. I avoid all common usages such as “noticing” a principle or abstract pattern.
- In foreign language vocabulary learning, conscious registration of the form (phonological or orthographic) of a word is an example of noticing. Knowing the meaning of a word and knowing its syntactic privileges of occurrence (other than in collocations and fixed expressions) are matters of understanding.

- In morphology, awareness that a target language speaker says, on a particular occasion, “He goes to the beach a lot,” is a matter of noticing. Being aware that *goes* is a form of *go* inflected for number agreement is understanding.
- In syntax, awareness that on some occasions speakers of Spanish omit subject pronouns is a matter of noticing. Being aware of that Spanish is a pro-drop language, which entails numerous syntactic consequences beyond such surface phenomena as the presence or absence of pronouns, is a matter of understanding.
- In pragmatics, awareness that on a particular occasion someone says to their interlocutor something like, “I’m terribly sorry to bother you, but if you have time could you look at this problem?” is a matter of noticing. Relating the various forms used to their strategic deployment in the service of politeness and recognizing their co-occurrence with elements of context such as social distance, power, level of imposition and so on, are all matters of understanding.
- In learning academic writing or other genres, remarking on the fact that journal articles are frequently subdivided into parts such as an introduction, method, results, discussion and conclusion is a matter of noticing. A learner of Japanese who comes to understand that the function of an initial section that might be called “introduction” is very different in English and Japanese is exercising the higher level of awareness I call understanding.

Since system learning clearly requires some process of generalization from individual instances, how does this happen? Because understanding can be either internally generated or externally provided, for those who are primarily concerned with foreign language teaching, the issue is often phrased as the question of whether or not explicit knowledge transmitted through instruction can become implicit knowledge (R. Ellis, 1993). For those who focus more on learning, especially learning through exposure to input, the question is whether system learning proceeds on the basis of conscious processes

of induction such as hypothesis creation and testing or on the basis of more basic, unconscious mechanisms that may be encapsulated in a way that makes them unaffected by any conscious knowledge. Is there, or can there be, unconscious induction and abstraction? This is the heart of the acquisition versus learning distinction in the foreign language field and the heart of the controversy over implicit learning in psychology.

## ARTIFICIAL GRAMMAR LEARNING AND NATURAL LANGUAGE

The battle in the foreign language field has been fought almost entirely in the realm of syntax, and in psychology also research using miniature artificial grammars (MAGs) has been the most discussed, so I will limit my report of research in psychology to studies using that particular paradigm. For nearly three decades, Arthur Reber has conducted experiments on the learning of miniature artificial grammars by adult subjects (Abrams and Reber, 1988; Reber 1967, 1969, 1976, 1989; Reber and Allen, 1978; Reber, Allen and Regan, 1985; Reber, Kasson, Lewis and Cantor, 1980; Reber and Lewis, 1977; Reber, Walkenfeld and Hernstadt, 1991). Many others have used the same experimental paradigm or variants of it (e.g., Brooks, 1978; Brooks and Vokey, 1991; Danks and Gans, 1975; Dienes, Broadbent, and Berry, 1991; Dulany, Carlson and Dewey, 1984; MacWhinney, 1983; Mathews, Buss, Stanley, Blanchard-Fields, Cho, and Druhan, 1989; Morgan, Meier, and Newport, 1987; Nation and McLaughlin, 1986; Perruchet and Pacteau, 1990; Vokey and Brooks, 1992). Reber (1989, 1992, 1993) has drawn upon the extensive results of such studies to formulate a general theory of implicit learning.

Although there have been numerous variations on the basic theme, the experimental paradigm developed by Reber involves exposing subjects to strings of letters (e.g., MXRMXT, VMTRRR) generated by an underlying “grammar” or rule system, usually a finite-state system that generate strings of symbols in a left-to-right, non hierarchical fashion, often referred to as a Markov grammar. In many experiments, groups of subjects are exposed to such input with either (a) instructions to try to figure out the rules for letter order or (b) instructions to memorize the examples for a memory test. The

acquisition phase, typically a few hours but sometimes longer, is followed by a testing and transfer phase to assess what subjects have learned. The testing phase requires subjects to identify new letter strings as grammatical (i.e., generated by the rules of the underlying grammar) or ungrammatical (items that violate the grammar). In some experiments, the testing phase has also included probing subjects' awareness in order to find out whether they were able to discover and can verbalize the underlying rules of the system.

The basic findings from these experiments are as follows:

- Through exposure to examples, subjects become sensitive to underlying regularities in input, as shown by the fact that they can accurately characterize new strings which they have never seen before as grammatical or ungrammatical at above chance levels.
- Subjects are generally unable to verbalize the rules of the underlying grammar used by the experimenters to generate strings.
- The grammaticality judgments of subjects receiving rule-search or memorization instructions typically do not differ significantly.

Although there are major differences between MAG experiments and real language learning, the artificial grammars used in implicit learning studies are roughly analogous to natural languages, in the sense that sentences of the language are viewed in both cases as the product of a complex underlying system. Through exposure to input containing exemplars of the grammar, in second language learning as in artificial grammar experiments, learners do become sensitive to regularities in the input, suggesting that the underlying grammar is internalized in some sense. In both cases, grammaticality judgments are seen as an appropriate test of this internalized competence, and in both cases, real learning is only considered demonstrated through transfer to new examples.



Reber has interpreted the findings of MAG experiments as support for a detailed conception of the process by which one develops intuitive knowledge about the underlying structure of a complex stimulus environment, an account that may be relevant for theories of SLA. As used by Reber, implicit learning is characterized by a number of critical features, each of which is also claimed for foreign language learning:

- Learning MAGs is an unconscious *process*, in two senses. First, because whether or not subjects have the intention to discover rules (assumed to follow from the instructions and demands of the experimental task) does not make a difference in learning outcomes, artificial grammar learning is considered to be unintentional or incidental. Natural language acquisition is also most often considered to be unconscious in the sense that it is incidental or non intentional learning. Second, implicit learning is believed to involve induction without awareness, on the grounds that processes such as the formation and testing of conscious hypotheses (encouraged by rule-search instructions and blocked by the demands of the memorization condition) do not make a difference in the outcome of these experiments. The second of these interpretations of implicit learning as an unconscious process is considered basic. As Reber (1989) puts it, “the pickup of information takes place independently of consciousness or awareness of what is picked up” (p.231). Second language learning is also widely believed to involve induction without awareness. It is in this sense that Seliger’s comment that “obviously, it is at the unconscious level that language learning takes place” (Seliger, 1983, p. 187) is most reasonably interpreted. Krashen is explicit on the matter. Conscious hypotheses about the underlying structure of language, whether obtained through rule teaching or through discovery by the learner, belong to *learning*, not *acquisition* in Krashen’s theory (Krashen, 1985). Felix (1981, 1985, 1991) is another SLA theorist who stresses the irrelevance of conscious hypothesis formation and other conscious processes typical of problem solving behavior for successful acquisition. In Felix’s view, such conscious processes are characteristic of adult second language learning, but they are ultimately detrimental to the process because general problem solving abilities are

inferior to the innate, domain-specific language acquisition device with which they compete.

- The *product* of implicit learning is also largely unconscious. Once again, *unconscious* has several senses. The first of these is that the information acquired exceeds what can be verbally expressed. This represents a significant revision to Reber's earlier position that the knowledge acquired in artificial grammar learning studies is completely inaccessible to consciousness (Reber, 1965). Subsequent studies have shown that this extreme position is inaccurate, since subjects in such experiments show an increase in their ability to communicate their knowledge of underlying rule systems (Mathews et al., 1989; Reber and Lewis, 1977). However, Reber maintains that "the implicitly acquired epistemic contents of mind are always richer and more sophisticated than what can be explicated" (Reber, 1989, p. 229). With respect to foreign language learning, it is commonly argued that implicit knowledge sometimes can be brought to conscious awareness, but that such explicit knowledge is the end product of acquisition, not its cause (Bialystok and Bouchard Ryan, 1985). Chomsky's position on first language acquisition is somewhat different, since he has argued that the principles, conditions and rules of universal grammar that determine the course of first language acquisition are *in principle* inaccessible to conscious awareness (Chomsky, 1975, 1986, 1990). The second sense in which the knowledge resulting from implicit learning is said to be unconscious is that, whether or not such knowledge is potentially accessible to conscious awareness and is expressible, it is presumably not present in consciousness awareness and not used deductively as the basis for making grammaticality judgments in the testing phase (Reber, 1989, p. 230). Instead, such judgments are intuitive. With respect to this issue, most SLA theories are in agreement that consciously held rules can only be applied by language learners under limited circumstances and cannot serve directly as the basis for truly fluent language performance. There is less agreement concerning how fluent performance is achieved, however (for review, see Schmidt, 1992). Sharwood Smith (1981) theorized that it develops through practice from an earlier nonfluent

stage in which rules are consciously applied. McLaughlin, Rossman and McLeod (1983) proposed a model based on Shiffrin and Schneider's (1977) information processing account of the development from controlled to automatic processing, avoiding discussion of conscious and unconscious processes. For others, there is no relationship at all between the application of consciously held rules and fluent production. Once again, Krashen's position is clearest by virtue of its categorical nature: only implicitly acquired knowledge can be the basis of fluent production.

- The product of implicit learning is abstract. The evidence for this derives from the fact that the knowledge acquired in such studies generalizes to strings that are not presented during the training phase, and even to different symbol sets as long as the same underlying rule structure is used to generate the strings (Reber, 1969, 1976; Mathews et al., 1989). Linguistic competence is similarly believed to be abstract.

In spite of a number of differences of interpretation and nuance, this comparison of theories based on artificial grammar experiments with theories of second language learning has identified a number of common issues. All of these issues are important for SLA theory, as well as for foreign language pedagogy, but the question of intentional vs. incidental learning, attended vs. unattended learning, the noticing hypothesis, and the issue of automatic performance are all separable from the most important issues involved in implicit learning studies, unconscious induction and abstractness of the knowledge that results from learning. It turns out that these two issues are intimately related.

#### UNCONSCIOUS ABSTRACTION AND ARTIFICIAL GRAMMAR LEARNING

The basic logic for establishing that implicit learning proceeds by unconscious induction in artificial grammar experiments is as follows:

- Establish that the system rests upon complex, abstract rules;

- Assess the performance of learners to establish that exposure has led to reasonably good performance in manipulating the outputs of the underlying grammar, including novel strings not encountered during training; and
- Assess learner awareness to establish lack of awareness of the underlying rules.

If all three conditions are met, the conclusion that some kind of unconscious abstraction is operative seems reasonable. To cast doubt on the reality of unconscious induction, one may attempt to show any of the following:

- The underlying knowledge is not as abstract as assumed;
- Learner performance is not as good as claimed; or
- Learners have more awareness than they have been given credit for.

In artificial grammar learning, the essence of the claim that implicit learning proceeds by an unconscious process of abstraction is that the experimenter's grammar has been internalized by learners without awareness. However, this claim has been challenged frequently, beginning with Dulany, Carlson, and Dewey (1984), who carried out an MAG experiment and then had subjects introspect their reasons for rejecting ungrammatical strings. Dulany et al. reported that their subjects reported personal sets of conscious rules (i.e., they had more awareness than they had been given credit for), and while these conscious rules were of much more limited scope than those built into the grammar by the experimenter, they predicted the judgments of grammaticality on novel test strings without significant residue (i.e., their performance wasn't so good to begin with), eliminating the need to posit any rules operating below the level of consciousness (i.e., the underlying knowledge was not as abstract as claimed). A number of recent MAG learning experiments have provided additional support for the claim that what is acquired is not abstract rules but more concrete knowledge, specifically knowledge of the likelihood of specific letter chunks appearing in grammatical strings (Brooks and

Vokey, 1991; Dienes, Broadbent, and Berry, 1991; Medin and Ross, 1990; Perruchet and Pacteau, 1990, 1991; Servan-Schrieber and Anderson, 1990).

The question of whether learning in MAG experiments and other implicit learning paradigms rests upon unconscious abstraction or much simpler forms of learning based on specific examples is currently the subject of lively debate (Shanks and St. John, 1994; Winter and Reber, 1994). However, there is a core of agreement concerning the mechanisms of implicit learning in MAG experiments. Reber's position is that the knowledge acquired in MAG experiments is abstract and that subjects can be said to have acquired knowledge of the underlying grammar "in some sense" (Reber, 1989, p. 221), but concedes that such knowledge is probably represented functionally in terms of sets of bigrams and trigrams, not as a formal system (p. 226). Abrams and Reber (1988), Hayes and Broadbent (1988) and Lewicki (1986) have all suggested that implicit learning should be viewed as a complex, covariational form of frequency counting. Mathews et al. (1989) hold the view that implicit learning is an automatic, memory-based process for detecting patterns of family resemblance among examples. Perruchet (Perruchet and Amorim, 1992; Perruchet, Gallego, and Savy, 1990; Perruchet and Pacteau 1991, 1992) rejects neither human abstraction ability nor the existence of unconscious processes. He accepts the existence of implicit learning, but argues that it rests upon the gradual accumulation of frequency information (Hasher and Zacks, 1979, 1984; Hintzman, 1976), rather than the ability to unconsciously abstract the complex rules used by the experimenter. Perruchet and Pacteau argue against the possibility of unconscious abstraction, on the grounds that abstraction is associated exclusively with explicit, conscious cognitive functions such as logical reasoning.

## UNCONSCIOUS INDUCTION AND FOREIGN LANGUAGE LEARNING

Turning to implicit and explicit learning mechanisms in SLA, consider the following example of two learners apparently figuring out something about the target language through conscious analysis, including the formation and testing of hypotheses:

While living in Spain, an English-speaking friend and I noticed that many times, after we had been talking at length with Spaniards, they would say *Pués nada*. At first, we felt a little insulted, since translated, it meant “Well, nothing,” as if what we had been saying was worth nothing. Due primarily to our aggravation, which slowly turned into curiosity, we decided we were going to figure out what it meant. We therefore began taking mental notes of the times we heard it and reported back to each other our findings. We finally narrowed it down to the fact that it was used whenever there was a lengthy pause in a conversation. Having realized this, we decided that the next time we were out with Spaniards, we would say it whenever such a pause occurred. When we did, the mystery unraveled itself, for every time we used it, without fail, a new topic of conversation was begun. *Pués nada* was a way of closing one topic and moving on to another. (Hribar, personal communication cited in Hatch and Hawkins, 1989, p. 349)

Schmidt and Frota (1986) report numerous similar instances in which a learner’s developing conscious understanding of the forms and functions of Brazilian Portuguese (recorded in a diary) matched the learner’s performance in recorded interview data, including cases in which incorrect use could be traced to specific misanalyses of what was heard in input. However, many SLA theorists reject this “learner as linguist” view of acquisition, arguing that learners do not construct their internal grammars of the target language through analysis and hypothesis testing (Eubank, 1991; White, 1981), but assuming that learners do construct a theory of the language they are learning unconsciously (perhaps under the influence of an innate acquisition device) and that the learner’s unconscious theory closely resembles the theory that the linguist constructs through conscious analysis of the distribution of possible and impossible sentences of the language, paraphrase relationships, and so forth. Parallel to assertions that MAG experiments demonstrate unconscious learning, claims for unconscious induction of an abstract underlying rule system in natural language also rest on the argument that there is a significant dissociation between what learners are aware of and the more abstract rules that linguistic theory holds govern the behavior of learners.

Krashen (1994) puts forth the “complexity argument”: the system is too complex to be consciously learned. With particular reference to reading, Krashen argues that even the rules of spelling and phonics in English are exceedingly complex, far beyond the capacity of any student to consciously learn, and that vocabulary is an even clearer example, since there are too many words to learn one at a time. Citing

Smith (1988), Krashen points out that if estimates are correct that educated adults know about 156,000 words, this could not possibly be the result of 156,000 trips to the dictionary, 156,000 flash cards, or 156,000 fill-in-the-blank exercises. Of course this is true and this is an argument for incidental learning, but it is completely beside the point as far as implicit learning is concerned. The alternative explanation, which stresses conscious learning, is that we do learn base words one at a time (there is no other way, because they are arbitrary), whether we encounter them in reading or on word lists, and that derived words and compounds are learned through a combination of item learning and more generalized learning as we gradually become aware of regularities in form-meaning matching and extend our competence through analogy (e.g., from *racism* to *sexism* and *age-ism*) and other conscious processes.

Paradis (1994) provides a more compelling example of the complexity argument with respect to morphosyntax:

Any native French speaker who taught French to speakers of another language had to refer to the grammar book the first time they were asked the inevitable question: "Why do you use the subjunctive in this sentence?" Before checking, the answer of course is "I don't know; it simply wouldn't sound right otherwise." "But why?" "Well, I don't have the faintest idea. I've been using the subjunctive in this context for 25 years, but I can't explain why." Whereupon the teacher quickly makes up a rule. Once you have looked it up, you teach that there are six expressions that are followed by the subjunctive, whether the subject of the verb that precedes is or is not co-referential with the subject of the verb that follows, and that another six expressions are followed by the subjunctive only if the subject of the first and of the second verb are not co-referential, for if they are, then the second verb must be in the infinitive. (p. 403)

VanPatten (1984, 1994) also refers to the subjunctive, this time in Spanish, as an illustration of the claim that attention (but not understanding) is required for learning:

Bob Smith is a learner of Spanish, a language that actively distinguishes between subjunctive and indicative mood through verbal inflection in the present and past tenses. He begins to notice subjunctive forms in others' speech. He attends to it. Soon, he begins to use it in his own speech, perhaps in reduced contexts, but nonetheless he is beginning to use it. If you ask him for a rule, he might make one up. But in actuality, he doesn't

have a rule. All he knows is that he has begun to attend to the subjunctive and the context in which it occurs and it has somehow begun to enter his linguistic system. He may or may not wind up with a native-like subjunctive rule system, but that is not the point. (p.p. 33–34)

Long (in press) provides a longer list of candidates for implicit learning:

Any claim for the necessity of noticing for SLA in the higher level sense of understanding would be problematic. Some linguistic knowledge, such as several rules for English articles, and subtle aspects of the use of the T/V distinction to mark power and solidarity in Romance languages, is too abstract, complex or semantically opaque to be understood by linguistically naive learners. Some, such as gender-marking in French and English dative alternation, involve too many irregularities and fuzzy categories, and some, such as subject-auxiliary inversion after preposed negative adverbials (“Seldom have I seen ...”) and uses of *whom* are too rare or perceptually non-salient. ... The fact that untutored, linguistically naive learners often are successful with such patterns suggests, therefore, that they usually learn them on the basis of the lower level conscious perception or implicitly.

In my opinion, none of these examples provides a very convincing case for implicit learning. Consider first the possibility that foreign language learners do not achieve a level of performance that is required to sustain the argument (VanPatten believes that this is not important, but as I have shown above, it is an essential link in the chain of argument). The subjunctive and T/V distinctions in both French and Spanish, gender marking in French, and the use of articles in English are all notorious problems in foreign language learning. This is true for both naturalistic, uninstructed learners and for classroom learners. Although the latter fact is an argument for the insufficiency of instruction, the typical failure of both instructed and uninstructed learners in these areas of grammar counts even more heavily against arguments for the success of implicit learning. Consider next the possibility that learners are aware of more than they are being given credit for. It seems to me that this might very well be the case with VanPatten’s hypothetical learner Bob Smith, who may be forming partial rules on the basis of the examples of the Spanish to which he attends, but of course since this is a hypothetical case to begin with, we have no idea what Bob might or might not be aware of. My point is that it is misleading to assume ignorance when ignorance has not been demonstrated. Long’s example of the English *who/whom*



distinction is perhaps even a better example. This is not a core rule of English (it is disappearing from the language), but a rule of linguistic etiquette, subject to teaching in school and occasional corrections by parents who are concerned with such things. There is no reason to believe that it is acquired implicitly. Consider finally the possibility that the knowledge gained by learners is not as abstract as is being assumed. This very likely applies to Long's examples of inversion with negative adverbs (note that the example given to illustrate the "rule" is a formulaic chunk, *never have I ...*) and learning of the Spanish subjunctive (chunk learning is common in the early stages of foreign language learning), as well as to Paradis' description of the French subjunctive (assuming the description is correct), a collection of facts that certainly sound confusing when gathered together but which do not add up to an abstract rule.

As Brewer (1974), Dawson and Schell (1987), Ericsson and Simon (1984), and Shanks and St. John (1994) have pointed out, many illegitimate claims for implicit learning arise either when awareness is insufficiently assessed or when the linguist's concept of what has been learned is not required to produce the observed behavior. Nevertheless, I think that there is a case to be made for some implicit learning of foreign languages. My position is identical to that of Perruchet and Pacteau (1991), who emphasize both human abstraction abilities and the existence of unconscious processes, but reject the possibility of unconscious abstraction. For an example of how this solution can be applied to foreign language learning, we can return to one of the examples cited by Long, the acquisition of French gender. Gender acquisition in French seems a likely case of implicit learning (Schmidt, 1990), because no rules for distinguishing gender classes are taught to children, adult native speakers cannot formulate coherent or consistent rules, and the "rules" of gender assignment are more like fuzzy regularities than categorical rules. Sokolik and Smith (1992) proposed that connectionist networks are especially appropriate for modeling the learning of such fuzzy categories and described a computer-based connectionist network that learned to identify the gender of a set of French nouns based on the phonological shape of the noun and to generalize to new examples. MacWhinney, Leinbach, Taraban, and McDonald (1989) have provided an even more impressive connectionist model that successfully simulated the acquisition of the German definite article. There are six different

forms of the article (*der, den, dem, des, die, das*), but since articles mark gender, number and case, there are sixteen different cells filled by the six forms. The result is that no form defines a unique combination of features, e.g., *der* marks the masculine nominative singular, the feminine genitive and dative singular, and the genitive plural. Gender assignment is so complex that some observers have concluded that there are no rules, but other have discovered 38 cues to gender, some phonological, some morphological and some syntactic, some absolute and some probabilistic. The dimension of plural maps directly onto nouns, but there are eight different ways to mark plural. Cues to case occur on the morphological, syntactic, and semantic level. MacWhinney et al. developed three computer simulations that successfully learned the article system. Two of these included various cues to gender. The third included only the raw phonological features of the noun stem. All three models learned the system and showed a good match to L1 developmental data, but the third — the most brute and blind of the three — outperformed the others in both training and generalization. What is important is that in the simulations of both Sokolik and Smith and of MacWhinney et al. it was demonstrated that implicit learning could take place (computers are not conscious), based on large collections of examples, but the mechanism of generalization was a complex form of frequency counting, not the abstraction of rules.

One account of implicit learning that, if it correct, cannot be reduced to simple associative learning is the universal grammar (UG) account, particularly versions of it in the second language field that argue for abstract parameters and parameter resetting. UG makes very interesting predictions concerning implicit learning:

- The assumption that UG is available to all language learners means that SLA learners already know a great deal about the target language before exposure and predicts that grammars of L2 learners will not violate UG principles, that interlanguages must be natural languages and not be describable as “rogue grammars.” If UG is available in SLA, then L2 sentences that violate universal principles should also be judged ungrammatical without the need for any explicit knowledge of the principles involved or even any evidence from the L1 (Bley-Vroman, Felix, and Ioup, 1988; Finer, 1991). This is an

interesting claim in itself, and one for which there is some evidence (Bley-Vroman, Felix, and Ioup, 1988), but since it concerns unmodified pre-existing knowledge it is not specifically relevant to the issue of implicit learning.

- If parameter setting or resetting is a part of L2 acquisition, then the theory predicts that where a cluster of structural properties represents a single parameter, all properties associated with that parameter setting should be acquired simultaneously (Finer, 1991). The parameter setting hypothesis is often presented as a claim about implicit learning: "Essentially, the [learner] 'notices' a triggering property in the input and then deduces that all the other correlated properties must also be present" (Bley-Vroman, 1989, p. 64).

In UG theory, parameters are abstract properties of grammar that cannot be directly equated with such surface-level phenomena as patterns or structures, and in the most interesting case a single parameter is held responsible at some deep level for seemingly unrelated surface properties. For example, by one account, the parameter of pro-drop includes the ability to omit subject pronouns, subject-verb inversion, and trace effects when subjects are extracted from clauses containing complementizers (White, 1985). If it could be shown that one aspect of a parameter language serves as the trigger for automatic adjustment of all other aspects of the parameter, this would constitute powerful evidence for implicit learning, because the proposed principles controlling generalization not just to different lexicalizations of a single structure but to completely different structures are so abstract that learners certainly never become consciously aware of them. If, on the other hand, each aspect of a parameter requires separate evidence, then no particular conclusions can be drawn concerning unconscious induction. White (1985, 1989, 1991, 1992) has attempted to show how such parameter resetting may work in second-language acquisition. Studies to date have not supported the abstract parameter re-setting hypothesis, but these have all involved short-term instruction, so it remains possible that implicit learning of this kind might emerge in future studies.

The issue of implicit learning remains open, with potentially interesting theoretical and pedagogic consequences. I close this section with two mysteries. The first is, why do we seem to know more than we can say? Consider the following examples of contraction in English:

- 1a. *When do you want to take the test?*
- 1b. *When do you wanna take the test?*
- 2a. *Who do you want to see?*
- 2b. *Who do you wanna see?*
- 3a. *Who do you want to take the test?*
- 3b. *\*Who do you wanna take the test?*

For speakers who agree that 1b and 2b are acceptable and normal but 3b is not, the question is why is 3b unacceptable and how did you learn that? Is it plausible that you have heard 1b and 2b before (these exact sentences) and noticed the absence of 3b? This cannot be simply an example of chunk learning, because the chunk *who do you wanna* is normal enough in 2b but not in 3b. If you can see now what is wrong with 3b, is this something you were taught or thought about before? Assuming that there are foreign language learners of English who have the same intuitions (it is not clear to me whether they do, since several quite advanced ESL learners I have asked about these sentences have rejected both 3a and 3b), is this a case of implicit foreign language learning?

The second mystery is taken from DeKeyser (1994):

There is a question I have asked many audiences over the last few years, and nobody has come up with a convincing example of what I, and *a fortiori* those who are eager to demonstrate the success of implicit second language learning, are looking for. I will leave it with the reader to ponder: How many people do you know personally (not from hearsay) who, as adults, have learned a language really different from their native language (not just a different dialect or a very closely related language), who have done this without any explicit teaching (or explicit learning from textbooks, linguistic fieldwork, or simply informal reflection ...) and who have attained a linguistic competence in that second language comparable to a native speaker? (p. 92)

# IMPLICATIONS FOR FOREIGN LANGUAGE LEARNERS AND TEACHERS

In my interpretation, the literature reviewed here supports the hypothesis that attention is required for all learning. For those who would still maintain that some learning takes place without attention, it is important to stress that those psychologists who hold that view concede that whatever small amount of learning may take place unattended is interesting theoretically but of little practical value. I have also argued that detection (in the information processing sense), subjective awareness at the level of noticing, and learning all coincide. Learning at the higher level of understanding also seems crucial in most cases, and where generalization without awareness does seem to take place this is accomplished through simple associative learning applied to a rich memory base, rather than the unconscious induction of abstract rules.

The implications for language learners seem clear:

- Pay attention to input.
- Pay particular attention to whatever aspects of the input (phonology, morphology, pragmatics, discourse, etc.) that you are concerned to learn. Nothing comes free.
- Look for clues as to why target language speakers say what they say. Compare what you say with what target language speakers say in similar contexts. Build and test hypotheses when you can.
- If you cannot find a general principle to explain how something works, concentrate on noticing how specific instances are used in specific contexts.

It should be emphasized that only very modest implications for foreign language teaching can be drawn from the studies discussed in this paper, which have dealt with core theoretical issues, not the specifics

of particular pedagogic techniques. As VanPatten (1994) points out, there is a great danger when talking about the role of consciousness in learning that this will be interpreted as a reactionary call for a return to the most traditional language teaching methods. It is not my intent to argue for abandonment of communicative language teaching or a return to traditional teaching methods, for the following reasons.

- The classic pedagogical question of how to communicate complex and richly structured information to learners resists any simple answer and is not resolved by recasting the discussion from one about conscious vs. unconscious learning to one that assesses the balance between lower-level associative learning and higher cognitive functions such as conscious hypothesis formation.
- An effective learning environment must cater to all aspects of language learning. Explicit skills are necessary for deep elaborative processing of semantic and conceptual representations, but naturalistic settings provide maximum opportunities for exposure and motivation (N. Ellis, 1994b, 1994c).
- Explicit instruction is more likely to facilitate L2 acquisition in the case of some features of language than in others (Hulstijn, this volume; VanPatten 1994).
- Instruction may work mainly indirectly rather than directly in L2 learning, through its role as a cognitive focusing device or advance organizer for learner attention (R. Ellis 1993; Reber, 1989; Schmidt and Frota, 1986; Seliger, 1979; Sharwood Smith, 1991; Terrell, 1991).
- Learning takes place within the learner's mind (brain) and cannot be completely engineered by teachers or syllabus designers. Students do not always attend to what teachers intend them to attend to (Slimani, 1992) and may prefer to achieve awareness at a higher or lower level than what is prepackaged by teachers.

- Even though many controlled studies show an overall advantage for explicit over implicit instructional approaches (Carroll and Swain, 1993; DeKeyser, 1994; Fotos, 1993; Lightbown and Pienemann, 1993; Master, 1994; Scott, 1990; VanPatten and Cadierno, 1993), classroom based studies that speak directly to the relative merits of experiential instructional approaches and awareness-oriented approaches remain inconclusive (Harley, 1994).
- The interesting question of whether instructional intervention should precede or follow exposure to input has been addressed in some experimental studies, but not resolved (Mathews et al., 1989; Reber, 1989)
- The results from single task and dual task learning experiments suggest that some level of decontextualization is probably valuable in foreign language teaching, but provide no clear basis for choosing among such instructional approaches as that of Loschky and Bley-Vroman (1990), who recommend the construction of closed communicative tasks that require attention to the target grammatical structures, that of R. Ellis (1993), who suggests that consciousness-raising considerations justify a return to a structural syllabus as long as it is understood that this cannot serve as a complete course, or that of Long (1991), who rejects any kind of structural syllabus as well as attention to linguistic forms except as these concerns arise incidentally during pedagogic tasks.
- Most pedagogical rules are wrong. Today's best linguistic descriptions will be revised next year (Paradis, 1994).
- Awareness alone (without input or interaction) is clearly inadequate. We all know people who know something *about* a language but can neither understand nor speak it.

Psychological studies of learning suggest that a pure meaning-focused approach to foreign language teaching is misguided, but there are many possible ways to combine exposure to input and communicative practice with a focus on form and consciousness raising (R. Ellis,

1994). Basic experimental research does not provide the answers to these detailed questions. I do not find this discouraging. It means that a great deal of theoretically interesting and practically important research lies ahead.



## REFERENCES

- Abrams, M., & Reber, A. W. (1988). Implicit learning: Robustness in the face of psychiatric disorders. *Journal of Psycholinguistic Research*, 17, 425–439.
- Allport, D. A., Antonis, B., & Reynolds, P. (1972). On the division of attention: A disproof of the single channel hypothesis. *Quarterly Journal of Experimental Psychology*, 24, 225–235.
- Anderson, J. R. (1985). *Cognitive psychology and its implications*. (2nd ed.) New York: Freeman.
- Baars, B. J. (1988). *A cognitive theory of consciousness*. Cambridge: Cambridge University Press.
- Berry, D. C. (1994). Implicit and explicit learning of complex tasks. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 147–164). London: Academic Press.
- Bialystok, E. (1990). The dangers of dichotomy: A reply to Hulstijn. *Applied Linguistics*, 11, 46–51.
- Bialystok, E. (1993). Symbolic representation and attentional control in pragmatic competence. In G. Kasper & S. Blum-Kulka (Eds.), *Interlanguage pragmatics* (pp. 43–57). Oxford: Oxford University Press.
- Bialystok, E. (1994a). Representation and ways of knowing: Three issues in second language acquisition. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 549–569). London: Academic Press.
- Bialystok, E. (1994b). Analysis and control in the development of second language proficiency. *Studies in Second Language Acquisition*, 16, 157–168.
- Bialystok, E., & Bouchard Ryan, E. (1985). A metacognitive framework for the development of first and second language skills. In D. Forest-Pressley, G. MacKinnon, & T. Waller (Eds.), *Metacognition, cognition, and human performance* (pp. 207–252). Orlando, FL: Academic Press.
- Bley-Vroman, R. (1989). What is the logical problem of foreign language learning? In S. Gass & J. Schachter (Eds.), *Linguistic*

*perspectives on second language acquisition* (pp. 41–68). Cambridge: Cambridge University Press.

- Bley-Vroman, R., Felix, S., & Ioup, G. (1988). The accessibility of universal grammar in adult language learning. *Second Language Research*, 4, 1–32.
- Bootzin, R. R., Kihlstrom, J. K., & Schachter, D. L. (Eds.). (1990). *Sleep and cognition*. Washington, DC: American Psychological Association.
- Bowers, K. (1984). On being unconsciously influenced and informed. In K. Bowers & D. Meichenbaum (Eds.), *The unconscious reconsidered* (pp. 227–272). New York: Wiley.
- Brewer, W. F. (1974). There is no convincing evidence for operant or classical conditioning in adult humans. In W. B. Weimer & D. S. Palermo (Eds.), *Cognition and the symbolic processes* (pp. 1–42). Hillsdale, NJ: Erlbaum.
- Brooks, L. R. (1978). Nonanalytic concept formation and memory for instances. In E. Rosch, & B. B. Lloyd (Eds.), *Cognition and categorization* (pp. 169–211). New York: Wiley
- Brooks, L. R. & Vokey, J. R.. (1991). Abstract analogies and abstracted grammars: Comments on Reber (1989) and Mathews et al. (1989). *Journal of Experimental Psychology: General*, 120, 316–323.
- Carlson, R. A., & Dulany, D. E. (1985). Conscious attention and abstraction in concept learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11, 45–58.
- Carr, T. H., & Curran, T. (1994). Cognitive factors in learning about structured sequences: Applications to syntax. *Studies in Second Language Acquisition*, 16, 205–230.
- Carroll, S., & Swain, M. (1993). Explicit and implicit negative feedback: An empirical study of the learning of linguistic generalizations. *Studies in Second Language Learning*, 15, 357–386.
- Cherry, E. (1953). Some experiments on the recognition of speech with one and with two ears. *Journal of the Acoustical Society of America*, 25, 975–979.
- Chomsky, N. (1975). *Reflections on language*. New York: Pantheon.
- Chomsky, N. (1986). *Knowledge of language: Its nature, origin and use*. New York: Praeger.

- Chomsky, N. (1990). Accessibility "in principle." *Behavioral and Brain Sciences*, 13, 600–601.
- Cohen, A., Ivry, R. I., & Keele, S. W. (1990). Attention and structure in sequence learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16, 17–30.
- Crookes, G. C., & Schmidt, R. (1991). Motivation: Reopening the research agenda. *Language Learning*, 41, 469–512.
- Curran, T., & Keele, S. W. (1993). Attentional and nonattentional forms of sequence learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 19, 189–202.
- Danks, P. L., & Gans, D. L. (1975). Acquisition and utilization of a rule structure. *Journal of Experimental Psychology: Human Learning and Memory*, 1, 201–8.
- Dawson, M., & Schell, A. (1987). Human autonomic and skeletal classical conditioning: The role of conscious cognitive factors. In G. Davey (Ed.), *Cognitive processes and Pavlovian conditioning in humans* (pp. 27–55). Chichester: John Wiley and Sons.
- DeKeyser, R. (1994). How implicit can adult second language learning be? *AILA Review*, 11, 83–96.
- Dennett, D. (1987). *The intentional stance*. Cambridge, MA: MIT Press.
- Dennett, D. (1991). *Consciousness explained*. Boston, MA: Little, Brown.
- Dennett, D. C. & Kinsbourne, M.. (1992). Time and the observer: The where and when of consciousness in the brain. *Behavioral and Brain Sciences*, 15, 183–247.
- Dienes, Z., Broadbent, D., & Berry, D. (1991). Implicit and explicit knowledge bases in artificial grammar learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 875–887.
- Doughty, C. (1991). Second language instruction does make a difference: Evidence from an empirical study of relativization. *Studies in Second Language Acquisition*, 13, 431–469.
- Dulany, D. E., Carlson, R. A., & Dewey, G. I. (1984). A case of syntactical learning and judgment: How conscious and how abstract? *Journal of Experimental Psychology: General*, 114, 25–32.

- Elley, W. B. (1991). Acquiring literacy in a second language: The effect of book-based programs. *Language Learning*, 41, 375–411.
- Ellis, N. (1993). Rules and instances in foreign language learning: Interactions of explicit and implicit knowledge. *European Journal of Cognitive Psychology*, 5, 289–318.
- Ellis, N. (1994a). Implicit and explicit language learning: an overview. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 1–31). London: Academic Press.
- Ellis, N. (1994b). Psychological perspectives on the role of conscious processes in vocabulary acquisition. *AILA Review*, 11, 37–56.
- Ellis, N. (1994c). Vocabulary acquisition: The implicit ins and outs of explicit cognitive mediation. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 211–282). London: Academic Press.
- Ellis, R. (1990). *Instructed second language acquisition*. Oxford: Blackwell.
- Ellis, R. (1993). The structural syllabus and second language acquisition. *TESOL Quarterly*, 27, 91–113.
- Ellis, R. (1994). Metalinguistic knowledge and second language pedagogy. Paper presented at the American Association of Applied Linguistics, Colloquium on Awareness, Baltimore.
- Ericsson, K., & Simon, H. (1984). *Protocol analysis: Verbal reports as data*. Cambridge, MA: MIT Press.
- Eubank, L. (1991). Introduction. In L. Eubank (Ed.), *Point counterpoint: Universal grammar in the second language* (pp. 1–48). Amsterdam: John Benjamins.
- Eysenck, M. W. (1982). Incidental learning and orienting tasks. In C. R. Puff (Ed.), *Handbook of research methods in human memory and cognition* (pp. 197–228). New York: Academic Press.
- Faltis, C., & Hudelson, S. (1994). Learning English as an additional language in K–12 schools. *TESOL Quarterly*, 28, 457–468.
- Felix, S. (1981). On the (in)applicability of Piagetian thought to language learning. *Studies in Second Language Acquisition*, 3, 201–220.
- Felix, S. (1985). More evidence on competing cognitive systems. *Second Language Research*, 1, 47–72.

- Felix, S. (1991). The accessibility of universal grammar in second language acquisition. In L. Eubank (Ed.), *Point counterpoint: Universal grammar in the second language* (pp. 89–103). Amsterdam: Benjamins.
- Finer, D. L. (1991). Binding parameters in second language acquisition. In L. Eubank (Ed.), *Point counterpoint: Universal grammar in the second language* (pp. 351–374). Amsterdam: Benjamins.
- Fisk, A. D., & Schneider, W. (1984). Memory as a function of attention, level of processing, and automatization. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 10, 181–197.
- Forest-Pressley, D., MacKinnon, G., & Waller, T. (Eds.). (1985). *Metacognition, cognition, and human performance*. Orlando, FL: Academic Press.
- Fotos, S. S. (1993). Consciousness-raising and noticing though focus on form: Grammar task performance versus formal instruction. *Applied Linguistics*, 14, 385–407.
- Fotos, S., & Ellis, R. (1991). Communicating about grammar: A task-based approach. *TESOL Quarterly*, 25, 605–628.
- Gardner, R. C. (1985). *Social psychology and language learning: The role of attitudes and motivation*. London: Edward Arnold.
- Gardner, R. C. (1988). The socio-educational model of second-language learning: Assumptions, findings, and issues. *Language Learning*, 38, 101–126.
- Gazzaniga, M. S. (1993). Brain mechanisms and conscious experience. In G. R. Bock & J. Marsh (Eds.), *Experimental and theoretical studies of consciousness* (pp. 247–257). New York: John Wiley.
- Glucksberg, S., & Cowan, G. N. (1970). Memory for nonattended auditory material. *Cognitive Psychology*, 1, 149–156.
- Greenwald, A. G., Spangeberg, E. R., Pratkanis, A. R., & Eskenazi, J. (1991). Double blind tests of subliminal self-help audiotapes. *Psychological Science*, 2, 119–122.
- Hanson, C., & Hirst, W. (1988). Frequency encoding of token and type information. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 14, 289–297.

- Hardcastle, V. G. (1993). The naturalists versus the skeptics: The debate over a scientific understanding of consciousness. *Journal of Mind and Behavior*, 14, 27–50.
- Harley, B. (1994). Appealing to consciousness in the L2 classroom. *AILA Review*, 11, 57–68.
- Harnad, S. (1990). Lost in the hermeneutic hall of mirrors. *Journal of Theoretical and Experimental Artificial Intelligence*, 2, 321–327.
- Harnad, S. (1991). Other bodies, other minds: A machine incarnation of an old philosophical problem. *Minds and Machines*, 1, 43–54.
- Hartman, M., Knopman, D. S., & Nissen, M. J. (1989). Implicit learning of new verbal associations. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15, 1070–1082.
- Hasher, L., & Zacks, R. T. (1979). Automatic and effortful processes in memory. *Journal of Experimental Psychology: General*, 108, 356–388.
- Hasher, L., & Zacks, R. T. (1984). Automatic processing of fundamental information: The case of frequency of occurrence. *American Psychologist*, 39, 1372–1388.
- Hatch, E., & Hawkins, B. (1987). Second-language acquisition: An experiential approach. In S. Rosenberg (Ed.), *Advances in applied psycholinguistics*, Vol. 2, *Reading writing and language learning* (pp. 241–283). Cambridge: Cambridge University Press.
- Hayes, N. A., & Broadbent, D. E. (1988). Two modes of learning for interactive tasks. *Cognition*, 28, 249–276.
- Hintzman, D. L. (1976). Repetition and memory. In G. H. Bower (Ed.), *The psychology of learning and motivation*, Vol. 10 (pp. 47–91). New York: Academic Press.
- Hulstijn, J. H., & de Graaff, R. (1994). Under what conditions does explicit knowledge of a second language facilitate the acquisition of implicit knowledge? A research proposal. *AILA Review*, 11, 97–113.
- Jackendoff, R. (1987). *Consciousness and the computational mind*. New York: Academic Press.
- James, W. (1890). *The principles of psychology*. New York: Holt.
- Joordens, S., & Merikle, P. M. (1992). False recognition and perception without awareness. *Memory and Cognition*, 20, 151–159.

- Kellogg, R. (1980). Is conscious attention necessary for long-term storage? *Journal of Experimental Psychology: Human Learning and Memory*, 6, 379–390.
- Kellogg, R. T., & Dare, R. S. (1989). Explicit memory for unattended information. *Bulletin of the Psychonomic Society*, 27, 409–412.
- Kihlstrom, J. (1984). Conscious, subconscious, unconscious: A cognitive perspective. In K. Bowers & D. Meichenbaum (Eds.), *The unconscious reconsidered* (pp. 149–211). New York: Wiley.
- Knowlton, B. J., Ramus, S. J., & Squire, L. R. (1992). Intact artificial grammar learning in amnesia: Dissociation of classification learning and explicit memory for specific instances. *Psychological Science*, 3, 172–179.
- Krashen, S. D. (1982). *Principles and practice in second language acquisition*. New York: Pergamon.
- Krashen, S. D. (1985). *The input hypothesis*. London: Longman.
- Krashen, S. D. (1989). We acquire vocabulary and spelling by reading: Additional evidence for the input hypothesis. *Modern Language Journal*, 73, 440–464.
- Krashen, S. D. (1993). The effect of formal grammar teaching: Still peripheral. *TESOL Quarterly*, 26, 722–725.
- Krashen, S. D. (1994). The input hypothesis and its rivals. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 45–77). London: Academic Press.
- Krashen, S. D., & Terrell, T. (1983). *The natural approach: Language acquisition in the classroom*. New York: Pergamon.
- Lamendella, J. (1977). General principles of neurofunctional organization and their manifestation in primary and second language acquisition. *Language Learning*, 27, 155–196.
- Larsen-Freeman, D., & Long, M. H. (1991). *An introduction to second language acquisition research*. Essex, UK: Longman.
- Lewicki, P. (1986). Processing information about covariations that cannot be articulated. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 12, 135–146.
- Lightbown, P. M., & Pienemann, M. (1993). Comments on Stephen D. Krashen's "Teaching issues: Formal grammar instruction." *TESOL Quarterly*, 26, 717–722.

- Lightbown, P. M., & N. Spada, N. (1994). An innovative program for primary ESL students in Quebec. *TESOL Quarterly*, 28, 563–579.
- Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review*, 95, 492–527.
- Long, M. H. (1988). Instructed interlanguage development. In L. Beebe (Ed.), *Issues in second language acquisition* (pp. 114–141). New York: Newbury House.
- Long, M. H. (1991). Focus on form: A design feature in language teaching. In K. deBot, R. B. Ginsberg, & C. Kramsch (Eds.), *Foreign language research in cross-cultural perspective* (pp. 39–52). Amsterdam: Benjamins.
- Long, M. H. (In press). The role of the linguistic environment in second language acquisition. In W. Ritchie & T. Bhatia (Eds.) *Handbook of research on language acquisition*. (Vol. 2) *Second language acquisition*. New York: Academic Press.
- Loschky, L., & Bley-Vroman, R. (1990). Creating structure based communication tasks for second language development. *University of Hawai'i Working Papers in ESL*, 9, 161–212.
- McLaughlin, B. (1990). "Conscious" versus "unconscious" learning. *TESOL Quarterly*, 24, 617–634.
- McLaughlin, B., Rossman, T., & McLeod, B. (1983). Second language learning: An information-processing perspective. *Language Learning*, 33, 135–157.
- MacWhinney, B. (1983). Miniature linguistic systems as tests of the use of universal operating principles in second-language learning by children and adults. *Journal of Psycholinguistic Research*, 12, 467–478.
- MacWhinney, B., Leinbach, J., Taraban, R., & McDonald, J. (1989). Language learning: Cues or rules? *Journal of Memory and Language*, 28, 255–277.
- Master, P. (1994). The effect of systematic instruction on learning the English article system. In T. Odlin (Ed.), *Perspectives on pedagogic grammar* (pp. 229–252). Cambridge: Cambridge University Press.
- Mathews, R. C., Buss, R. R., Stanley, W. B., Blanchard-Fields, W. B., Cho, J. R., & Druhan, B. (1989). Role of implicit and explicit processes in learning from examples: A synergistic effect. *Journal of*



*Experimental Psychology: Learning, Memory, and Cognition*, 15, 1083–1100.

- Medin, D. L., & Ross, B. H. (1990). The specific character of abstract thought: Categorization, problem solving, and induction. In R. J. Sternberg (Ed.) *Advances in the psychology of human intelligence*, (Vol. 5) (pp. 189–224). Hillsdale, NJ: Erlbaum.
- Merikle, P. M. (1988). Subliminal auditory messages: An evaluation. *Psychology and Marketing*, 5, 355–372.
- Merikle, P. M. (1994). On the futility of attempting to demonstrate null awareness. *Behavioral and Brain Sciences*, 17, 412.
- Moore, T. E. (Ed.). (1988). Subliminal influences in marketing. *Psychology and Marketing*, 5, 291–372.
- Moray, N. (1959). Attention in dichotic listening: Affective cues and the influence of instructions. *Quarterly Journal of Experimental Psychology*, 11, 56–60.
- Morgan, J. L., Meier, R. P., & Newport, E. L. (1987). Structural packaging in the input to language learning: Contributions of prosodic and morphological marking of phrases to the acquisition of language. *Cognitive Psychology*, 19, 498–550.
- Nagel, T. (1974). What is it like to be a bat? *Philosophical Review*, 83, 435–451.
- Nagel, T. (1993). What is the mind-body problem? In G. R. Bock & J. Marsh (Eds.), *Experimental and theoretical studies of consciousness* (pp. 1–7). Chichester: John Wiley.
- Nation, R., & McLaughlin, B. (1986). Novices and experts: An information processing approach to the “good language learner” problem. *Applied Psycholinguistics*, 7, 41–56.
- Nissen, M., & Bullemer, P. (1987). Attentional requirements of learning: Evidence from performance measures. *Cognitive Psychology*, 19, 1–32.
- Norman, D. A. (1969). Memory while shadowing. *Quarterly Journal of Experimental Psychology*, 21, 85–93.
- O’Keefe, J. (1985). Is consciousness the gateway to the hippocampal cognitive map? A speculative essay on the neural basis of mind. In D. Oakley (Ed.), *Brain and mind* (pp. 59–98). London: Methuen.
- Paradis, M. (1994). Neurolinguistic aspects of implicit and explicit memory: Implications for bilingualism. In N. Ellis (Ed.), *Implicit*

- and explicit learning of languages (pp. 393–419). London: Academic Press.
- Perruchet, P., & Amorim, M-A. (1992). Conscious knowledge and changes in performance in sequence learning: Evidence against dissociation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18, 785–800.
- Perruchet, P., Gallego, J., & Savy, I. (1990). A critical reappraisal of the evidence for unconscious abstraction of deterministic rules in complex experimental situations. *Cognitive Psychology*, 22, 493–516.
- Perruchet, P., & Pacteau, C. (1990). Synthetic grammar learning: Implicit rule abstraction or explicit fragmentary knowledge. *Journal of Experimental Psychology: General*, 119, 264–275.
- Perruchet, P., & Pacteau, C. (1991). Implicit acquisition of abstract knowledge about artificial grammar: Some methodological and conceptual issues. *Journal of Experimental Psychology: General*, 120, 112–116.
- Pica, T. (1994). Questions from the language classroom: Research perspectives. *TESOL Quarterly*, 28, 49–79.
- Pintrich, P. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In M. Maehr & C. Ames (Eds.), *Advances in motivation and achievement*, (Vol. 6) *Motivation enhancing environments* (pp. 117–160). Orlando: Academic Press.
- Poldrack, R. A., & Cohen, N. J. (1994). On the representational/computational properties of multiple memory systems. *Behavioral and Brain Sciences*, 17, 416–417.
- Posner, M. I. (1992). Attention as a cognitive and neural system. *Current Directions in Psychological Science*, 1, 11–14.
- Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, 13, 25–42.
- Posner, M. I., & Rothbart, M. K. (1991). Attentional mechanisms and conscious experience. In D. Milner & M. Rugg (Eds.), *The neuropsychology of consciousness* (pp. 91–111). San Diego, CA: Academic Press.
- Prabhu, N. S. (1987). *Second language pedagogy*. Oxford: Oxford University Press.

- Reber, A. S. (1965). *Implicit learning of artificial grammars*. Unpublished MA. thesis. Brown University.
- Reber, A. S. (1967). Implicit learning of artificial grammars. *Journal of Verbal Learning and Verbal Behavior*, 77, 317–327.
- Reber, A. S. (1969). Transfer of syntactic structure in synthetic languages. *Journal of Experimental Psychology*, 81, 115–119.
- Reber, A. S. (1976). Implicit learning of synthetic languages: The role of instructional set. *Journal of Experimental Psychology: Human Learning and Memory*, 2, 88–94.
- Reber, A. (1989). Implicit learning and tacit knowledge. *Journal of Experimental Psychology: General*, 118, 219–235.
- Reber, A. S. (1992). The cognitive unconscious: An evolutionary perspective. *Consciousness and Cognition*, 1, 93–133.
- Reber, A. S. (1993). *Implicit learning and tacit knowledge: An essay on the cognitive unconscious*. Oxford: Oxford University Press.
- Reber, A. S., & Allen, R. (1978). Analogy and abstraction strategies in synthetic grammar learning: A functionalist interpretation. *Cognition*, 6, 189–221.
- Reber, A. S., Allen, R., & Regan, S. (1985). Syntactical learning and judgment, still unconscious and still abstract: Comment on Dulany, Carlson, and Dewey. *Journal of Experimental Psychology: General*, 114, 17–24.
- Reber, A. S., Kassin, S. M., Lewis, S., & Cantor, G. W. (1980). On the relationship between implicit and explicit modes in the learning of a complex rule structure. *Journal of Experimental Psychology: Human Learning and Memory*, 6, 492–502.
- Reber, A. S., & Lewis, S. (1977). Toward a theory of implicit learning: The analysis of the form and structure of a body of tacit knowledge. *Cognition*, 5, 333–561.
- Reber, A. S., Walkenfeld, F. F., & Hernstadt, R. (1991). Implicit and explicit learning: Individual differences and IQ. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 888–896.
- Robinson, P. (in press). Attention, memory, and the “noticing” hypothesis. *Language Learning*.
- Rutherford, W. (1987). *Second language grammar: Learning and teaching*. London: Longman.

- Schachter, D. L. (1987). Implicit memory: History and current status. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 13, 501–518.
- Schmidt, R. (1990). The role of consciousness in second language learning. *Applied Linguistics*, 11, 129–158.
- Schmidt, R. (1992). Psychological mechanisms underlying second language fluency. *Studies in Second Language Acquisition*, 14, 357–385.
- Schmidt, R. (1993a). Awareness and second language acquisition. *Annual Review of Applied Linguistics*, 13, 206–226.
- Schmidt, R. (1993b). Consciousness, learning, and interlanguage pragmatics. In G. Kasper & S. Blum-Kulka (Eds.) *Interlanguage pragmatics* (pp. 21–42). Oxford: Oxford University Press.
- Schmidt, R. (1994a). Implicit learning and the cognitive unconscious. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 165–209). London: Academic Press.
- Schmidt, R. (1994b). Deconstructing consciousness in search of useful definitions for applied linguistics. *AILA Review*, 11, 11–26.
- Schmidt, R., & Frota, S. (1986). Developing basic conversational ability in a second language: A case study of an adult learner of Portuguese. In R. R. Day (Ed.), *Talking to learn: Conversation in second language acquisition* (pp. 237–322). Rowley, MA: Newbury House.
- Schneider, W., & Detweiler, M. (1988). The role of practice in dual-task performance: Toward workload modeling in a connectionist/control architecture. *Human Factors*, 30, 539–566.
- Scott, V. M. (1990). Explicit and implicit grammar teaching strategies: New empirical data. *The French Review*, 63, 779–788.
- Scovel, T. (1991). *Attention, apperception, awareness, and acquisition*. Paper presented at the Thai TESOL Eleventh Annual Convention, Bangkok.
- Seliger, H. (1979). On the nature and function of language rules in language teaching. *TESOL Quarterly*, 13, 359–369.
- Seliger, H. (1983). The language learner as linguist: Of metaphors and realities. *Applied Linguistics*, 4, 179–191.

- Servan-Schreiber, E., & Anderson, J. R. (1990). Learning artificial grammars with competitive chunking. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16, 592–608.
- Shanks, D. R., & St. John, M. F. (1994). Characteristics of dissociable human learning systems. *Behavioral and Brain Sciences*, 17, 367–447.
- Sharwood Smith, M. (1981). Consciousness-raising and the second language learner. *Applied Linguistics*, 7, 239–256.
- Sharwood Smith, M. (1991). Speaking to many minds: on the relevance of different types of language information for the L2 learner. *Second Language Research*, 7, 118–132.
- Sharwood Smith, M. (1993). Input enhancement in instructed SLA: Theoretical bases. *Studies in Second Language Acquisition*, 15, 165–179.
- Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing II: Perceptual learning, automatic attending, and a general theory. *Psychological Review*, 84, 127–190.
- Skehan, P. (1992). Second language acquisition strategies and task-based learning. *Thames Valley University Working Papers in English Language Teaching*, 1, 178–208.
- Slimani, A. (1992). Evaluation of classroom interaction. In J. C. Alderson & A. Beretta (Eds.), *Evaluating second language education* (pp. 197–220). Cambridge: Cambridge University Press.
- Slobin, D. I. (1985). Crosslinguistic evidence for the language-making capacity. In D. Slobin (Ed.), *The crosslinguistic study of language acquisition*, (Vol. 2) *Theoretical issues* (pp. 1157–1256). Hillsdale, NJ: Erlbaum.
- Smith, F. (1988). *Understanding reading*. (4th ed.). Hillsdale, NJ: Ablex.
- Sokolik, M. E., & Smith, M. E. (1992). Assignment of gender to French nouns in primary and secondary language: A connectionist model. *Second Language Research*, 8, 39–58.
- Terrell, T. D. (1991). The role of grammar instruction in a communicative approach. *Modern Language Journal*, 75, 52–63.
- Tomlin, R., & Villa, V. (1994). Attention in cognitive science and second language acquisition. *Studies in Second Language Acquisition*, 16, 183–203.

- Tye, M. (1993). Blindsight, the absent qualia hypothesis, and the mystery of consciousness. In C. Hookway & D. Peterson (Eds.), *Philosophy and cognitive science* (pp. 19–40). Cambridge: Cambridge University Press.
- van Lier, L. (1991). Inside the classroom: Learning processes and teaching procedures. *Applied Language Learning*, 2, 29–68.
- van Lier, L. (1994). Language awareness, contingency, and interaction. *AILA Review*, 11, 69–82.
- VanPatten, B. (1990). Attending to content and form in the input: An experiment in consciousness. *Studies in Second Language Acquisition*, 12, 287–301.
- VanPatten, B. (1993). Grammar teaching for the acquisition-rich classroom. *Foreign Language Annals*, 26, 435–450.
- VanPatten, B. (1994). Evaluating the role of consciousness in second language acquisition: Terms, linguistic features & research methodology. *AILA Review*, 11, 27–36.
- VanPatten, B., & Cadierno, C. (1993). Explicit instruction and input processing. *Studies in Second Language Acquisition*, 15, 225–241.
- Velmans, M. (1991). Is human information processing conscious? *Behavioral and Brain Sciences*, 14, 651–669.
- Vokey, J. R., & Brooks, L. R. (1992). Salience of item knowledge in learning artificial grammars. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 18, 328–344.
- Weiskrantz, L. (1986). *Blindsight: A case study and its implications*. New York: Oxford University Press.
- Weiskrantz, L. (1990). Outlooks for blindsight: Explicit methodologies for implicit processes. *Proceedings of the Royal Society London*, 239, 247–278.
- White, L. (1981). The responsibility of grammatical theory to acquisition data. In N. Hornstein & D. Lightfoot (Eds.), *Explanation in linguistics: The logical problem of language acquisition* (pp. 240–271). London: Longman.
- White, L. (1985). The pro-drop parameter in adult second language acquisition. *Language Learning*, 35, 47–62.
- White, L. (1989). *Universal grammar and second language acquisition*. Amsterdam: John Benjamins.

- White, L. (1991). Adverb placement in second language acquisition: Some effects of positive and negative evidence in the classroom. *Second Language Research*, 7, 133–161.
- White, L. (1992). On triggering data in L2 acquisition: A reply to Schwartz and Gubala-Ryzak. *Second Language Research*, 8, 120–137.
- White, L., Spada, N., Lightbown, P. M., & Ranta, L. (1991). Input enhancement and L2 question formation. *Applied Linguistics*, 12, 416–432.
- Winter, B., & Reber, A. S. (1994). Implicit learning and the acquisition of natural languages. In N. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 114–145). London: Academic Press.
- Wolford, G. & Morrison, F. (1980). Processing of unattended visual information. *Memory & Cognition*, 8, 521–527.
- Wyer, R., & Srull, T. (1994). *Handbook of social cognition* (Vol. 1). Hillsdale, NJ: Erlbaum.
- Zalewski, J. P. (1993). Number/person errors in an information-processing perspective: Implications for form-focused instruction. *TESOL Quarterly*, 27, 691–703.