

PSYCHOLINGUISTIC APPROACHES TO SLA*

Norman Segalowitz and Patsy M. Lightbown

INTRODUCTION

These are exciting times for research into the psychological processes underlying second language acquisition (SLA). In the 1970s, SLA emerged as a field of inquiry in its own right (Brown 1980), and in the 1980s, a number of different approaches to central questions in the field began to develop in parallel and in relative isolation (McLaughlin and Harrington 1990). In the 1990s, however, these different approaches began to confront one another directly. Now we are entering a period reminiscent, in many ways, of the intellectually turbulent times following the Chomskyan revolution (Chomsky 1957; 1965). Now, as then, researchers are debating basic premises of a science of mind, language, and learning. Some might complain, not entirely without reason, that we are *still* debating the same issues after 30–40 years. However, there are now new conceptual and research tools available to test hypotheses in ways previously thought impossible. Because of this, many psychologists believe there will soon be significant advancement on some SLA issues that have resisted closure for decades. We outline some of these developments and explore where the field may be heading. More than ever, it appears possible that psychological theory and SLA theory are converging on solutions to common issues.

Questions that have remained central for psycholinguists since SLA emerged as a discipline include the following: What cognitive processes underlie success and failure in people's attempts to master the syntactic patterning of a second language (L2)? Do the data on this question support the idea that SLA involves *rule* acquisition? If so, do the nature of these rules and the conditions under which they are acquired suggest involvement of an innate linguistic capacity or can learning alone account for SLA? How does a person become a *fluent* user of a second language? How are general mechanisms of memory and attention involved in SLA, and how do they contribute to fluency?

These questions serve as departure points for the present review. The issues they raise are grouped into three sections as follows. The first deals with SLA and the debate about the place of an *innate Universal Grammar* in language acquisition. Traditionally, the concern here has been whether evidence concerning L2 acquisition necessarily implies the existence of innate, specifically linguistic, predispositions. The second section looks at *basic cognitive mechanisms* underlying SLA, in particular, attention and memory, and their role in the achievement of fluency. The third section addresses some *pedagogical implications* of recent developments in the psychological literature.

INNATE UNIVERSAL GRAMMAR

When Chomsky (1957) introduced the idea that innate linguistic knowledge underlies language acquisition over 40 years ago, the impact was dramatic; it created a revolution in psychological thinking about language (Lightbown and White 1987, Lyons 1991). Initially, there was a period of collaboration between linguists and psychologists on fundamental questions of L1 development and language functioning (e.g., Bloom 1970, Brown 1973, McNeill 1970). Later, however, linguistic and psycholinguistic approaches diverged to such an extent that the disciplines operated in relative isolation (Lyons 1991, Reber 1987). Many linguists have adopted the view that human language capacity depends on an innate Universal Grammar (UG) that constrains language development while psycholinguists have generally approached language acquisition from the perspective that general principles of skill learning and information processing can alone account for language acquisition. Now, after a period of relative mutual neglect, it appears that lively debate over fundamentals has arisen once again between linguists and psychologists (e.g., Brown, Malmkjaer and Williams 1996, Müller 1996 and commentaries contained therein). This time, the participation of SLA researchers is more visible.

In linguistics, the central question is whether the evidence justifies postulating that innate UG is an underlying factor in *first language acquisition*. The case in favor of such innate knowledge rests on the following four premises:

1. Language development involves the acquisition of a rule governed system, many of the details of which turn out to be universal, complex, and arbitrary.
2. Language acquisition takes place in what appears to be a very short time, given the apparent inadequacy of the input and the complexity of the system acquired.
3. The input provided to the learner/acquirer includes not only grammatical sentences but also incomplete or incorrect sentences, false starts, and misleading phonetic representations of the words and phrases which make up the sentences.
4. The learner/acquirer does not receive negative evidence (information about what potential patterns are *not* part of the language).

According to UG theorists, these considerations pose an insurmountable challenge for any learning theory that does not include some innate predisposing factor(s). This is the logical problem of language acquisition, also known as Plato's problem: How can people come to know so much if they are born without knowledge and if the evidence provided to them by the learning environment is extremely limited? Plato's problem has always been at the center of Chomsky's work and of modern linguistics (Lyons 1991:164). The solution offered by UG linguistics is to propose the existence of an innate Universal Grammar underlying language acquisition. In SLA research, a particularly influential version of UG theory has been the principles and parameters model (Chomsky 1995, Epstein, Flynn and Martohardjono 1996, Lyons 1996, Meisel 1995, White 1996). This model distinguishes between principles, which underlie all human languages, and parameters, which reflect the different ways in which individual languages realize these principles.

Plato's problem is also at the center of the discussion about whether innate UG is implicated in SLA. Schachter (1996a; 1996b) and White (1989; 1996), among others, discuss how SLA could be understood in terms of parameter setting within UG theory. White (1996:91) goes on to say that "Arguments in favor of a role for UG in L2 acquisition hinge on the logical problem of L2 acquisition: L2 learners often end up with a highly complex unconscious mental representation of their L2...which is underdetermined by the L2 input, suggesting that built-in knowledge must be involved." Of course, because the primary motivation for UG theory comes from the premises underlying the logical problem of L1 acquisition, success or failure to resolve it in that domain has consequences for SLA theory.

The debate regarding innate factors in *first* language acquisition has become reanimated in recent years. The premises underlying the innateness position described earlier are now being increasingly challenged by empiricists who believe that language acquisition can be accounted for solely in terms of general principles of learning and cognition. These challenges are based on new data and new models of learning. It is beyond the scope of this paper to review these challenges in detail, but the following points can be made by way of summary. First, connectionist accounts of learning claim that, in principle at least, it is not necessary to assume a learner has knowledge of rules even though the newly acquired behavior appears to be rule governed (Broeder and Plunkett 1994, Ellis 1999, Elman, *et al.* 1996).¹ Second, the assumption that the language input is inadequate has been called into question (Snow 1995; see de Houwer 1995 for discussion of input in SLA). Third, a learning environment that provides degenerate (incomplete, inconsistent) data, contrary to what has been assumed, may be able to support a surprising amount of learning, as demonstrated by Landauer and Dumais (1997) in their modeling of vocabulary acquisition. Finally, claims regarding the absence of negative evidence have been challenged with new accounts of the amount and nature of the negative evidence available to young children (Sokolov and Snow 1994). Of course, there is still a great deal of discussion about how serious these challenges really are for innatist positions.

However, given the empirical nature of these challenges, it is likely that further research will soon make clear whether they are as compelling as their authors claim.

Where is this debate heading? Certainly in recent years the introduction of new research techniques has changed the nature of the discussion. Now it appears possible to subject many of the assumptions held by UG theorists or by psycholinguists to disconfirmation tests by using tools not available before (e.g., computer simulations of learning, the use of large data bases; MacWhinney 1995). Such developments are to be welcomed, regardless of what one thinks about any specific study, if for no other reason than that they provide a fresh way to look at old questions. This evolution, in turn, may help remove an important obstacle that has for decades prevented closure in the debate between UG theorists and psycholinguists, an obstacle that may be described in the following way (Watts [1970] made a similar point in a related context).

Linguists and psycholinguists (as do all scientists) employ certain economy criteria for evaluating competing theories within their own disciplines. That is, given two possible accounts of a phenomenon, both UG theorists and psycholinguists will prefer the one that provides the optimal trade-off between generalizability (accounting for more data) and simplicity (avoiding the use of unnecessary theoretical constructs). UG theorists and psycholinguists, however, differ in terms of how they use these economy criteria. The former evaluate a theory's economy with respect to how well it accounts for native speakers' intuitions regarding the structure of their language. The latter, on the other hand, assess a theory's economy with respect to how well it accounts for language behavior, including acquisition patterns, errors, memory for language, neurological representations, and the like. The goals of the two groups are thus fundamentally different in terms of what they each expect a theory to account for. As theories within each discipline evolve through the selection of newer theories to replace older ones, the disciplines necessarily diverge rather than converge on solutions to what started out as common problems. The advent of new ways of defining issues and collecting data, however, should help refocus theorists' explanatory goals and move us closer to achieving consensus on what theories of language and language acquisition are expected to explain.

At the moment, however, such consensus has not been achieved. As mentioned earlier, although linguists differ as to the details of UG's influence, many argue, nonetheless, that UG does underlie L2 acquisition (see White 1996 for details of the different positions within UG theory). Others, however, maintain that UG applies to L1 acquisition only and that a psychological learning theory approach is appropriate for SLA (e.g., Schachter 1996a; 1996b). While such a position is not logically indefensible, it generally is not favored by psycholinguists, since, they argue, if a learning theory account works for SLA then it might also work for L1 acquisition.

One psycholinguistic approach to SLA is the Competition Model (Bates and MacWhinney 1989, MacWhinney 1997). The Competition Model views both L1 and L2 acquisition as a learning process based on universals of cognitive structure rather than on principles of UG. A basic principle underlying acquisition, according to this model, is input-driven learning based on the cue-validity of elements present in the environment. An element's strength of cue-validity is the reliability with which the cue is associated with the correct functional choice (interpretation of a sentence or word). Sometimes the cue validity of a given marker (say, word order) will differ between the L1 and the L2 (e.g., word order in English versus Russian). MacWhinney and his colleagues report studies involving many different languages. Their work supports the hypothesis that input-driven learning based on cue-validity predicts L1 and L2 acquisition patterns and performance (see references in MacWhinney 1997, MacWhinney and Bates 1989). In a typical study, participants are asked to indicate which noun in a sentence is, for example, the agent or recipient of the action indicated by the verb. Response patterns indicate how the participant interprets the cues present in the sentence (word order, case markings). By means of such techniques, it has been shown, for example, that even an individual who has used English as a second language for decades may continue to use the cue strength hierarchy of the L1 to guide L2 interpretations (Bates and MacWhinney 1981).

For several reasons, the Competition Model has proven attractive to psycholinguists, including SLA researchers (e.g., Gass 1987; 1996, Kilborn 1994). It is founded upon clearly articulated general principles of cognitive functioning, including those underlying connectionist theories; empirical tests have provided good support for hypotheses derived from the model; and the conditions for disconfirming the model have been explicitly identified (MacWhinney 1997). Nevertheless, some authors have raised questions about how far this approach can take us. McLaughlin and Harrington (1990), for example, have questioned Competition Model researchers' tendency to use semantically anomalous sentences when testing the model (but see MacWhinney 1997). Gass (1996) wonders whether the Competition Model can account for how the learner comes to attend to the cue dimensions relevant to the hierarchy in the first place. These are interesting questions that future research will have to address.

What we have seen in the 1990s is a shift in the debate over basic questions about the nature of language and language learning. In the early days of the Chomskyan revolution, debate about innate competence versus the primacy of learning was largely nonempirical. In contrast, we see now that new methods for gathering data and constructing models are enabling theorists to test ideas in fresh ways, leading some to believe that closure on some issues may be in sight.

BASIC COGNITIVE MECHANISMS IN SLA

In recent years, a number of authors have attempted to present fully elaborated, cognitively oriented frameworks for thinking about SLA (e.g., Gass 1997, Johnson 1996, Skehan 1998). These works build upon earlier efforts to bring an information-processing orientation to the SLA field (e.g., McLaughlin 1987, McLaughlin, Rossman and McLeod 1983, McLeod and McLaughlin 1986), and they draw upon theories of attention, memory, and skill to be found in both the SLA and general cognitive psychology literatures. In this section, we highlight some of the principal psychological issues and recent developments in these areas.

1. Attention

Perhaps the most widely discussed psychological topic in the SLA literature at the present time is the role attention plays in L2 acquisition. (See Neumann 1996 for an overview of developments in psychological research on attention.) In his "Noticing Hypothesis," Schmidt (1998) argues that virtually every aspect of SLA involves attention. Of special concern is whether there is such a thing as "implicit learning" or whether all learning requires explicit attention or noticing, and whether attention—if it is necessary for learning—is also sufficient. These topics are at the center of a lively debate among SLA researchers, partly because they impact on proposed solutions to Plato's problem, and partly because they have implications for L2 pedagogy (see below).

Several positions have been staked out with respect to attention and learning in SLA. The Competition Model, for example, is based on the premise that learning takes place in the absence of attention, that is, learning is automatic (does not consume attentional capacity), learning is implicit (does not require intention), and repetitive exposure to input is sufficient for learning to take place. In formulating his "Noticing Hypothesis," Schmidt (1998) argues the contrary, namely, that attention is essential for learning. He does acknowledge that a person can register information without focal attention or awareness. This has been demonstrated, for example, in priming studies where a briefly presented initial stimulus word (the prime) can influence responses to the subsequent target word even though there is no conscious awareness of the prime (Fowler, Wolford, Slade and Tassinary 1981, Marcel 1983; but see Holender 1986, and discussions contained therein). Schmidt's point, however, is that, while such registration of information can take place without attention, the effects do not last long and do not affect longer term learning. He calls his position a strong version of the Noticing Hypothesis because he holds that while there may be subliminal perception there is no subliminal learning. Truscott (1998), on the other hand, opposes the view that noticing is a necessary condition for learning and claims that the cognitive foundations of the Noticing Hypothesis are weak and without supporting data.

Psychologists continue to debate the role attention plays in learning. An interesting study is presented by Nissen and Bullemer (1987), who looked at

implicit learning of a serial pattern in a reaction time (RT) task. In their experiment, participants had to press buttons to indicate the position of a target appearing on the computer screen. The target location was changed either in a random fashion or according to a patterned sequence; reaction times became faster in the pattern condition, indicating implicit learning of the pattern. Nissen and Bullemer found that when participants performed a concurrent tone-counting task, implicit learning was significantly reduced. They concluded that the implicit learning had required attentional capacity since it was disrupted by a secondary task that itself required attentional capacity. Stadler (1995), however, repeated the experiment with additional conditions and found that the reduction of implicit learning by tone-counting was no greater than the reduction observed from inserting long and short pauses between trials. The pauses segmented the pattern sequences and hence disrupted the processing of the serial pattern, but the pauses themselves did not draw upon attentional capacity. Stadler concluded that the implicit learning did not require attentional capacity; the reduced learning could be explained fully in terms of the disruption of the processing of pattern information, not in terms of attentional capacity.

It is becoming increasingly recognized that part of what may underlie controversies in this area, especially in the SLA literature, is lack of agreement on the meaning of such terms as attention and implicit learning. For example, definitions of implicit learning include learning with and without the use of attentional capacity, conscious awareness, intention to learn, recollection or intention to remember, and noticing, to name but some. Frensch (1998) provides a useful discussion of the problems posed by multiple meanings in this area and recommends criteria for choosing among various definitions. Other guides for this complex issue can be found in Ellis (1994a), Roediger (1997), and Stadler and Frensch (1998). Papers by Ellis (1994b), Reingold and Merikle (1988), Stadler (1997), Stadler and Roediger (1998), and Whittlesea and Dorken (1997) provide important discussions concerning the requirements for satisfactorily distinguishing implicit from explicit processes.

Closely related to these topics is the distinction between automatic and controlled processing (Schmidt 1992), where automatic processing is sometimes defined as processing that does not require attentional capacity, and sometimes defined as processing that is "ballistic," that is, once triggered, continues autonomously and cannot be intentionally interfered with. Often, however, authors operationally define automatic processing simply as very fast responding. Unfortunately, this criterion for automaticity, while convenient, is inadequate since fast responding could equally be due to fast, controlled, nonautomatic processing (Segalowitz 1991, Segalowitz and Segalowitz 1993). Finding appropriate measures of automaticity is a challenge, but one that must be met if we hope to study the role of automaticity in such areas as L2 fluency development (see below).

2. Memory

Most psychological research on memory and SLA has focused on how concepts and words are mapped onto each other in the bilingual mind. Researchers have asked whether the lexical stores of the bilingual's two languages are functionally independent or integrated, and how the particular languages involved and the conditions under which they were acquired affect the way words and their meanings are represented. Kroll and de Groot (1997) provide a thorough review of this literature.

The majority of this research has involved tasks with single word stimuli presented out of context rather than in the context of ongoing communication. Typical experiments in this literature involve priming tasks which explore whether response time to a target will be affected by previous presentation of its translation equivalent, same language synonym, etc. Attempts to demonstrate cross language priming effects have so far yielded mixed results, creating problems for theories that posit separate stores for the two lexicons. Kroll and de Groot (1997) review the issues involved here and propose new models of the bilingual lexicon to account for some of the apparently contradictory results.

While the organization of the bilingual's lexical store has been the main focus of SLA memory research for a long time, there are other memory-related issues that are (or should be) of interest to SLA researchers. Excellent reviews of current general psychological research on memory can be found in Bjork and Bjork (1996). One area of potentially great relevance, but so far little represented in the SLA literature, concerns *transfer appropriate processing*, also sometimes referred to as transfer appropriate learning.

The fundamental idea underlying transfer appropriate processing is that when a person learns new information, that information is encoded in a cue dependent or context sensitive manner (what Tulving [1983] refers to as "encoding specificity"). A person's success in retrieving previously learned information is, therefore, facilitated to the extent that the mental operations engaged in at the time of recollection (i.e., at the time of test) match those previously engaged in at the time of encoding or learning. This effect occurs because the internal mental state of the individual provides clues to assist recollection; if the retrieval cues activated at the time of test match the cues encoded during learning of the to-be-remembered information, then retrieval will be facilitated. Put another way, learning is said to be "transfer appropriate" if it involves processing mechanisms that match those that will be activated later at the time of test. Thus, for example, Blaxton (1989) found that free recall of word targets (a semantically driven task) was enhanced when the targets of recall had been generated (a semantically driven activity) by participants in an earlier phase of the experiment than when they had been read (a perceptually driven activity) and found the reverse for word fragment completion (a perceptually driven activity).

There is considerable general evidence to support the principle of transfer appropriate processing (Blaxton 1989, Roediger and Guynn 1996), and the concept is encountered widely in the cognitive literature. In the SLA literature, Durgunoglu and Roediger (1987) have shown how apparently inconsistent results concerning the nature of lexical stores in bilinguals (separate versus integrated stores) may have reflected methodological confounds related to transfer appropriate processing. Healy and Bourne (1995; *in press*), Healy and Sinclair (1996), and Segalowitz (1997) discuss how the principle of transfer appropriate processing applies to a number of skill learning situations, including SLA. This context-sensitive view of learning and memory is also consistent with assumptions underlying connectionist models of learning and the Competition Model of language acquisition. As discussed in the next main section, the principle of transfer appropriate processing has important pedagogical implications.

3. Fluency

Recent research developments in memory and attention have opened up new avenues for studying the acquisition of L2 fluency. The term "fluency," of course, has been used in many different senses (Riggenbach *in press*). For purposes of this discussion, however, fluency refers to performance in speaking or reading that is rapid and smooth. At least three component cognitive abilities of fluency can be identified: 1) the ability to rapidly retrieve from memory appropriate linguistic knowledge and speech routines as they are needed, 2) the ability to perform in a smooth manner in the face of competition from potentially distracting ongoing, unrelated events (external noises, intrusive thoughts), and 3) the ability to perform without disruption when confronted with related but unexpected events (a surprise turn in the conversation, an unexpected word from the interlocutor or text being read, a change in speech register, etc.). Each of these three component abilities involves specific cognitive mechanisms which, presumably, are implicated in L2 fluency acquisition.

For example, according to the principle of transfer appropriate processing, the learning environment that best promotes rapid, accurate retrieval of what has been learned is that in which the psychological demands placed on the learner resemble those that will be encountered later in natural settings. A challenge for research now is to identify what those demands are, to build them into a learning environment, and then to assess their impact on learning. The wealth of memory research techniques developed in the past few years will no doubt provide useful tools for investigating this element of skill acquisition (Healy and Bourne 1995).

The ability to perform fluently in the face of potential distraction from unrelated events requires a high level of automatization; such automatization allows language processing mechanisms to operate without interference from outside sources of information. Psychological studies have steadily refined our understanding of automaticity and are providing new ways to operationalize it for research purposes (Schmidt 1992). These developments open up possibilities for

assessing the degree of automatic processing in L2 users at various times during L2 acquisition (Segalowitz, Segalowitz and Wood 1998), thereby enabling one to measure the impact of particular learning experiences on this aspect of fluency. A related fluency issue concerns the ability to suppress inappropriately activated representations of information (e.g., an irrelevant meaning or thought elicited by a word) from distracting the focus of attention. Gernsbacher (Gernsbacher and Faust 1995), among others, has used various priming techniques to study individual differences in L1 reading skills. Her studies suggest that it is the ability to suppress irrelevant meanings efficiently, and not the ability to enhance the representation of relevant meanings, that distinguishes fluent readers from less fluent readers. These techniques can be used to study similar distinctions in L2 fluency, including how such suppression skills develop.

Finally, L2 fluency also requires an ability to cope with related but unexpected changes in the communicative environment. This type of fluency requires an ability to shift (as opposed to suppressing) one's focus of attention easily from one dimension of the communicative situation to another. While there are no published studies yet on this facet of fluency, recent developments in techniques for investigating attention-shifting skills (e.g., Rogers and Monsell 1995) may soon make it possible to investigate its acquisition.

PEDAGOGICAL IMPLICATIONS.

We turn briefly now to two topics where psychological research may prove valuable in resolving some controversial pedagogical issues. Both concern possible limitations of the communicative language teaching (CLT) methodologies that currently dominate L2 instruction. The first concerns how CLT is supposed to promote those aspects of fluency which require automatic processing without compromising its communicative nature; the second concerns the place, if any, for focus on form in CLT.

1. CLT and fluency

It is widely acknowledged that CLT has the merit of avoiding many of the shortcomings of the repetition-based, decontextualized techniques characteristic of audiolingual teaching approaches (DeKeyser 1998, Lightbown 1998). What is not so clear is how, in theory, CLT is supposed to promote general fluency (rapid, smooth performance). The problem can be formulated in psychological terms as follows. Fluency involves, among other things, the ability to process information automatically, and both research and conventional wisdom suggest that automaticity is achieved only through repetition practice (Schneider, Dumais and Shiffrin 1984). Because it would appear that repetition practice is inherently uncommunicative, it follows that one potential limitation of CLT methodologies is that they are ill-suited for promoting fluency (automaticity).

This limitation may be more apparent than real, as can be seen from trying to understand the cognitive bases of CLT methodologies. This topic has received little discussion in the SLA literature (see Gatbonton and Segalowitz 1988, Johnson 1996, Segalowitz and Gatbonton 1995), but some testable hypotheses can be derived from current psychological research on memory and attention. CLT methodologies emphasize *genuine* communication, that is, communication based on a real desire by the learner to understand and communicate meanings. CLT methodologies attempt to provide life-like situations in the classroom to enable this to happen. Gatbonton and Segalowitz (1988) argue that, when approached in a certain way, CLT activities can be designed to meet the requirements of transfer appropriate processing. Such adaptation requires making the psychological context (the learner's perceptions, feelings, intentions, etc.) in which learning takes place match the psychological context that will obtain outside the classroom when the learner's language skills are called upon. If this condition is met, then the memory-access component of fluency should be enhanced—what was learned in the classroom should be more readily accessed when needed at a later time than would otherwise be the case. Of course, skills can be learned under conditions that do not meet the criteria of transfer appropriate processing; in this case, what is learned should be less readily accessed when needed, and performance should be correspondingly less fluent. It should be noted too that not all communicative activities meet the criteria of transfer appropriate processing. One has to examine closely the psychological demands associated with each learning activity and consider the contexts in which the target language skills will be called upon. (Gatbonton and Segalowitz [1988] present examples showing how conventional CLT activities can be looked at from this perspective.)

CLT activities can also be designed to promote the other two elements of fluency discussed earlier. For example, communication activities can be designed to be inherently repetitive, thereby providing meaningful repetition practice that leads to automaticity. Activities can also be constructed to be open-ended, allowing for surprise turns of events, thereby providing possibilities for developing skills in switching attention focus. They can also provide sources of distraction, thereby creating opportunities for developing focusing skills that involve suppression of elicited, irrelevant information.

What we see here is that the psychological literature on memory and attention can provide new ways of thinking about CLT methodologies. These innovations include criteria for designing activities to promote fluency and methods for testing the outcomes. Such considerations may help overcome what some have believed to be an inherent limitation of CLT methodologies.

2. CLT and focus on form

An issue hotly debated in recent years is whether there are benefits to be derived from focusing the L2 learner's attention on language form, and if so, how best to do this in terms of timing and manner. (Does one match focus on form activities to the learner's stage of development? Should focus on form be integrated into communicative activities or handled separately?) Overviews of the issues involved can be found in DeKeyser (1998) and Doughty and Williams (1998). Implicit here is the idea of another CLT limitation, namely, that these methodologies do not readily permit learners to learn about structural features of the language. Evidence supporting the effectiveness of integrating focus-on-form and communicative activities during instruction is provided by a number of researchers (Doughty and Varela 1998, Lightbown 1991, Lightbown and Spada 1990, Lyster 1994, Lyster and Ranta 1997, Spada and Lightbown 1993). Lightbown (1998) also summarizes the potential limitations of separate activities that focus on form and reviews teaching techniques that can incorporate focus on form within CLT activities.

Of particular interest for the present review is how a psychological perspective on SLA might make a contribution to the focus-on-form debate. DeKeyser (1998) raises the question of how one can promote the gradual transition from declarative knowledge (conscious, verbalizable) about language features to procedural knowledge that is automatized. Such a transition is considered central in most cognitive models of skill learning (e.g., Ackerman 1989, Anderson 1983). Given the techniques that now exist for studying automaticity, one can envisage testing hypotheses about the way knowledge of language structure gained through focus-on-form becomes part of the learner's repertoire of automatized language abilities. In a similar vein, the principle of transfer appropriate processing provides a theoretical framework for thinking about the effects of integrating form and meaning focus during instruction (Lightbown 1998). Here, the testable hypothesis would be that learners will have easier access to knowledge about language features that were noticed during classroom-learning communicative activities when later placed in communicative situations than if they learned about language features outside a communicative context.

CONCLUSION

In the 1990s, there has been an enormous increase in the level—both quantitative and qualitative—of research into SLA issues (e.g., Hulstijn and DeKeyser 1997, Tomlin and Gernsbacher 1994). The present review has had to be very selective. For example, we have said little about psychological studies of L2 word recognition and reading (Durgunoglu 1997, Koda 1994; 1996), L2 vocabulary development (Hulstijn 1997, Meara 1993; 1997), or the neuro-linguistics of bilingualism (Obler and Hannigan 1996, Paradis 1997), to name just some areas not covered. In these areas, as well as in those reviewed above, increasingly sophisticated research techniques are being brought to bear on

challenging problems. Until relatively recently, however, a major problem has been that the SLA research community and the L2 psycholinguistic and cognitive psychology community operated mostly in parallel with little interaction between them. Our reading of recent developments suggests that this period is coming to an end, a change that is both welcome and long overdue. Driving this change is the appearance of new research methodologies. What is especially exciting is that a number of longstanding issues that have resisted resolution may now be seen in a new light, and perhaps some of them may even be resolved.

NOTES

* The authors thank Nilmini de Silva, Elizabeth Gatbonton, Catherine Poulsen and Vivien Watson for their comments on an earlier draft of this article. Grant support for this work came from a Natural Sciences and Engineering Research Council of Canada award to the first author, from a Social Sciences and Humanities Research Council of Canada award to the second author, and from a Quebec Ministry Education grant (FCAR) held by both authors.

1. Not everyone agrees that connectionist models make good neuropsychological sense (e.g., S. Segalowitz and Bernstein 1997). However, as Ellis (1999) has suggested, one does not necessarily have to view connectionism as an attempt to model neural architecture for it to be useful. Connectionist analysis can, instead, be understood as a mathematical tool that reveals how the process of simple associative learning can contain hidden within it the basis for establishing response patterns that appear to be rule-governed in the absence of explicit rule representation. This use of connectionism as a tool is analogous to, say, the way one uses Fourier analysis to analyze complex wave forms to reveal underlying hidden, simpler acoustic patterns (e.g., the component frequencies, formant structures of speech). How the brain actually performs the equivalent analysis is another question.

ANNOTATED BIBLIOGRAPHY

Bjork, E. and R. Bjork (eds.) 1996. *Memory: Handbook of perception and cognition*. 2nd ed. New York: Academic Press.

This edited volume is an outstanding collection of 15 chapters reviewing major recent developments in the study of memory. Included are in-depth discussions of memory systems, short-term/working memory, long-term memory, retrieval, conscious and unconscious forms of memory,

individual differences in memory, and memory for real-world events. This volume should definitely serve as a basic reference work for SLA researchers interested in current psychological thinking about memory.

- Brown, G., K. Malmkjaer and J. Williams (eds.) 1996. *Performance and competence in second language acquisition*. Cambridge: Cambridge University Press.

This edited volume presents, in the context of SLA research and theory, an examination of the issues underlying Chomsky's competence-performance distinction and the theory of UG. The papers included here provide a wide range of perspectives. Some papers provide a historical context for understanding the theory of UG and the competence-performance distinction as it relates to SLA. Others focus on making a case for, or against, a UG approach to SLA. One chapter provides a useful tutorial on connectionism, and others deal with the competence-performance distinction in relation to lexical competence, sociolinguistic issues, and language testing.

- Epstein, D., S. Flynn and G. Martohardjono. 1996. Second language acquisition: Theoretical and experimental issues in contemporary research (plus commentaries). *Behavioral and Brain Sciences*. 19.677–758.

The target article addresses the question of whether UG constrains second language acquisition. The authors argue in favor of what they call the "Full Access" hypothesis, namely, that UG in its entirety constrains second language acquisition. The main article is followed by commentaries from 32 authors drawn from a variety of fields plus the authors' reply. The comprehensive debate and the reference section containing over 300 entries provides an excellent overview of the many perspectives on the issue of UG in SLA.

- Gernsbacher, M. A. (ed.) 1994. *Handbook of psycholinguistics*. New York: Academic Press.

This edited volume contains 34 chapters that provide excellent reviews of a wide range of psycholinguistic topics of interest to SLA researchers. The chapters cover various aspects of psycholinguistic theory and research methodology, and touch on areas that include L1 acquisition, reading, neurolinguistics, speech perception, and adult SLA. The volume is a valuable resource, providing entry points into the psycholinguistic literature in a number of major areas.

Hulstijn, J. and R. DeKeyser (eds.) 1997. *Testing SLA theory in the research laboratory*. [Special Issue of *Studies in Second Language Acquisition*. 19.2.]

This special issue of *SSLA* addresses the possibilities and limitations of laboratory studies in contributing to our understanding of SLA. The seven articles in this collection by well-known and respected authors in the field of SLA touch mainly on the themes of automaticity and implicit versus explicit processes in acquisition and instruction. This is a useful collection for illustrating how theoretical issues in SLA can be operationalized and submitted to laboratory testing.

Müller, R-A. 1996. Innateness, autonomy, universality? Neurobiological approaches to language (plus commentaries). *Behavioral and Brain Sciences*. 19.611-676.

The target article by Müller presents a neurobiological perspective on the concepts of innateness, universality, and the possible autonomy of human language capacity with respect to how these ideas have affected debate between UG theorists and psycholinguists. The author examines issues such as whether there could be language genes, hard-wiring of language capacity, a critical period for language learning, and a biological basis for a species-specific, human language capacity. He concludes that linguistic specialization of brain areas can be accounted for without appeal to genetic hard-wiring. The article is followed by a lively set of commentaries from 21 researchers drawn from a variety of areas, with a concluding reply by the author. The article and commentaries contain over 800 references.

Stadler, M. A. and P. A. Frensch. 1998. *Handbook of implicit learning*. Thousand Oaks: Sage Publications.

This edited collection provides an excellent and comprehensive discussion of a topic that is currently a major theme in the SLA literature—the role of attention in learning. The volume contains chapters presenting criteria for defining implicit learning and reviewing the most recent methodologies for investigating the place of attention in learning. Many SLA researchers will find the analyses of research using artificial grammars to study implicit learning especially interesting. This volume will serve as a major resource for anyone interested in how psychologists are currently addressing questions about implicit learning.

Tomlin, R. and M. Gernsbacher (eds.) 1994. *Cognitive foundations of second language acquisition*. [Special issue of *Studies in Second Language Acquisition*. 16.2.]

As the title of this special issue might suggest, this collection of papers by leaders in the field provides a possible "agenda" for cognitive psychological approaches to second language acquisition. The topics covered are varied, ranging across the nature of attention and control, the role of implicit learning, the effect of cognitive biases on interlanguage development, and the neurobiological dimensions of emotion and affect in SLA.

UNANNOTATED BIBLIOGRAPHY

- Ackerman, P. 1989. Individual differences and skill acquisition. In P. Ackerman, R. J. Sternberg and R. Glaser (eds.) *Learning and individual differences*. New York: Freeman. 165–217.
- Anderson, J. R. 1983. *The architecture of cognition*. Cambridge, MA: Harvard University Press.
- Bates, E. and B. MacWhinney. 1981. Second language acquisition from a functionalist perspective: Pragmatic, semantic and perceptual strategies. In H. Winitz (ed.) *Annals of the New York Academy of Sciences, Conference on native and foreign language acquisition*. New York: New York Academy of Sciences. 190–214.
- _____ 1989. Functionalism and the Competition Model. In B. MacWhinney and E. Bates (eds.) *The crosslinguistic study of sentence processing*. New York: Cambridge University Press. 3–73.
- Blaxton, T. 1989. Investigating dissociations among memory measures: Support for a transfer appropriate framework. *Journal of Experimental Psychology: Learning, Memory and Cognition*. 15.657–668.
- Bloom, L. 1970. *Language development: Form and function in emerging grammars*. Cambridge, MA: MIT Press.
- Broeder, P. and K. Plunkett. 1994. Connectionism and second language acquisition. In N. Ellis (ed.) *Implicit and explicit learning of languages*. New York: Academic Press. 421–453.
- Brown, H. D. 1980. Second language acquisition/learning: Psycholinguistic factors. In R. B. Kaplan, *et al.* (eds.) *Annual Review of Applied Linguistics*, 1. New York: Cambridge University Press. 108–113.
- Brown, R. 1973. *A first language: The early stages*. Cambridge, MA: Harvard University Press.
- Chomsky, N. 1957. *Syntactic structures*. The Hague: Mouton.
- _____ 1965. *Aspects of the theory of syntax*. Cambridge, MA: MIT Press.
- _____ 1995. *The minimalist program*. Cambridge, MA: MIT Press.
- de Houwer, A. 1995. Bilingual language acquisition. In P. Fletcher and B. MacWhinney (eds.) *The handbook of child language*. Oxford: Blackwell Publishers. 219–250.

- DeKeyser, R. 1998. Beyond focus on form: Cognitive perspectives on learning and practicing second language grammar. In C. Doughty and J. Williams (eds.) *Focus on form in classroom second language acquisition*. Cambridge: Cambridge University Press. 42–63.
- Doughty, C. and E. Varela. 1998. Communicative focus on form. In C. Doughty and J. Williams (eds.) *Focus on form in classroom second language acquisition*. Cambridge: Cambridge University Press. 114–138.
- _____. 1998. Pedagogical choices in focus on form. In C. Doughty and J. Williams (eds.) *Focus on form in classroom second language acquisition*. Cambridge: Cambridge University Press. 197–261.
- Durgunoglu, A. 1997. Bilingual reading: Its components, development and other issues. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 255–276.
- _____. 1987. Test differences in accessing bilingual memory. *Journal of Memory and Language*. 26.377–391.
- Ellis, N. (ed.) 1994a. *Implicit and explicit learning of languages*. New York: Academic Press.
- _____. 1994b. Vocabulary acquisition: The implicit ins and outs of explicit cognitive mediation. In N. Ellis (ed.) *Implicit and explicit learning of languages*. New York: Academic Press. 211–282.
- _____. 1999. Cognitive approaches to SLA. In W. Grabe, et al. (ed.) *Annual Review of Applied Linguistics, 19. Survey of Applied Linguistics*. New York: Cambridge University Press. 22–42.
- Elman, J., E. Bates, M. Johnson, A. Karmiloff-Smith, D. Parisi and K. Plunkett. 1996. *Rethinking innateness: A connectionist perspective on development*. Cambridge, MA: MIT Press.
- Fowler, C., G. Wolford, R. Slade and L. Tassinary. 1981. Lexical access with and without awareness. *Journal of Experimental Psychology: General*. 110.341–362.
- Frensch, P. 1998. One concept, multiple meanings: On how to define the concept of implicit learning. In M. Stadler and P. Frensch (eds.) *Handbook of implicit learning*. London: Sage Publications. 47–104.
- Gass, S. 1987. The resolution of conflicts among competing systems: A bidirectional perspective. *Applied Psycholinguistics*. 8.329–350.
- _____. 1996. Second language acquisition and linguistic theory: The role of language transfer. In W. Ritchie and T. Bhatia (eds.) *Handbook of second language acquisition*. New York: Academic Press. 317–345.
- _____. 1997. *Input, interaction and the second language learner*. Mahwah, NJ: L. Erlbaum.
- Gatbonton, E. and N. Segalowitz. 1988. Creative automatization: Principles for promoting fluency within a communicative framework. *TESOL Quarterly*. 22.473–492.
- Gernsbacher, M. and M. Faust. 1995. Skill suppression. In F. Dempster and C. Brainerd (eds.) *Interference and inhibition in cognition*. New York: Academic Press. 295–327.

- Healy, A. and L. E. Bourne, Jr. (eds.) 1995. *Learning and memory of knowledge and skills: Durability and specificity*. Thousand Oaks, CA: Sage.
- _____. (eds.) In press. *Foreign language learning: Psycholinguistic studies on training and retention*. Mahwah, NJ: L. Erlbaum.
- _____. and G. Sinclair. 1996. The long-term retention of training and instruction. In E. Bjork and R. Bjork (eds.) *Memory: Handbook of perception and cognition*. 2nd ed. New York: Academic Press. 525–564.
- Holender, D. 1986. Semantic activation without conscious identification in dichotic listening, parafoveal vision and visual masking: A survey and appraisal. *Behavioral and Brain Sciences*. 9.1–66.
- Hulstijn, J. 1997. Mnemonic methods in foreign language vocabulary learning: Theoretical considerations and pedagogical implications. In J. Coady and T. Huckin (eds.) *Second language vocabulary acquisition*. New York: Cambridge University Press. 203–224.
- Johnson, K. 1996. *Language teaching and skill learning*. Oxford: Blackwell.
- Kilborn, K. 1994. Learning a language late: Second language acquisition in adults. In M. A. Gernsbacher (ed.) *Handbook of psycholinguistics*. New York: Academic Press. 917–944.
- Koda, K. 1994. Second language reading research: Problems and possibilities. *Applied Psycholinguistics*. 15.1–28.
- _____. 1996. L2 Word recognition research: A critical review. *The Modern Language Journal*. 80.450–460.
- Kroll, J. and A. de Groot. 1997. Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism: Psycholinguistic perspectives*. Mahwah, NJ: L. Erlbaum. 169–199.
- Landauer, T. and S. Dumais. 1997. A solution to Plato's problem: The Latent Semantic Analysis theory of acquisition, induction and representation of knowledge. *Psychological Review*. 104.211–240.
- Lightbown, P. 1991. What have we here? Some observations on the influence of instruction on L2 learning. In R. Phillipson, E. Kellerman, L. Selinker, M. Sharwood Smith and M. Swain (eds.) *Foreign/second language pedagogy research*. Clevedon, Avon: Multilingual Matters. 197–212.
- _____. 1998. The importance of timing in focus on form. In C. Doughty and J. Williams (eds.) *Focus on form in classroom second language acquisition*. Cambridge: Cambridge University Press. 177–196.
- _____. and N. Spada. 1990. Focus on form and corrective feedback in communicative language learning. *Studies in Second Language Acquisition*. 12.429–448.
- _____. and L. White. 1987. The influence of linguistic theory on language acquisition research. *Language Learning*. 37.483–510.
- Lyons, J. 1991. *Chomsky*. 3rd ed. London: Harper Collins.
- _____. 1996. On competence and performance and related notions. In G. Brown, K. Malmkjaer and J. Williams (eds.) *Performance and competence*

- in second language acquisition*. Cambridge: Cambridge University Press. 11–32.
- Lyster, R. 1994. The effect of functional-analytic teaching on aspects of French immersion students' sociolinguistic competence. *Applied Linguistics*. 15.263–287.
- _____, and L. Ranta. 1997. Corrective feedback and learner uptake: Negotiation of form in communicative classrooms. *Studies in Second Language Acquisition*. 19.37–66.
- MacWhinney, B. 1995. Computational analysis of interactions. In P. Fletcher and B. MacWhinney (eds.) *The handbook of child language*. Oxford: Blackwell Publishers. 152–178.
- _____, 1997. Second language acquisition and the Competition Model. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism: Psycholinguistic perspectives*. Mahwah, NJ: L. Erlbaum. 113–142.
- _____, and E. Bates (eds.) 1989. *The crosslinguistic study of sentence processing*. New York: Cambridge University Press.
- Marcel, A. 1983. Conscious and unconscious perception: An approach to the relations between phenomenal experience and perceptual processes. *Cognitive Psychology*. 15.238–300.
- McLaughlin, B. 1987. *Theories of second language learning*. London: Edward Arnold.
- _____, and M. Harrington. 1990. Second language acquisition. In R. B. Kaplan, et al. (eds.) *Annual Review of Applied Linguistics*, 10. *Survey of applied linguistics*. New York: Cambridge University Press. 122–134.
- _____, T. Rossman and B. McLeod. 1983. Second language learning: An information processing perspective. *Language Learning*. 33.135–158.
- McLeod, B. and B. McLaughlin. 1986. Restructuring or automaticity? Reading in a second language. *Language Learning*. 36.109–123.
- McNeill, D. 1970. *The acquisition of language: The study of developmental psycholinguistics*. New York: Harper & Row.
- Meara, P. 1993. The bilingual lexicon and the teaching of vocabulary. In R. Schreuder and B. Weltens (eds.) *The bilingual lexicon*. Amsterdam: John Benjamins. 279–297.
- _____, 1997. Towards a new approach to modelling vocabulary acquisition. In N. Schmitt and M. McCarthy (eds.) *Vocabulary: Description, acquisition and pedagogy*. New York: Cambridge University Press. 109–121.
- Meisel, J. 1995. Parameters in acquisition. In P. Fletcher and B. MacWhinney (eds.) *The handbook of child language*. Oxford: Blackwell Publishers. 10–35.
- Neumann, O. 1996. Theories of attention. In O. Neumann and A. F. Sanders (eds.) *Handbook of perception and action, Volume 3: Attention*. London: Academic Press. 389–446.
- Nissen, M. and P. Bullemer. 1987. Attentional requirements of learning: Evidence from performance measures. *Cognitive Psychology*. 19.1–32.

- Obler, L. and S. Hannigan. 1996. The neuropsychology of second language acquisition and use. In W. Ritchie and T. Bhatia (eds.) *Handbook of second language acquisition*. New York: Academic Press. 509–523.
- Paradis, M. 1997. The cognitive neuropsychology of bilingualism. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 331–354.
- Reber, A. 1987. The rise and (surprisingly rapid) fall of psycholinguistics. *Synthèse*. 72.325–339.
- Reingold, E. and P. Merikle. 1988. Using direct and indirect measures to study perception without awareness. *Perception and Psychophysics*. 44.563–575.
- Riggenbach, H. (ed.) In press. *Perspectives on fluency*. Ann Arbor, MI: University of Michigan Press.
- Roediger, H. L., III (ed.) 1997. *Implicit learning: A symposium*. [Special issue of the *Psychonomic Bulletin and Review*. 4.]
- _____, and M. Guynn. 1996. Retrieval processes. In E. Bjork and R. Bjork (eds.) *Memory: Handbook of perception and cognition*. 2nd ed. New York: Academic Press. 197–236.
- Rogers, R. and S. Monsell. 1995. Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General*. 124.207–231.
- Schachter, J. 1996a. Learning and triggering in adult L2 acquisition. In G. Brown, K. Malmkjaer and J. Williams (eds.) *Performance and competence in second language acquisition*. Cambridge: Cambridge University Press. 70–88.
- _____, 1996b. Maturation and the issue of universal grammar in second language acquisition. In W. Ritchie and T. Bhatia (eds.) *Handbook of second language acquisition*. New York: Academic Press. 159–193.
- Schmidt, R. 1992. Psychological mechanisms underlying second language fluency. *Studies in Second Language Acquisition*. 14.357–385.
- _____, 1998. The centrality of attention in SLA. *University of Hawai'i Working Papers in ESL*. 16.1–34.
- Schneider, W., S. Dumais and R. Shiffrin. 1984. Automatic and control processing and attention. In R. Parasuraman and D. Davies (eds.) *Varieties of attention*. New York: Academic Press. 1–23.
- Segalowitz, N. 1991. Does advanced skill in a second language reduce automaticity in the first language? *Language Learning*. 41.59–83.
- _____, 1997. Individual differences in second language acquisition. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 85–112.
- _____, and E. Gatbonton. 1995. Automaticity and lexical skills in second language fluency: Implications for computer assisted language learning. *Computer Assisted Language Learning*. 8.129–149.
- _____, and S. Segalowitz. 1993. Skilled performance, practice and the differentiation of speed-up from automatization effects: Evidence from second language word recognition. *Applied Psycholinguistics*. 14.369–385.

- Segalowitz, S. and D. Bernstein. 1997. Neural networks and neuroscience: What are connectionist simulations good for? In D. Johnson and C. Erneling (eds.) *The future of the cognitive revolution*. New York: Oxford University Press. 209–216.
- _____, N. Segalowitz and A. Wood. 1998. Assessing the development of automaticity in second language word recognition. *Applied Psycholinguistics*. 19.53–67.
- Skehan, P. 1998. *A cognitive approach to language learning*. Oxford: Oxford University Press.
- Snow, C. 1995. Issues in the study of input: Finetuning, universality, individual and developmental differences and necessary causes. In P. Fletcher and B. MacWhinney (eds.) *The handbook of child language*. Oxford: Blackwell Publishers. 180–194.
- Sokolov, J. and C. Snow. 1994. The changing role of negative evidence in theories of language development. In C. Gallaway and B. Richards (eds.) *Input and interaction in language acquisition*. Cambridge: Cambridge University Press. 38–55.
- Spada, N. and P. Lightbown. 1993. Instruction and the development of questions in the L2 classroom. *Studies in Second Language Acquisition*. 15.205–221.
- Stadler, M. 1995. Role of attention in implicit learning. *Journal of Experimental Psychology: Learning, Memory and Cognition*. 21.674–685.
- _____. 1997. Distinguishing implicit and explicit learning. *Psychonomic Bulletin and Review*. 4.56–62.
- _____. and P. Frensch (eds.) 1998. *Handbook of implicit learning*. London: Sage Publications.
- _____. and H. L. Roediger, III. 1998. The question of awareness in research on implicit learning. In M. Stadler and P. Frensch (eds.) *Handbook of implicit learning*. London: Sage Publications. 105–132.
- Tomlin, R. and V. Villa. 1994. Attention in cognitive science and second language acquisition. *Studies in Second Language Acquisition*. 16.183–203.
- Truscott, J. 1998. Noticing in second language acquisition: A critical review. *Second Language Research*. 14.103–135.
- Tulving, E. 1983. *Elements of episodic memory*. New York: Oxford University Press.
- Watts, W. 1970. On two hypotheses concerning psycholinguistics. In J. Hayes (ed.) *Cognition and the development of language*. New York: John Wiley. 137–220.
- White, L. 1989. *Universal Grammar and second language acquisition*. Amsterdam: John Benjamins.
- _____. 1996. Universal Grammar and second language acquisition: Current trends and new directions. In W. Ritchie and T. Bhatia (eds.) *Handbook of second language acquisition*. New York: Academic Press. 85–120.
- Whittlesea, B. and M. Dorken. 1997. Implicit learning: Indirect, not unconscious. *Psychonomic Bulletin and Review*. 4.63–67.