10 Instructed SLA: Constraints, Compensation, and Enhancement

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1 Introduction

The domain of this chapter is instructed SLA by adult (i.e., post-critical period) learners. We focus mainly on the development of L2 speech comprehension and production, leaving aside entirely the vexing complexities of the acquisition of L2 literacy. Post-critical period SLA is notorious for its difficulty, high degree of variation, and often very poor outcome (see Long, 1993; Hyltenstam and Abramsson, this volume). The primary aim of L2 instruction is to ameliorate, if not solve, these problems. But the potential for instruction to do so has always been contentious among SLA researchers.

The debate concerning the effectiveness of L2 instruction takes place at two fundamental levels. At the first level, SLA theorists address in absolute terms any potential at all for (even the best possible) instructional intervention in SLA. A small number of SLA researchers claim that instruction can have no effect beyond the provision of an environment conducive to SLA. At the second level of debate, a case is made for the benefits of instruction. Then, assuming the effectiveness and sometimes even the necessity of relevant and principled instruction, researchers investigate the comparative efficacy of different types. A fundamental question in this second line of research is whether adult SLA involves, in the main, implicit or explicit language processing, and the related question of whether the most effective instruction is implicit or explicit.

After reviewing the cases for and against L2 instruction, we will conclude that instruction is potentially effective, provided it is relevant to learners' needs. However, we will be forced to acknowledge that the evidence to date for either absolute or relative effectiveness of L2 instruction is tenuous at best, owing to improving, but still woefully inadequate, research methodology. Furthermore, since instructional procedures have often been operationalized in terms of declarative L2 knowledge, it is not clear that much of the evidence amassed to date is valid. Thus, an important aim of this chapter is to make recommendations for future empirical studies of instructed SLA of the psycholinguistically relevant kind. These will be studies investigating pedagogical procedures that appropriately engage SLA processes. Accordingly, we will examine how human processing mechanisms change as a consequence of primary language acquisition, and how implicit and explicit modes of complex learning interact. In the end, we will see that, for adult SLA, instruction is necessary to compensate for developmental changes that put adults at a cognitive disadvantage.

2 The Case Against L2 Instruction

Let us begin by considering the argument sometimes made against any kind of L2 instruction whatsoever. As evident in the following, in the early days of research on SLA, skepticism concerning L2 instructional intervention prevailed:

> foreign language learning under classroom conditions seems to partially follow the same set of natural processes that characterize other types of language acquisition . . . there seems to be a universal and common set of principles which are flexible enough and adaptable to the large number of conditions under which language learning may take place. These observations furthermore suggest that the possibility of manipulating and controlling the students' verbal behavior in the classroom is in fact quite limited. (Felix 1981, p. 109)

> the only contribution that classroom instruction can make is to provide comprehensible input that might not otherwise be available outside the classroom. (Krashen, 1985, pp. 33–4, and passim)

Two proposals, implicit in the above proscriptions, motivate what Long and Robinson (1998) have called the strong non-interventionist position: (i) that SLA is driven by the same Universal Grammar (UG) that guides first language acquisition, and (ii) that SLA, like first language acquisition, is entirely incidental. With regard to the first proposal, there are also competing views (see White, this volume). The full-transfer, full-access hypothesis (Schwartz, 1993; Schwartz and Sprouse, 1996) posits that first and second language acquisition involve the resetting of parameterized universal principles, triggered only by positive evidence (i.e., input), and that there is no role for negative evidence (e.g., instruction concerning what is not possible in the L2). The second UG account of SLA is one that allows for, or even requires, negative evidence, such as that provided by instruction, but the need for instruction is strictly limited to cases where triggering evidence is not sufficiently informative. More specifically, when the L2 is a proper subset of the L1 with respect to a certain aspect of language, L2 learners will have to retreat from the overly general hypothesis that emanates from their L1 (White, 1987, 1991), something which cannot be done on the basis of positive evidence alone. By the UG SLA accounts, then, instruction is either entirely or largely unnecessary.

The second proposal, more commonly known as the Input Hypothesis within Krashen's (1982, 1985) monitor theory of SLA, proscribes traditional instructional devices (grammar teaching, linguistic grading, error correction, etc.) due to the so-called "non-interface" concerning any potential relationship between learned and acquired knowledge (Krashen and Scarcella, 1978). Krashen (1982, 1985) has claimed that knowledge of consciously learned language is distinct in memorial representation from unconsciously acquired language, that only the latter type of knowledge can be deployed in spontaneous language use, and, furthermore, that there can be no interaction between these two independent knowledge systems (i.e., the so-called *learning/acquisition* distinction). The non-interface position states that *learned* knowledge can never become *acquired* knowledge. This claim has been given some credence by the all-too-common observation of two kinds of typical L2 classroom learner performance: fluent use, which appears to derive from intuitive knowledge, and more deliberate use, which clearly depends upon expressible knowledge. Until recently, language teachers have been persuaded by this view to adopt a laissez-faire approach to the development of accuracy in instructed SLA, concentrating only on providing opportunities for learners to process rich and comprehensible input (for discussion, see Doughty, 1998).

Following the arguments of Doughty and Williams (1998c), the position taken in this chapter is that both the no-negative-evidence and non-interface versions of the non-interventionist position are too extreme in their nearly complete prohibition on L2 instruction. Even if a UG explanation of SLA were to prevail, the elements of language that are governed solely by UG are limited. Much more of the L2 remains which is potentially acquired more efficiently provided instruction appropriately engages learners' cognitive processing ability (see also Doughty, 2001). Furthermore, while there can be no doubt that both spontaneous and more deliberate L2 performance exist, what type of knowledge underlies each, and whether there is any connection between the two during SLA and L2 use, are contentious issues that are far from settled in SLA, let alone any other domain of human cognition (Berry, 1997; Berry and Dienes, 1993; Stadler and Frensch, 1998).

There are further arguments that L2 instruction is likely to be necessary for some aspects of adult SLA. As has often been noted, the prognosis for adult second language acquisition is not nearly as good as that for child (first or second) language acquisition. Given adequate exposure, normal intelligence, and normal social conditions, children can be expected to learn the language(s) of their caregivers incidentally and fully, such that they are eventually indistinguishable from other native speakers of their speech community. In stark contrast, language acquisition by adults is guaranteed only to be variable both within and across individuals, most typically relatively unsuccessful, and always incomplete, such that non-native speakers can be invariably identified as such, provided judgments are made on adequate samples of performance (see Hyltenstam and Abrahamsson, this volume; Long, this volume). Thus, as will be discussed further in the next section, it appears that child language acquisition and adult SLA are not instances of the same phenomenon taking place at different points in the life span. Rather, they involve different or somehow altered cognitive processes, and, without instruction, adult SLA is more difficult, slower, and less successful. In sum, it is far too soon to announce a moratorium on L2 instruction. Rather, the position taken by Doughty and Williams (1998c) is the prudent one:

> we do not consider leaving learners to their own devices to be the best plan. Does this mean that practitioners should take up the opposite position that [instruction] is appropriate . . . for all learners all the time? We think not, and that, between the two poles, there are many ensuing pedagogical decisions to be made. At the outset, it must be said that it is not the case that adult second language acquisition cannot take place in the absence of instruction . . . ; for many learners, clearly much of it can. However, our interest is not limited to what is merely possible, but extends to a determination of what would comprise the most *effective* and *efficient* instructional plan given the normal constraints of acquiring a second language in the classroom. (p. 197, emphasis added)

3 The Case For Instructed SLA

What evidence is there that L2 instruction is efficient and effective? In comparison with other fields, work on instructed SLA is still in its infancy. Nonetheless, the past decade has witnessed a virtual explosion of interest in instructed SLA research of all types (Lightbown, 2000), and of experimental or quasi-experimental effects-of-instruction studies, in particular (Doughty and Williams, 1998a, 1998b). Furthermore, there is every reason to be optimistic about continued progress, given the increasing number of researchers interested in classroom language learning who are also sufficiently trained in SLA theory and research methodology (see Chaudron, this volume; Norris and Ortega, this volume, for discussions of L2 research methodology). The discussion will now turn to a consideration of the evidence for the benefits of instruction in adult SLA.

3.1 Overall effectiveness of L2 instruction

The question of whether second language instruction makes a difference was first posed in earnest by Long (1983), who attempted a preliminary answer to this question by reviewing the handful of empirical studies which directly tested Krashen's then influential claim of a learning/acquisition distinction (outlined above in the case against L2 instruction). In those early studies, only very global comparisons were made, for instance between the L2 proficiency of subjects who either had or had not attended L2 classes, or who had done both in varying combinations. Such studies yielded instruction vs. exposure comparisons or independent assessments of five types (see table 10.1). In general, the findings indicated that, for those for whom the classroom is the

Table 10.1 The advantage for instruction over exposure (principal findings of Long's, 1983, review)

Type of comparison	*Findings*	*Interpretation*
1 The relative utility of equal amounts of instruction and exposure	Four studies showed no differences	Instruction beneficial for those for whom classroom is the only opportunity for exposure
2 The relative utility of varying amounts of instruction and exposure when the sum total of both is equal	Two studies with ambiguous findings	None possible
3 Varying amounts of instruction when the amount of exposure is held constant	Two studies showed that more instruction led to more SLA	Either more instruction is beneficial, or more instruction merely serves as more exposure
4 Varying amounts of exposure when the amount of instruction is held constant	Three studies showed variable results. One study was matched to the type of study in type 3 and showed that fewer subjects with more exposure scored higher on proficiency measures	Taken together, the results of studies of types 3 and 4 support the benefits of instruction *per se*
5 Independent effects of varying amounts of both instruction and exposure when the sum total of both also varies	Of four studies of this type, all showed a benefit for instruction, and three showed a benefit for exposure. The strength of the relationship was greater for instruction than for exposure	Taken together, the results of studies of types 4 and 5 support the benefits of instruction

only opportunity for exposure to L2 input, "instruction" is beneficial. When differing amounts of instruction were added on to a fixed amount of exposure, positive outcomes were interpreted to mean either that more instruction is beneficial *or* that more instruction merely serves as more L2 exposure. However, when differing amounts of exposure were added on to a fixed amount of instruction, these findings, taken together with instruction-plus-exposure findings, favored the benefits of the L2 instruction *per se*. Finally, although very few in number, when studies independently varied the amounts of instruction and L2 exposure, positive outcomes, taken together with all of the other findings, lent credence to this interpretation.

While Long concluded that second language instruction does make a difference, his work was more noteworthy for having identified a number of weaknesses in the prevailing research methodology, and for having inspired the ensuing line of empirical effects-of-instruction research, than for the trustworthiness of the reviewed findings. In particular, since the studies themselves did not directly make the appropriate comparisons, considerable reanalysis and reinterpretation of findings was needed to overcome design flaws even to be able to tease out this preliminary indication of an advantage for L2 instruction over naturalistic exposure. There were at least three fundamental problems. First, the comparisons between instruction and exposure were too global: it was not known whether instruction and exposure constituted different opportunities for SLA, let alone what specific SLA processes, cognitive or otherwise, might have taken place during the course of the investigations. Second, there were no direct comparisons of either instruction or exposure conditions with true control groups; and third, neither the type of instruction nor any specific aspect of SLA were operationalized in the study variables. Without any information on the type of L2 instruction *per se* and the relevant SLA processes, study findings were always open to the interpretation that a null finding was due to poor quality or mismatched instruction.

Several years later, Long (1988) reconsidered the question of whether instruction makes a difference, but this time within four operationalized domains of SLA. By now, these domains are well known, if not entirely understood: (i) SLA processes; (ii) SLA route; (iii) SLA rate; and (iv) level of ultimate SL attainment. Table 10.2 provides a synopsis of early research findings within these domains.

SLA processes include, for instance, transfer, generalization, elaboration, stabilization, destabilization, noticing, omission, and oversuppliance (see chapters by DeKeyser, Hulstijn, Long, Odlin, Romaine, and Segalowitz, this volume; Hulstijn, forthcoming). Even now, the proportion of studies that investigate SLA processes in instructed settings is very small. The general findings were that, while instructed and untutored populations of learners follow similar paths in SLA (see below), the processes observed differ. For instance, although morphemes emerge in roughly the same order for both groups, naturalistic learners tend to omit obligatory morphemes at lower proficiency levels, whereas classroom learners tend to oversupply them (Pica, 1983), presumably as a consequence of instruction.

Table 10.2 Effects of instruction within domains of SLA (categories from Long, 1988)

Domain of SLA	*Findings*	*Interpretation*
SLA processes	Both similarities and differences exist in naturalistic and classroom SLA	These must be understood in order to enhance SLA
SLA route	Routes of development have been identified for negation, questions, and word order. Instruction on non-contiguous stages was ineffective	Where development hinges upon processing constraints, stages cannot be skipped, even with instruction. L2 learners must be psycholinguistically ready for instruction
SLA rate	At least four studies show a rate advantage for instructed learners	Taken together with the SLA route findings, appropriately timed instruction can speed SLA
Level of ultimate SL attainment	Instructed learners advance further down markedness hierarchies than untutored subjects	Instruction may be necessary to bring L2 learners closer to nativelike competence (for instance through provision of enhanced input or feedback)

In the second domain, SLA route, developmental sequences (i.e., fixed series of stages) have been identified in, for example, the acquisition of negation, interrogatives, relativization, and word order. Progress through the routes can be affected by the L1 in complex ways (e.g., speed-up or delay) (Zobl, 1982) or by instruction (Doughty, 1991; Pienemann, 1989), but only in terms of sub-stages or rate of passage. In other words, stages are not skipped, and the route itself cannot be altered (Pienemann, 1989), a phenomenon known as developmental readiness. Despite this constraint, evidence continues to accumulate that the rate of instructed SLA is faster than that of naturalistic SLA. However, it is sometimes the case that what is learned quickly is forgotten equally fast (Lightbown, 1983). This may depend upon the mode of learning that is evoked by the L2 instruction, an issue to which we return in a later section.

In the final domain discussed by Long, level of ultimate attainment in the L2, three studies indicated that, perhaps owing to the different types of input to which naturalistic and instructed learners are exposed, or to negative feedback, instructed learners make more progress toward the target language. For example, when learners are provided with input that includes marked examples (where markedness refers to infrequency) of systems that enter into implicational hierarchies (e.g., relativization), they are able to acquire both the marked and unmarked aspects of the system (Doughty, 1988; Eckman, Bell, and Nelson, 1988; Gass, 1982). Uninstructed learners, who may never gain access to marked input, tend to acquire only the unmarked elements in the system hierarchies (Pavesi, 1986).

By the 1990s, the evidence in the four domains of SLA, although scant, formed the basis of an assumption that L2 instruction is effective. Research interest then turned to the question of the type of instruction most facilitative of SLA. Like early investigations of the benefits of instruction versus exposure in SLA, initial comparisons of the relative effectiveness of types of instruction were too global. Typically in such studies, two "methods" of instruction were pitted against one another, and the findings were always the same: no difference (see, e.g., Smith, 1970). This was because, as has been found to be the case in general education research, the variable of instructional method is actually a composite one (Clark, 1985), and, even if a method has an overall description (see, e.g., Richards and Rodgers, 1986), any particular implementation by a teacher is subject to significant variation. Furthermore, many typical teaching practices are each components of a range of so-called methods, and it may, in fact, be those specific L2 pedagogical procedures that are responsible for observed effects (and, hence, which cancel each other out when different methods employing the same critical techniques are compared). Thus, "method" is not the appropriate level of analysis in type-of-instruction studies (Long, 1980).

The problem of overly general comparisons of input, exposure, and instructional conditions meant that, when interpreting research findings, no direct link between learning outcomes and instructional treatments could be made. To remedy this, Doughty (1988) identified three crucial elements of experimental design that needed to be present in effects-of-instruction research: (i) a specific learning target must be identified (i.e., some aspect of the L2); (ii) the instructional treatment must be psycholinguistically appropriate (i.e., take into account constraints discussed in section 4, and attempt the relevant compensation or enhancement that may be necessary); and (iii) specific gains in the L2 must be evaluated with respect to the target of instruction (e.g., by including a control group).

Furthermore, because of the difficulty noted earlier regarding interpretation of results obtained after a period of unspecified instruction unknown to, and hence not analyzable by, the researcher, effects-of-instruction designs must specify that treatments be documented in some fashion (e.g., through video- or audio-recording or via computer delivery of treatments). In this way, at some point later in the investigation, the nature of the treatment can be examined in conjunction with the findings. For instance, to explain similar gains made by both instructional groups in a study of the development of relative clauses in English as a second language, Doughty pointed to the coding features of both computer-delivered treatments, which might have drawn the subjects' attention to the target of instruction in the same psycholinguistically relevant way (i.e., promoting salience of the elements in the input). In addition to facilitating the interpretation of study findings, the documentation of instructional treatments must be reported in detail if systematic replication is to become a regular practice in research on instructed SLA.

Following these guidelines *in vivo* is by no means a simple matter, and by 1997, some SLA researchers were arguing that to conduct SLA research was "almost impossible in 'normal' classrooms with real L2 learners" (Hulstijn, 1997, pp. 131–2), and, hence, they recommended that the investigation of SLA issues primarily be pursued under laboratory conditions. This proposal, however, raises the issue of ecological validity, since L2 instruction most often takes place in classrooms.

3.2 *Relative effectiveness of different types and categories of L2 instruction*

The most recent review of empirical studies that attempts to determine the overall effectiveness of L2 instruction, as well as the relative effectiveness of types of instruction, is also by far the most rigorous. In a statistical meta-analysis[1] of the burgeoning literature published between 1980 and 1998, Norris and Ortega (2000)[2] identified 250 potentially relevant studies from the published applied SLA literature. Although they noted a publishing bias in the research pool,[3] it is nonetheless clear that the state of instructed SLA research is more robust now than it was 20 years ago when Long published the first review.

Norris and Ortega's investigation included a careful assessment of the components of instructed SLA research methodology that, as noted above, had been identified as utterly lacking in precision (e.g., operationalization of instructional treatments and consideration of appropriate research design), as well as a host of new considerations (e.g., comparison of instructional treatment types, influence of measures, and duration and durability of instructional treatments).[4] Unfortunately, only 77 studies of the original pool of 250 studies survived the initial screening for inclusion in the coding phase of the meta-analysis (i.e., that they be quasi-experimental or experimental in design; that the independent variable be reasonably well operationalized in the report; and that L2 features be targeted). Furthermore, of those, only 49 studies reported sufficient statistical information to be included in the final round of the meta-analysis. Thus, despite the increase in sheer quantity of work and improvement in operationalizing variables, it must be admitted that the state of the instructed SLA research is still far less robust than is required for the findings reported to be considered truly trustworthy. For this reason, a clear understanding of the findings of the meta-analysis and their interpretations are important for an assessment of the state of the science of instructed SLA, and to delineate directions for future research.

Rather than at the level of "method," the operationalization of instructional treatments is now considered best analyzed psycholinguistically in terms of input-processing enhancements that facilitate L2 learners' extracting forms and mapping them to meaning and function. The general issues are whether an explicit or implicit approach to instruction is best, and to what extent and in what ways learner attention should be directed to the elements of language involved in mapping. Explicit instruction includes all types in which rules are explained to learners, or when learners are directed to find rules by attending to forms (see also DeKeyser, this volume). Conversely, implicit instruction makes no overt reference to rules or forms. During either explicit or implicit instruction, attention may be directed to language forms in isolation, during the processing of meaning, or not at all. These types of attention can be understood as forming a tripartite contrast. Long offers the following definitions of *focus on form*: "focus on form . . . overtly draws students' attention to linguistic elements as they arise incidentally in lessons whose overriding focus is on meaning or communication" (Long, 1991, pp. 45–6); and "focus on form involves . . . an occasional shift in attention to linguistic code features – by the teacher and/or one or more students – triggered by perceived problems with comprehension or production" (Long and Robinson, 1998, p. 23). Doughty and Williams (1998b) contrast focus on form and the other two foci in Long's original discussion of options in language teaching (Long, 1988, 1991, 2000), namely *focus on meaning* and *focus on forms*, in the following way:

> focus on formS and focus on form are *not* polar opposites in the way that "form" and "meaning" have often been considered to be. Rather, a focus on form *entails* a focus on formal elements of language, whereas focus on formS is *limited to* such a focus, and focus on meaning *excludes* it. Most important, it should be kept in mind that the fundamental assumption of focus-on-form instruction is that meaning and use must already be evident to the learner at the time that attention is drawn to the linguistic apparatus needed to get the meaning across. (Doughty and Williams, 1998b, p. 4)[5]

Particular pedagogical procedures can be ranged along a continuum describing degree of obtrusiveness of attention to form during instruction, as shown in the taxonomy displayed in figure 10.1 (Doughty and Williams, 1998c).

Building upon DeKeyser's (1995) definition of explicit instruction, Long's tripartite distinction among *focus on forms*, *meaning*, and *form*, and Doughty and Williams's continuum of degree of intrusiveness of the pedagogical intervention on the processing of meaning, Norris and Ortega (2000) set out to classify each instructional type in the studies they reviewed as implicit or explicit, and as focusing on meaning only, forms only, or form. In practice, deciphering operationalizations of L2 instruction has continued to prove difficult.

Unobtrusive ← **Attention to form** → **Obtrusive**

Input flood	X						
Task-essential language	X						
Input enhancement		X					
Negotiation		X					
Recast			X				
Output enhancement			X				
Interaction enhancement				X			
Input processing					X		
Dictogloss						X	
Consciousness-raising tasks						X	
Garden path							X

Figure 10.1 A taxonomy of degree of obtrusiveness
Source: Doughty and Williams (1998c, p. 258)

Although initially guided by these constructs, Norris and Ortega (2000) ultimately had to resort to extrapolating the operational definitions for coding the type-of-instruction variable from the studies themselves, a problem to which we will return (see table 10.3). In sum, attention is said to be directed to meaning via exposure to L2 targets or experience with L2 tasks, but without explicit attempts to effect shifts of learner attention. Attention to both forms and meaning can occur in any of the six ways listed under the heading of "focus on form." These include both psycholinguistic and task-inherent means of promoting form–meaning connections. Finally, we see that when the first four types of focus-on-form conditions did not apply, and when the learners' attention nonetheless was focused in some particular way on a specific structure targeted for investigation, this was considered focus on forms.

Table 10.4 lists the 20 or so different pedagogical procedures employed, alone or in combination, in the instructional treatments of the studies analyzed, and groups them according to the categories of implicit/explicit approach and type of attention to meaning, to form–meaning connections, and to forms in isolation.

Of the many important comparisons that were made by Norris and Ortega, the following are of greatest interest here: (i) overall effectiveness of instruction in comparison with exposure; (ii) relative effectiveness of implicit and explicit types of instruction; and (iii) relative effectiveness of attention to meaning, form–meaning connections, or forms. The major findings of the meta-analysis concerning the five instructional type variables (two describing degree of explicitness of instruction, and three levels of obtrusiveness of attention to form) are displayed in table 10.5. Leaving aside for the moment the case of meaning-only groups (meaning-only treatments were considered to be

Table 10.3 Operationalizing the construct of L2 instruction (adapted from Norris and Ortega, 2000)

Instructional type	*Operationalization, as derived from study descriptions*
Explicit	+ Rule explanation (deductive/metalinguistic), *or* + direction to attend to forms and arrive at rules (explicit induction)
Implicit	– Rule explanation, *and* – direction to attend to forms
Focus on meaning	Exposure to L2 targets or experience with L2 tasks, *but* no attempts to effect shifts of learner attention
Focus on form	Integration of forms and meaning, *any of*: (a) designing tasks that promote engagement with meaning prior to form (b) seeking task essentialness/naturalness of L2 forms (c) ensuring unobtrusiveness (d) documenting L2 mental processes (e.g., "noticing") (e) selecting target forms by analysis of learner needs (f) considering IL constraints
Focus on forms	None of (a)–(d) above apply, *and* learner attention was nevertheless focused in some particular way on the particular structure targeted for learning

a type of classroom exposure, and hence, along with control groups, were classified as comparison, not instructed, groups), the general findings of the overall and relative effectiveness of L2 instruction and instructional types can be summarized as follows. Once again, as had been the case in the two earlier comparisons of the effectiveness of L2 instruction with simple exposure or with meaning-driven communication (Long, 1983, 1988), the answer to the overall research question is in the affirmative: second language instruction makes a difference, and, furthermore, the difference is substantial (effect size $d = 0.96$, where 0.80 is considered a large effect).

With regard to differences among instructional types (see table 10.5), the clearest finding (and, according to Norris and Ortega, the only trustworthy one) is an apparent advantage for explicit over implicit types of L2 instruction. Moreover, combining the nature of the instruction with the degree of obtrusiveness of attention to form in the pedagogical procedures employed, the findings are as follows: Explicit focus on form (large effect) > Explicit focus on forms (large effect) > Implicit focus on form (medium effect) > Implicit focus

Table 10.4 Distribution of pedagogical procedures in the type-of-instruction studies (adapted from Norris and Ortega, 2000)

Focus on form	*Focus on forms*
Implicit (30% of the instructional types):	
18% of the instructional types:	11% of the instructional types:
form-experimental (anagram)	corrective models
input enhancement	pre-emptive modeling
input flood	traditional implicit
recasts	
other implicit	
Explicit (70% of the instructional types):	
26% of the instructional types:	45% of the instructional types:
compound focus on form (enhancement + feedback)	rule-oriented forms-focused
consciousness-raising	garden path
processing instruction	input practice
metalinguistic task essentialness (cross-word)	metalinguistic feedback
rule-oriented focus on form	output practice
	traditional explicit (e.g., rule explanation)

on forms (small effect).[6] In the 20 or so different pedagogical procedures utilized in these types of instruction (table 10.4), it was not possible to discern any patterns of effectiveness, mainly because of the lack of sufficient replication studies. In sum, Norris and Ortega (2000) interpret the results of their meta-analysis to mean that: "L2 instruction can be characterized as effective in its own right, at least as operationalized and measured within the domain" (p. 480).

Another clear finding in this phase of the meta-analysis was that, where a comparison could be made between instructed groups and control (true) or comparison (defined as non-focused exposure) groups, the control/comparison groups experienced 18 percent pre-test to post-test gains (see also Doughty, 1991; Hulstijn, 1997). Moreover, although instructed subjects experienced greater improvement, the nature of interlanguage change exhibited by instructed subjects was variable, whereas that exhibited by control/comparison subjects was more homogeneous. However, at delayed post-testing (in studies where this was carried out), instructed groups both maintained a modest advantage in gains over control/comparison groups, and were more homogeneous. These findings can be interpreted in a number of ways. The most plausible explanations concerning the progress made by groups not receiving targeted instruction are (i) the already-demonstrated rate advantage for instruction (i.e., uninstructed subjects improve, but instructed subjects improve more, hence they are faster), and (ii) test effect. These possibilities have not yet been

Table 10.5 Type of instruction effects (results of Norris and Ortega's, 2000, meta-analysis)

Type of treatment	*Findings*	*Interpretation*
Control/comparison groups	18% gain	Any of practice effect, effect of exposure, maturation
All instructional types (vs. all comparison groups)	49 studies examined (98 treatments) Large effect size, but only 70% include a comparison group (e.g., exposure or control)	"As operationalized thus far in the domain, L2 instruction is effective" (Norris and Ortega, 2000)
All explicit	Large effect size	Explicit > Implicit
All implicit	Medium effect size	
All focus on form	Large effect size	(FonF > FonFs)
All focus on forms	Large effect size	1 FonF explicit
Implicit focus on form	Medium effect size	2 FonFs explicit
Explicit focus on form	Large effect size	3 FonF implicit
Implicit focus on forms	Small effect size	4 FonFs implicit
Explicit focus on forms	Large effect size	

Note: FonF = focus on form; FonFs = focus on forms.

systematically teased apart. Individual variation in effects of instruction shown by subjects in experimental treatment groups could have been due to true individual differences factors (e.g., aptitude for language learning), or to mismatches between cognitive learning style and instructional type. Again, such factors have not routinely been included in the design of instructed SLA studies, although they have figured prominently in the very recent SLA literature (see Robinson, 2002; Dörnyei and Skehan, this volume). That the individual variation has disappeared by the time of the delayed post-test is also in need of explanation. Given that the delayed post-test interval is typically quite short (four weeks on average), it might be expected that the effects of instruction demonstrated would not remain after a longer period of time, either because control subjects have caught up (a common finding), or because the particular type of instruction favored in this set of studies leads to the type of knowledge that is easily forgotten, as discussed in section 3.1.

Finally, by virtue of somewhat improved reporting in the published literature, Norris and Ortega were able to revisit the question of the differential effects of exposure and instruction originally raised by Long (1983). In the more recent published studies, exposure is operationalized as pure exposure or experience with L2 tasks without any focus on form or forms, or some minimal amount of both. Results are straightforward: the effect of instruction in comparison with exposure is still substantial, but smaller than when instructed subjects are compared with true controls. This finding is consistent with the rate advantage for instruction already discussed.

3.3 *Problems of research bias*

To interpret the relative effectiveness findings properly, we must revisit the operationalizations of instructional treatments in the studies in the instructed SLA research base, and, crucially, we must note the accumulation of research bias reported by Norris and Ortega. Table 10.3 above reveals that the operational definitions of types of instruction unfortunately comprise a rather convoluted set of features, which, as noted earlier, simply reflects the state of the current research. Norris and Ortega reported that coding the types of instruction using these categories involved a high degree of inference in comparison with other variables examined in the meta-analysis. To illustrate, consider the definition of *focus on forms* extracted from table 10.3: "None of (a)–(d) above [i.e., features defining focus on form] apply, *and* learner attention was nevertheless focused in some particular way on the particular structure targeted for learning." More importantly, perhaps, a strong bias was identified concerning the number of comparisons within each approach to L2 instruction: within the 49 studies, there were 98 distinct instructional treatments, owing to some studies comparing two or more types of treatment with a control or an exposure-only group. Of these, 70 percent were explicit in approach, and 30 percent implicit. With regard to attention to form, 56 percent were focus-on-forms type, and 44 percent were classified as focus on form. The bias also reveals itself in the hybrid classifications: of the focus-on-forms type treatments, 80 percent were explicit in approach, and of the focus-on-form type treatments, 58 percent were explicit in approach. Figure 10.2 illustrates the over-representation in the

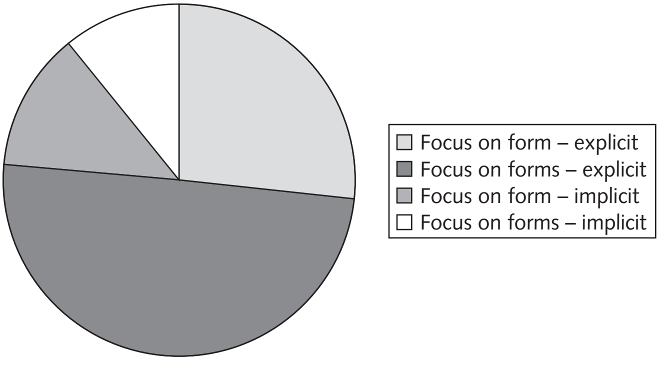

Figure 10.2 Type of L2 instruction: attention to form and degree of explicitness (n = 98)

sample of explicit approaches to L2 instruction, in particular the favoring of explicit focus-on-forms procedures above all others.

It must be emphasized that, given the completely decontextualized nature of explicit focus on forms, this type of instruction promotes a mode of learning that is arguably unrelated to SLA, instructed or otherwise, in that the outcome is merely the accumulation of metalinguistic knowledge about language.

A final bias in the design of effects-of-instruction studies concerns the duration of the instructional treatment. Norris and Ortega report four lengths of duration: brief (< 1 hour), short (1–2 hours), medium (3–6 hours), and long (> 7 hours). The typical period of instruction was 1–4 hours. One study provided 50 hours of instruction, but this was rare (and also involved instruction on a large number of L2 features). The only real difference found among these durations was that between "short" and "medium"-length treatments, with shorter treatments of two hours or less being more effective. Instruction that is intensive but only of short duration is well known to be the most vulnerable to rapid forgetting (Lightbown, 1983).

In addition to problems of study design and conceptualization of L2 instructional types, there is an enormous problem concerning validity of outcome measures. This problem has at least three dimensions: (i) a bias in favor of testing explicit, declarative knowledge (which is not surprising, given the pedagogical procedure bias just discussed); (ii) insensitivity to interlanguage change; and (iii) a lack of concern with the reliability of the measures used. We will elaborate on only the first two here, except to note that just 16 percent of the studies included in the meta-analysis reported reliability estimates for the dependent measures (see Norris and Ortega, this volume, for a detailed discussion of reliability issues).

The 49 studies of instructed SLA employed 182 measures (studies typically measuring outcomes in more than one way), which were coded by Norris and Ortega according to the type of L2 knowledge that was tapped by the measure, as shown in table 10.6. Most striking is that approximately 90 percent of the type-of-instruction studies implemented discrete-point or declarative knowledge-based measures (i.e., the first three categories in table 10.6), rather than requiring any real deployment of L2 knowledge under anything like spontaneous conditions (i.e., only the last category in table 10.6). This constitutes an extreme bias in the response type, as illustrated in figure 10.3. Norris and Ortega (2000, p. 486) concluded that "[g]enerally, the observed instructional effectiveness within primary research to date has been based much more extensively on the application of explicit declarative knowledge under controlled conditions, without much requirement for fluent spontaneous speech."

A detailed consideration of the 182 measures in type-of-instruction studies reveals that the problem of type of L2 knowledge assessed is even more severe than might be surmised from Norris and Ortega's interpretation. The essential difficulty is that most of the outcome measures do not appear to be measuring L2 ability in any valid sense (see this chapter's appendix for a detailed list of measures used in the type-of-instruction studies). Fundamentally, whereas it

Table 10.6 The measurement bias toward declarative knowledge (definitions from Norris and Ortega, 2000, p. 440)

Outcome measure	*Directions to subjects*	*Example*
Metalinguistic judgment	Evaluate the appropriateness or grammaticality of L2 targets as used in item prompts	Grammaticality judgments
Selected responses	Choose the correct response from a range of alternatives	Multiple choice in verbal morphology
Constrained, constructed responses	Produce the target form(s) under highly controlled circumstances, where the use of the appropriate form was essential for grammatical accuracy	Sentence-combination with relative clauses
Freely constructed responses	Produce language with relatively few constraints and with meaningful responses or communication as the goal for L2 production	Written composition

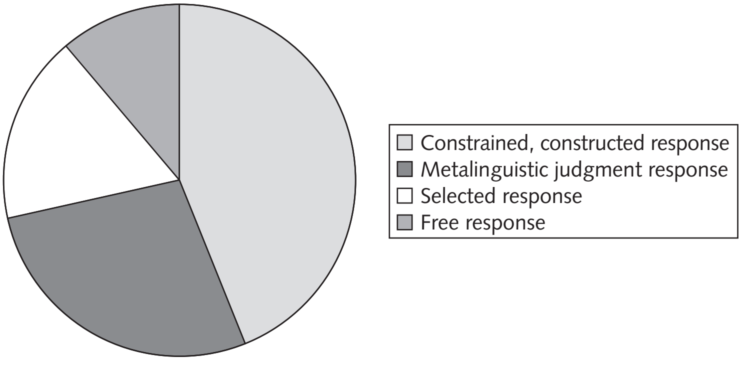

Figure 10.3 Response type in measures (n = 182)

is well established that completely unconstrained data collection is not likely to result in a sample of L2 ability sufficient for study, the bias in instructed SLA research to date has been toward *overly* constraining outcome measures, such that their construct validity is severely compromised. On Chaudron's continuum of available data-collection measures ranging from naturalistic

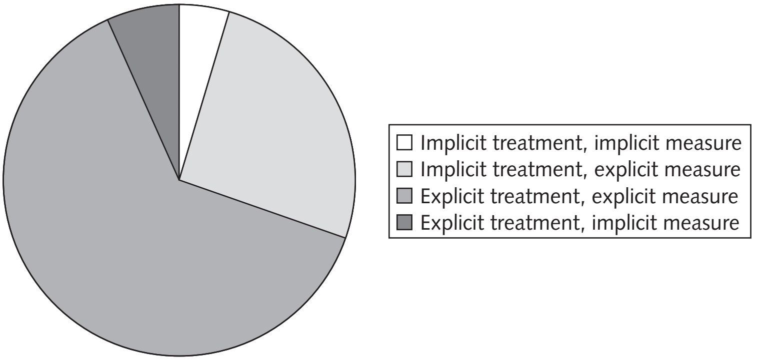

Figure 10.4 Match of treatments and measures (n = 182)

to decontextualized (this volume, p. 764), the vast majority used in type-of-instruction studies to date would be placed at the most decontextualized end, and many of them test metalinguistic rather than usable L2 knowledge.

These types of measures, termed "constrained, constructed responses" by Norris and Ortega, typically involve giving subjects much of a linguistic construction, together with some directions as to how to complete it (e.g., filling in blanks, being given the verb in its infinitive and told to use the direct object). Moreover, the tests look very much like the dominant approach to instruction, that is to say, explicit focus on forms. Such decontextualized focus-on-forms instruction and metalinguistic assessment measures draw neither upon L2 competence nor upon L2 performance during either the instruction or assessment phases of the studies. Rather, they merely teach and require knowledge of language as object. Furthermore, it should be noted that, even when L2 targets were taught by implicit pedagogical procedures, they still tended to be measured in this discrete, decontextualized fashion. Thus, compounding the problem of outcomes measures being overwhelmingly explicit in nature and number, measures are often mismatched with instructional type, as shown in figure 10.4. At the very least, both types of measures, implicit and explicit, should be employed. Having said all this, it remains to be noted that the research requirement to target (in order to be able to measure improvement in) a particular aspect of the L2 may, in part, be responsible for the over-representation of explicit instructional procedures.

The validity of instructed SLA outcome measures is compromised not only by decontextualization and the tapping primarily of metalinguistic knowledge, but also in terms of the analytic framework typically used to measure language change. Measures of interlanguage development have tended to be inappropriate, in the sense that they are overly target-language oriented. Child language researchers have long been employing analyses which enable the precise tracking of L1 development unencumbered by comparisons with the adult target. Adult SLA, being likewise systematic and non-linear in its progress, and, furthermore, seldom reaching the accuracy levels of the target language, must be studied in an interlanguage-sensitive fashion. For example, Doughty and Varela (1998) have shown that L2 instructional effects can be traced by looking at four types of evidence: (i) decreases in the complete absence of an L2 feature (zero marking or base form); (ii) increased attempts at expressing the L2 feature (in whatever form); (iii) temporary oversuppliance of the L2 features; and, eventually, (iv) increasing accuracy. Measures that set the target language as the only criterion for success of an instructional treatment will often fail to capture relevant evidence of interlanguage development.

3.4 Summary

In this overview of the empirical research on instructed SLA, we have seen that considerable understanding has been gained of instructional effects in the domains of rate, route, and ultimate attainment. In contrast, to date little is known concerning SLA processes in instructed settings. With respect to research on type of instruction, taking together biases revealed in approach to, and duration of, L2 instruction, and the demonstrated biases in measurement, we have more properly interpreted the apparent advantage for explicit instruction as an artifact of cumulative bias. More specifically, when the outcome of very short-term, explicitly focused instruction is measured on artificial, discrete-point tests, it has proven effective.[7] Put more simply, the case for explicit instruction has been overstated. This is because, although the primary aim is to understand SLA processes under instructed conditions, the design of L2 instruction and its assessment have tended to be based upon knowledge of language as object. That is to say, while ostensibly focusing on the psycholinguistic processes that operate in establishing form–meaning connections, once again researchers have used the wrong level of analysis. Furthermore, for the same reasons, the construct validity of L2 instructional treatments and measures is seriously in doubt.

In the remaining sections of this chapter, we will argue that a completely different approach is now needed in instructed SLA research. Rather than starting from a composite construct such as "method," or from static linguistic descriptions as bases for pedagogical procedures and measures, researchers must conceptualize instruction in terms of dynamic L2 processing. Accordingly, the remaining sections of this chapter examine processing-oriented research, much of which, heretofore, has been carried out in untutored settings, to shed light on how to investigate processing during instructed SLA.

4 Constraints on Adult SLA

Determination of the potential for L2 instruction, in terms of either absolute or relative effectiveness, hinges in part upon whether SLA processes are essentially the same as or different from those involved in child first language acquisition and, if different, how so. As noted at the outset of this chapter, the normal observation with regard to level of ultimate attainment in SLA is tremendous inter-learner variation, and frequently a poor, non-nativelike level of ultimate attainment. Given these vast differences in outcomes, a logical inference is that child language acquisition and adult SLA involve different types of processing for language learning. At least three positions in the literature make the claim that SLA is indeed radically different from child language acquisition. The Fundamental Difference Hypothesis (Bley-Vroman, 1990) proposes that whereas child language learning is implicit, automatic, and domain-specific (a UG first language acquisition view), adult SLA is best characterized by more explicit, general problem-solving strategies. DeKeyser (this volume) likewise argues that adult SLA is mainly explicit, and that adults rely on analytical thinking to acquire their second language. Similarly, the Competition Hypothesis (Felix and Hahn, 1985) claims that whereas implicit UG and explicit problem-solving processes initially compete in adult SLA, the latter eventually win out.

The explanation in common for these child–adult differences is that there are maturational constraints on language acquisition. Keeping to the very general outline of this account (see Hyltenstam and Abrahamsson, this volume, for details), such constraints are defined in terms of the onset and offset of special language-learning mechanisms that only operate when biologically scheduled to do so (i.e., during critical or sensitive periods). If exposure to input does not occur during the requisite time, the end result is an imperfectly learned language. As noted earlier, crucial in the critical period debate are the aforementioned considerable differences in ultimate attainment of learners whose ages of first exposure differ. In sum, what these three fundamental difference views have in common is the notion that processing for language learning shifts utterly from a child mode, involving automatic acquisition from exposure by a language-specific mechanism, to a non-domain-specific, adult mode involving explicit analytical thinking during the processing of L2 input.

In contrast to this drastic and complete, shift-of-processing type of explanation, a second possibility is that maturationally constrained changes in language processing result from and, in turn, subsequently influence the learner's experience with language input. More specifically, early in child language development, at a low, input-driven level of processing, there is a pronounced developmental sharpening of initially general and robust input-processing mechanisms for learning ambient language(s) (Nazzi, Jusczyk, and Johnson, 2000). The function of developmental sharpening of input processing is twofold: to enable the child initially to break into the language system of the surrounding environment, and, subsequently with greater ability, to facilitate everyday processing of rapid and continuous natural speech by use of perceptual cues to make predictions about the input. At a higher level of cognition, the onset of analytical thinking in later childhood changes the way information is processed overall. This enables the individual to advance in all areas of cognition. What is at issue in adult SLA is the extent to which the already developmentally sharpened low-level input processing mechanisms are useful (or detrimental) in breaking into a new language system, and whether the dominant adult mode of cognition (i.e., analytical thinking or explicit learning), which is designed to process non-linguistic information, can process language input in ways relevant to SLA.

The following is a necessarily brief consideration of the nature of language processing changes during primary language acquisition, all of which at once facilitate child cognitive and linguistic development, but conspire to make adult SLA more difficult. In section 5, the discussion turns to how instruction can potentially enhance L2 processing.

4.1 Developmental sharpening

Input processing in very early child language acquisition chiefly involves bootstrapping utterance structure from the speech signal (Jusczyk, 1997, 1999a, 2001). This is by no means an easy task. Although input to infants is certainly modified (slower, with exaggerated pitch, etc.), Van de Weijer (1999) has shown that 91 percent of the language addressed to an infant during all of her or his waking hours from age 6 months to 9 months was continuous speech, and, hence, that only 9 percent of the input consisted of isolated words. Thus, since fluent, adult language, even when directed at children, remains highly complex at the acoustic level (i.e., rapid, coarticulated, and variable within and across speakers), it does not enable one-to-one mapping of acoustic percepts to meaning. Nonetheless, despite the seemingly overwhelming complexity of the input, children do perceive, segment, encode, and remember the organization of linguistic information in the speech signal, enabling them subsequently to map acoustic forms onto meaning and, eventually, to figure out phrase and clause structure.

In order to explain how children accomplish this prosodic bootstrapping, L1 researchers posit that, from birth or perhaps even prenatally, infants have specialized, but ever adaptive, language-processing abilities that ultimately are constrained by both linguistic and cognitive factors (Jusczyk, 2001). Generally speaking, during the first year or so of life, children shift from processing primarily on the basis of acoustic features of the input (e.g., phonemes) to using their newly acquired knowledge as a foundation for processing other information (e.g., rhythm or distribution) salient in the input and relevant to the next developmental stage (e.g., determining word, phrase, and utterance boundaries). In the following sections we examine the evidence for, and consequences of, developmental sharpening in both child language acquisition and adult SLA. Table 10.7 provides a set of examples of the specialized language processing mechanisms.

The most dramatic example of developmental sharpening is the case of phonemic discrimination leading to categorization of the native language phoneme inventory. Whereas the capacity to process acoustic features is not determined initially by the child's native language (i.e., infants can process *any*

Table 10.7 Input processing mechanisms in L1A and SLA

A LA mechanisms that undergo developmental sharpening

	Mechanism				
Type of processing	*Initial*	*Developmental sharpening*	*Consequent processing change*	*Child L1A advantage*	*Adult SLA "disability"*
Segment sounds from speech (phonemic discrimination)	Categorical perception of all language contrasts	Tuning of phonetic segment perception to the adult language input 6–9 months	Decline in sensitivity to non-native contrasts	Early tuning of phonetic segment perception	L2 accent
Segment whole words from rapid, coarticulated speech (detect word boundaries) (metrical segmentation strategy)	No preference among syllables, morae, or stress patterns	Sensitivity to predominant rhythm pattern of the NL 6–9 months	Reliance upon only one segmentation strategy	Ignore "irrelevant" details to get major boundaries, thus narrowing the processing space	Mismatch of major segmentation strategy to input cues
Detect remaining word boundaries using less salient cues (phonotactics, distribution tallies, and allophonic variation)	Overly general rhythm-based segmentation strategy	Preference for NL over NNL and for frequent NL over infrequent NL phonotactic sequences; ability to track syllable following stress 6–9 months Preference for most frequent among allophonic variants 10.5 months	Decline in ability to process according to ALL features in the input (tuning to NL "details")	Pay attention to details within a narrowed processing space	Mismatch of details segmentation strategy to input cues

Table 10.7 (*Cont'd*)

Type of processing	*Mechanism*		*Consequent processing change*	*Child L1A advantage*	*Adult SLA "disability"*
	Initial	*Developmental sharpening*			
Detect phrase and clause boundaries	Sensitivity to prosodic cues (pause, pitch, final lengthening) in NL, NNL, and music input	Preference for native prosodic cues 4.5 months		Ignore "irrelevant" details to get major boundaries, thus narrowing the processing space	Mismatch of major segmentation strategy to input cues
Discover phrase and clause structure	Preference for real over nonsense function words	Ability to track position of function words 16 months		Pay attention to details within a narrowed processing space	Mismatch of details segmentation strategy to input cues

B Other constraining mechanisms

Type of processing	*Mechanism*		*Child L1A advantage*	*Adult SLA "disability"*
Encode and remember word	Segmentation	Store forms in the absence of meaning 9 months →	Enables fast mapping	Mismatch of segmentation strategy to input
Map word forms onto meaning (whole object, taxonomic, and mutual exclusivity constraints)	Fast mapping	Assume that labels refer to whole objects, entire classes, and are unique 12 months →	Narrows the hypothesis space for forms–meaning mapping	Unknown
Lexical	Joint attention	Ostensive → nouns Impending → verbs 6–21 months	Temporary facilitation of forms–meaning mapping	Unknown

language), between 6 and 9 months of age, this general processing receptivity declines, or more precisely stated, becomes attuned to the native language. In other words, although infants appear to be endowed with universal segmentation abilities – for instance, phoneme perception abilities that are sufficiently receptive to enable discrimination among any and all of the universal set of sounds (Eimas, Siqueland, Jusczyk, and Vigorito, 1971) – after six to nine months of experience with adult input, the influence of the native language begins to take hold, for instance such that the infant's sensitivity to non-native contrasts declines, and phonemic categories begin to organize along the lines of the adult language (Best, Lafleur, and McRoberts, 1995; Werker and Tees, 1984). The evidence for phoneme discrimination is found in high amplitude sucking rate and preferential head-turning experiments. The results of these studies clearly indicate a fine attunement of input processing to the native language, one which may already be complete by as early as 6 months of age.

Sensitivity to prosodic cues that indicate word boundaries, or "prosodic packaging," is another early and general processing capacity which gives way to more native-language-specific processing. During this same early time period (0–6 months), sensitivity to the predominant rhythm of the native language develops (Jusczyk, Cutler, and Redanz, 1993). Although very young infants learning any language exhibit no preference among rhythm types (e.g., stress-based, syllabic, or mora-based), studies have shown that American children at age 9 months prefer to listen to lists of English words with the dominant English stress pattern (strong/weak, as in *longer* rather than weak/strong as in *along*) (Jusczyk et al., 1993). The claim is that children use their preference for the dominant native language stress pattern as a first attempt to segment whole word forms from rapid, fluent input (Jusczyk, 1999a). Further evidence for this initial word segmentation approach is that, when just the strong initial syllables are trained and represented in a word, the listening preferences disappear, such that infants familiarized with strong/weak words do not prefer the passages containing monosyllabic words derived from the strong syllables (Jusczyk, 1998a). Thus, infants appear to be segmenting whole words using the complete rhythmic pattern of the native language, in this case, stress in English. (See Otake, Hatano, Cutler and Mehler, 1993, for a study showing a mora-based strategy for word segmentation in Japanese.) Cutler (Cutler, 1990, 1994; Cutler and Butterfield, 1992) has termed this the *metrical segmentation strategy*.

Of course, the dominant rhythmic pattern of a language is often incomplete as far as indicating the boundaries of all words is concerned. Nonetheless, infants appear to use the overly general approach – for example, the English word-initial segmentation stress cue – and this seems to be in order to derive smaller chunks of input which may then facilitate the discovery of other, initially less salient cues to word boundaries, such as distributional cues and allophonic variation (Jusczyk, Hohne, and Baumann, 1999). Once generalized phonetic and prosodic processing have been underway for six or more months, children demonstrate increasing sensitivity to the distribution of various types of information in the native language input, all of which are tied to features that are frequent in the language that surrounds them. For example, between 6 and 9 months of age, infants develop a preference for native over non-native phonotactic sequences, and for frequent native over infrequent native phonotactic sequences (Jusczyk et al., 1993). This is demonstrated by much longer listening times by 9-month-olds to lists of words in their native language than to lists in a non-native language (or longer listening times to frequent native word lists than to infrequent native word lists). Six-month-olds, on the other hand, listen to all types of lists for the same amount of time. Furthermore, additional experiments with 9-month-olds have shown that when all the phonotactic information is filtered from the lists, leaving only prosodic cues, infants no longer listen differentially, suggesting that, indeed, it is the phonotactic sequence information to which they are now paying attention in the input (Jusczyk et al., 1993).

Distributional cues help infants learning English to discover the problematic weak/strong pattern, where the strong stress now indicates a word-*final* boundary. To determine the difference between word-initial and word-final boundaries, children learning English appear to pay attention to the frequency of the next syllable (Jusczyk, Goodman, and Baumann, 1999). That is to say, they notice that initial strong stress is always followed by the same weak syllable (i.e., this is an entire word), and that final strong stress is always followed by a different weak syllable (i.e., this is the end of a word, followed by a new word). Evidence for this comes from studies showing that when children are fooled by regularizing the syllable following the weak/strong stress pattern, they no longer reveal a listening preference for the strong/weak word initial stress pattern (Newsome and Jusczyk, 1995; and see Jusczyk, 2001, for an overview). These findings are obtained with real and artificial language input (see Saffran, Newport, and Aslin, 1996, for artificial language studies). Furthermore, in studies of allophonic variation in which infants are familiarized with a pair of words like *nitrate* vs. *night rate*, where the differences between word-initial and word-medial segments are +/− aspiration of [t] and +/− voicing of [r], 9-month-olds listen equally long, regardless of word familiarized with, but by 10.5 months of age, they listen longer to, and hence are said to segment, the familiarized word (Hohne and Jusczyk, 1994; Jusczyk and Hohne, 1997).

The initial developmental milestones of prosodic bootstrapping for word learning can be summarized as follows: at age 7.5 months, word segmentation from fluent speech only approximates adult ability, but by 10.5 months, sensitivity to additional cues has developed. In other words, using a major cue, which is but part of the eventual adult parsing strategy, infants segment the input into developmentally relevant chunks, in effect limiting the search space, and thus enabling subsequent strategies to seek regularities in organization within the chunks (Nazzi, Bertoncini, and Mehler, 1998; Nazzi, Nelson, Jusczyk, and Jusczyk, 2000). As we have seen, infants then begin keeping track of phonotactic, distributional, and allophonic cues to infer other word boundaries.

By 10.5 months, English-learning infants seem to have developed segmentation abilities that are similar to those displayed by English-speaking adults. Infants need to use all of these cues for word segmentation because no one cue alone is sufficient for segmenting all words from highly complex continuous speech. Starting with one major and generally successful segmentation strategy enables the infant to pay attention to other, initially less noticeable, but relevant cues to word extraction.

Once the ability to segment words from the input has developed, the next task for children is to encode the words in memorial representation. The mechanism responsible for this is fast-mapping, which itself develops in two phases. Children appear first to encode and remember the segmented word forms; only later do they fast-map meanings onto the word forms. To demonstrate word-form encoding in the absence of meaning, researchers have used a modification of the head-turn-preference procedure, which is based on the principle of priming (Jusczyk and Aslin, 1995). In such experiments, very young infants are familiarized with particular targets (either in isolation or in fluent speech), and then researchers measure how long they listen to passages with the stimulus and with a relevant comparison. Results show that the recognition of familiarized word forms is a very precise ability, since if the familiarized words are changed by just one phoneme, infants no longer prefer the passage. Furthermore, they can recognize familiarized word forms in the presence of a distracting voice and generalize across speakers (this ability develops, too: at 7.5 months, only from one female to another, not female to male; at 10.5 months, to both) (Houston, Jusczyk, and Tager, 1998; Jusczyk, 2001). While, at this stage, infants are encoding word forms in the absence of processing for meaning, the resulting memorial representations lay the foundation for the later process, fast-mapping the lexicon (of forms to meanings), which they are then able to do at great speed.

In the second year, infants begin to link sound patterns to meaning. Mapping appears to be a constrained process, as well. For instance, research on children's word learning has suggested that children never consider the full range of hypotheses about what a given word could mean. Instead, they narrow the range of possible meanings for a word on the basis of innate constraints that force them to consider only certain relevant cues, for instance when trying to map a new word onto an object. Markman (1989, 1994) proposes three constraints on word meaning: the *whole-object constraint*, the *taxonomic constraint*, and the *mutual-exclusivity constraint*. When children see an adult point to an object and name it, they almost never assume the word refers to some part of the object; instead, they assume the person is naming the *whole* object, thus obeying the whole-object constraint. Similarly, the taxonomic constraint narrows children's guesses about word meaning by helping them to figure out the level of generality for which an object name is intended. In other words, the taxonomic constraint points children to the fact that, typically, a new word refers to a known *class* of things: *dog* refers to all members of the class of dogs, and not to this particular dog. Finally, when a child encounters two objects, one for which they already know a word, he or she will generally assume that the novel word applies to the object for which they do not already know a name – in other words, names for things are *mutually exclusive*.

Whereas these three constraints are considered necessary for lexical acquisition, another mechanism, joint attention, appears at least to be facilitative (Baldwin, 1993; Tomasello, 1995). Joint attention can be focused on objects (for noun learning) or actions (for verb learning). In naturalistic studies, children with the largest vocabularies are those whose mothers label the child's impending actions or their own completed actions (Tomasello and Kruger, 1992). In experimental studies, joint attention established during ostensive context is shown to lead to noun learning (Tomasello and Barton, 1994), and an impending context ("Now I'm going to roll the ball") is the most conducive to learning verbs (Tomasello and Kruger, 1992). Investigations of the capacity of infants to respond to the joint attention bids of others (e.g., gaze shift, pointing, and vocalizing) indicate that responding to joint attention at 6, 8, 10, 12, and 18 months is positively related to individual differences in vocabulary development (Morales et al., forthcoming). However, by 21 months of age, this correlation between response to joint attention bids and vocabulary growth no longer holds. Overall, joint attention with equal participation by the child in the activity appears to be the most effective for novel word learning (Tomasello and Todd, 1983).

Thus far, we have seen a number of examples of the approach taken by children to the enormously difficult problem of breaking into the native language in the face of complex input in the form of continuous speech. At first, guided by innate constraints, and ignoring "irrelevant" details, they adopt an overly general, but reasonably successful strategy to segmenting out the words. While it is certainly beyond the scope of this chapter to describe all of first language acquisition, it is important to point out that the same general-to-specific strategy, with increasing attention to distributional cues, has been demonstrated for the learning of phrase structure and syntax (for a collection of relevant studies, see Weissenborn and Höhle, 2001). For example, very early on, children (4.5 months old) demonstrate that they are sensitive to, and thus detect, prosodic cues to major phrase and clause boundaries (e.g., pitch, final lengthening, and pausing) in all of the following types of input: their native language, non-native languages, and music (Jusczyk, 1998a, 2001; Jusczyk and Krumhansl, 1993). The evidence for this is preference for listening to passages in which pauses coincide with boundaries rather than to passages with pauses inserted in mid-clause.

It is argued that, once the input has been divided into these smaller chunks, or "prosodic phrase packets," children may then be able to discover cues to syntactic organization within what is now a smaller processing space (Jusczyk, 1999b, 2001). Such cues include knowledge of the typical position of function words with respect to content words (Shady, 1996) and sensitivity to local dependencies like person–number agreement and between auxiliaries and verbs (Santelmann and Jusczyk, 1998). Interestingly, given a long-distance dependency, as when there is considerable intervening material between an auxiliary and a verb ("Grandma is almost always singing"), children no longer track dependencies (Santelmann and Jusczyk, 1997, p. 508). However, the longer the distance between the dependent elements, the less likely they are to appear in the same prosodic unit. As Jusczyk (2001, p. 22) has noted, "fortunately for language learners long adverbial phrases between adverbials and verb endings are apt to be very rare in the input." Apparently the everyday packaging of utterances in prosodic chunks is sufficiently effective for incrementally discovering the structure of language.

With respect to understanding the nature of input-processing mechanisms and developmental sharpening, it is worth noting that the metrical segmentation strategy and the preferences for salient or frequent cues in the native language input develop at just the same time as universal discrimination of non-native phonemic contrasts declines (Jusczyk, 1998a). Furthermore, for each language-learning problem (e.g., extracting word forms, mapping forms to meaning, determining phrase and clause boundaries, and discovering phrase and clause structure), the overly general strategy constrains the problem space such that children can then pay attention to less salient, previously ignored, but nonetheless now relevant cues in the input. Likewise, while detailed discussion of general cognitive development is well beyond the scope of the current chapter, a significant observation is that analytical thinking appears to develop in somewhat the same constrained fashion as do language input-processing mechanisms. That is to say, in very early life, children are generally perseverative in their approach to problem-solving tasks (Deák, 2000b), settling upon one successful solution (usually discovered in determinate tasks) and persisting in using it, even when encountering a new, indeterminate task, or in the face of explicit directions to adopt a new strategy. For example, while 3-year-olds can easily sort a group of objects according to their shape, the children cannot shift their sorting behavior when asked to sort according to function. At about age 4, children begin to use a more flexible style of induction, one that is based upon the original solution, but now takes into account more details of the problem. Four-year-olds can also follow instructions to change to a new sorting strategy. Deák (2000a) has termed this "adaptive-problem solving."

4.2 *Non-native speech processing*

We have seen that the preponderance of evidence in the studies of pre-lexical L1 processing, and of the subsequent association of forms with meaning, indicates that segmentation and mapping strategies used during child native language acquisition are constrained such that, while initially receptive to any type of salient cue, input processing rapidly becomes attuned to the ambient language during the first year of life. That is to say, segmentation and mapping procedures are refocused and readied to attend to previously unnoticed cues in the complex speech signal and in the agents, entities, and actions of the events in which the child participates, that is, those cues which now are most relevant to the next phase of language acquisition (see Jusczyk, 1993, 1997, 1998b, 2001). The consequence of this is that input processing during native language acquisition is highly efficient and relevant to the language-learning task at hand (e.g., extracting word forms, mapping forms to meaning, figuring out phrase structure, etc.). In child language acquisition, developmental sharpening is beneficial, since the attunement proceeds stepwise in concert with input and interaction. But what of adult SLA? An unfortunate drawback to the extreme efficiency of L1 processing, in particular to the developmental sharpening that it entails, is that adults are rendered "disabled second-language learners later in life" (Cutler, 2001). This is because speech-processing abilities are altered, through experience with the native language, so that adults acquiring their L2 typically process input with mechanisms already attuned to their L1.

To illustrate this, let us revisit the pre-lexical segmentation strategy that exploits the dominant rhythm pattern of the native language in order to extract word forms from continuous speech. When listening to their L2, adults face the same complexity in the input as do children, if not more.[8] Cutler and her colleagues have investigated the nature of speech segmentation by adults during native and non-native listening, adopting a cross-linguistic approach.[9] In a series of sound-segment monitoring experiments that were originally designed to test whether the syllable is the universal speech segmentation unit (as had been claimed by Mehler, Dommergues, Frauenfelder, and Segui, 1981), it was discovered that adult English speakers do not use a syllabification strategy when listening to their native language (Cutler, Mehler, Norris, and Segui, 1986). Since French is much more easily described in terms of syllables than English, the researchers wondered whether English speakers listening to French, a foreign language, but one which is much easier to syllabify, would be able to apply the syllabification strategy. Results showed clearly that, even when listening to French, English speakers do not use the strategy of syllabification. Native speakers of French, on the other hand, *always* use syllabification in speech segmentation, regardless of whether they are listening to familiar, easy-to-syllabify French or to foreign, hard-to-syllabify English (Cutler et al., 1986). In separate investigations, it was demonstrated that, rather than exploiting cues found in syllables, L1 English adults use a stress-based segmentation strategy when listening to their native language (Cutler and Butterfield, 1992; Cutler and Norris, 1988), and, crucially, that they use the same stress-based strategy when listening to a foreign language with a different rhythmic structure (in this case, Japanese, which is mora-based) (Otake, Hatano, and Yoneyama, 1996). Note that this is the very strategy which we discussed above in describing prosodic bootstrapping by infants learning English.

Likewise, Cutler and Otake (1994) have shown that Japanese adults do not use the syllabic strategy, but rather they segment their native Japanese by exploiting its mora-based rhythm. When English speakers listened to the same Japanese materials, they used neither the syllabic nor the mora-based strategy, and when French speakers listened to the Japanese materials, they clearly used their native syllabification rather than the Japanese-like mora-based segmentation strategy. In a second task involving phoneme detection, Japanese speakers were once again shown to use the native-language, mora-based strategy during non-native listening (to English), whereas English native speakers listening to the same materials were not influenced by the mora (Cutler and Otake, 1994). Thus, Japanese are sensitive to moraic structure even in L2 English, and even though native English speakers are not. Results such as these have been replicated with several combinations of rhythmically different native and non-native languages (see Cutler, 2001, for an overview). Taken together, the findings of the cross-linguistic speech segmentation studies suggest strongly that segmentation strategies are language-specific, not universal, processing routines (Cutler et al., 1986).[10] More specifically, Cutler et al. (1986, p. 397) claim that "[d]uring language acquisition, speakers adapt their perceptual routines so as to exploit with maximal efficiency the phonological properties of their native language."

Most important for the discussion at hand is another logical conclusion emanating from the findings of cross-linguistic speech segmentation comparisons: "Language-specific segmentation is in the listener, not in the speech signal" (Cutler, 2001, p. 11). That is to say, although it is indeed the salient features of the speech signal that initially attract the infant's processing attention very early on in native language acquisition, experience with the ambient input results in developmental sharpening such that one, and, as we shall now see, only one, dominant segmentation strategy is applied from that point onward, regardless of the features of the input encountered (including non-native languages). Evidence for this comes from studies of proficient bilinguals raised by native-speaking parents, one each of English and French (Cutler, Mehler, Norris, and Segui, 1989, 1992). Upon first analysis, the findings of the bilingual studies were perplexingly variable and not at all like the findings of the monolingual studies. It was then discovered that the group of bilingual subjects was not homogeneous in all regards. The difference among subjects was found not to be based on country of residence, or on the language of either parent. Rather, it was based on the subjects' stated language preference, that is, when asked, in case of brain injury, which language they would rather keep. When subjects were grouped according to their preferred language, the findings revealed that they commanded only the native strategy of the preferred language. Thus, subjects who said that they would keep French in the event of brain injury used the syllabic strategy, and those who preferred English exhibited stress-based segmentation. Further studies reveal that English–Dutch bilinguals use stress when processing both languages (both languages have stress-based rhythm), and that French-dominant French–Dutch bilinguals do not use stress-based segmentation in Dutch (van Zon, 1997, reported in Cutler, 2001). No studies have found simultaneous command of two processing strategies.

Interestingly, Cutler et al. (1992) note that, since the French–English bilinguals in their study were so high-functioning in both languages, listening clearly does not *depend* on the use of the strategy. Rather, the purpose of a dominant strategy is to facilitate the acquisition of the lexicon during native language acquisition. Whether or not the highly proficient bilinguals *ever* used more than one processing strategy during the simultaneous acquisition of their two languages is not known, as no such studies of early bilingual segmentation, in particular of infants exposed to rhythmically different languages from birth, have yet been carried out (Cutler, 2001). What does seem to be the case, however, is that the developmental change involved does not necessarily constitute a complete loss of "perceptual acuity" (Cutler, 2001). For instance, it has been shown that discrimination ability remains in adulthood for phonemes which are not present in the native language, but, crucially, which also are not pre-empted by any native language contrast: English speakers can, for example, discriminate Zulu clicks (Best, McRoberts, and Sithole, 1988). Cutler and Otake (1994) argue that such findings indicate that infants identify the acoustic distinctions that are important to pay attention to in order to learn the words of the native language, and, more importantly, that irrelevant variation, for instance between pronunciations within and across speakers, can be ignored.

For L2 purposes, this raises the crucial question of whether or not adults can be trained to use processing strategies other than their dominant native language ones. Cutler (2002, p. 3) offers an overall diagnosis: non-native listening skills are less flexible. In their native language, people cope effortlessly with unfamiliar voices and intra- and inter-speaker variations in pronunciation, and have little difficulty processing speech in the presence of noise or distraction. All of these factors cause great difficulty in non-native listening. Thus far it appears that, without training, listeners command a repertoire of procedures relevant to the efficient processing of their native language, and that they do not use new procedures more appropriate to L2 input. What is problematic is that they use their native language strategies even when mismatched to the input. This is clearly not efficient. Could second language instruction make a difference?

With regard to the discrimination of phonemes, the prognosis is not good. Intensive and laborious training in non-native discrimination results in only a small improvement (Lively et al., 1994). Once native phonemic categorization has taken place, it cannot be altered. Only phonemes that are not found in the native language inventory can be discriminated (Best et al., 1995). However, some evidence suggests that other segmentation strategies may not be so severely limited. Proficient German–English bilinguals have been shown to be sensitive to *both* their native German phonotactic sequence restrictions and non-native English constraints (Weber, 2000). In a word-spotting study, in which listeners had to detect the English word *luck* within nonsense words like *moysluck*, *moyshluck* or *moyfluck*, English speakers were fastest at detecting *luck* in *moyshluck*, presumably since *shl-* is not a possible onset in English, thus rendering the segmentation boundary more salient than *fl-* and *sl-*, which are both possible English onsets. Both *fl*- and *shl*- are possible onsets in German. Although the German–English proficient bilinguals found *luck* easiest to detect in *moysluck* (as would be predicted on the basis of the German phonotactic constraints), their detection responses were faster for *moyshluck* than for *moyfluck*. Weber interprets this to mean that, while the German listeners maintained sensitivity to their native sequencing constraints, they had also acquired some sensitivity to English phonotactics. With regard to segmentation on the basis of rhythm, recall the experiments with French–English bilinguals which revealed a language preference that was linked to its matching native language segmentation strategy (Cutler et al., 1992). Cutler (2001) discusses a very revealing finding in this study: the proficient bilinguals *never* misapplied their segmentation strategy in listening to their other language. That is to say, subjects who stated that they preferred French used the syllabic strategy in French listening but not in English listening. Exactly the same was true for the subjects who stated a preference for English. They exhibited the stress-based strategy in processing English, but not in French. Cutler (2001, p. 16) concludes the following: "Inappropriate language-specific segmentation is avoidable."

If, as evidence has shown, untutored bilinguals have developed an incipient sensitivity to phonotactic constraints in their less-preferred language, as well as the ability to inhibit a segmentation strategy that is mismatched to the rhythm of the language being processed, this suggests that adults retain something of the perceptual acuity they once called upon as child language learners. Furthermore, unlike the case of phonemic categorization, which appears to be immutable once completed, this constitutes tantalizing evidence that other patterns of language structure have not been unalterably fixed in memorial representation. Bilinguals still appear to be able to pay attention to the cues *located in the input*, as they did when they were infants first breaking their native language code.

A clear research priority in instructed SLA has thus presented itself: can L2 learners overcome the developmental sharpening effects of adopting procedures efficient for the processing of their L1, the outcome of which is a highly native-language-specific approach to input? More specifically, can they return to a mode of processing similar to that used during native language acquisition in which, *at least at first*, they pay attention to the cues in the input that are most useful in signaling the relevant lexical, phrasal, and syntactic boundaries of the L2, and use that information to narrow the processing problem space such that other cues may be perceived?

5 Enhancing Adult SLA

Ways in which to alter, with a view to enhancing, input processing by adults acquiring their second language have just begun to be investigated in SLA. Two recent lines of research – processing instruction studies and focus-on-form studies – both address the fundamental question of how L2 learner attention can most efficiently be directed to cues in the input which "disabled" adult learners fail to perceive when left to their own devices. Such work is motivated by the Noticing Hypothesis, which, stated in general terms, is as follows: "SLA is largely driven by what learners pay attention to and notice in target language input and what they understand the significance of noticed input to be" (Schmidt, 2001, pp. 3–4; and see also Robinson, this volume; Schmidt, 1990, 1992, 1993, 1995, 1998). On the face of it, this would appear to be the same type of process as drives primary language acquisition. However, given developmental sharpening, *what* is noticed differs, and presumably is less efficient, for adults acquiring their second language.

5.1 Processing instruction

Processing instruction studies address the issue of non-native input processing at the utterance level. As was the case with pre-lexical segmentation strategies discussed above, it has been shown that, when listening to their L2, adults rely upon L1 strategies for assigning grammatical roles in an utterance. For example, L1 English speakers consistently apply a word-order strategy which is highly reliable for identifying the subject of an utterance (i.e., since English sentences are nearly always SVO, the first noun encountered is going to be the subject of the utterance). They do so when processing their L1, and when processing their L2. Thus, L1 English speakers learning Spanish as a second language have difficulty with utterances like *Lo sigue la madre* ("His mother is following him"). Given the task of matching one of two pictures to an utterance which they hear, learners will assume, even though *lo* is an object pronoun, that "he" is the subject of the utterance, since it is a noun-like entity encountered sentence intially. Other cross-linguistic bilingual processing studies, most conducted within the competition model paradigm (Ellis, this volume; MacWhinney, 2001), have replicated this finding of reliance on L1 cues (for instance, to determine the grammatical subject, L1 Spanish speakers rely most on agreement cues found in morphology, and L1 Japanese speakers depend upon animacy cues). To overcome the mismatch between the L1 strategy and the L2 input, processing instruction informs learners that the L1 cues are not reliable, and alerts them to cues in the L2 to which they should pay attention instead. Learners are then given numerous opportunities (called structured processing) to interpret the L2 in the appropriate way (see VanPatten, 2002, for an overview).

While promising, there have been two problems with PI instruction studies to date. First, there is usually some component of explicitly presented, metalinguistic instruction that precedes (and, hence, is isolated from) the structured processing phase. Researchers working within the PI paradigm themselves have shown this component to be unnecessary in both classroom (VanPatten and Oikkenon, 1996) and computer-based (Sanz and Morgan-Short, 2002) environments. More specifically, in both of these studies, it was shown that explicit instruction had no effect beyond that of the structured processing component. A second difficulty with PI studies to date is that not all researchers adhere to the PI guidelines for designing L2 instruction. Processing instruction is supposed to address a *processing problem*, for example, the well-known first-noun strategy used by English speakers processing L2 Spanish input. More often than not, however, when the research has investigated something other than the first-noun strategy, it has been based on a linguistic description of an observed learner error. If the error was not a consequence of a processing problem, then PI would not be expected to be effective. Rather, the overall purpose of PI is to help learners process what is actually in the input, that is to say, to circumvent what their L1 systems expect.

5.2 Focus on form

Focus-on-form instruction is another approach to redirecting learner attention during input processing both within and across utterances. In accordance with the Noticing Hypothesis, the essential idea is that aspects of the L2 input learners need to notice, but do not (for whatever reason), will require some kind of pedagogical intervention. Well-known examples of recalcitrant L2 learning problems are found in research on the language competence of Canadian English–French bilinguals who have been immersed in their L2 at school for most of their academic careers. Arguably, this is the best possible context for L2 instruction, given the amount of time spent functioning in the second language. However, despite this opportunity, findings show that, after up to 12 years of immersion, while the listening, reading, and cognitive abilities of bilinguals are on a par with or superior to those of their monolingual counterparts in the two languages, their productive abilities (speaking and writing) are clearly non-native (Allen, Swain, Harley, and Cummins, 1990). Typical problems include grammatical gender agreement errors, absence of tense marking, and lack of politeness markers (Swain and Lapkin, 1982). Learners may not be able to notice these aspects of the L2 because they are not communicatively problematic, not conceptually similar to the L1, or perhaps not acoustically salient (perhaps because they are processed through the developmentally sharpened L1 mechanisms). Focus-on-form interventions draw learners' attention to these persistent problems when they arise incidentally during language use in the classroom that is otherwise meaning oriented (Doughty and Williams, 1998c; Long, 1988, 1991; Long and Robinson, 1998).

Examples of FonF pedagogical procedures include visual input enhancement and auditory recasting. (See table 10.4 for many others.) Studies of the former have tended to indicate that enhancements involving font manipulations or color coding are not salient enough for learners to notice (Jourdenais, 1998, 2001). In contrast, auditory recasts, although still among the more implicit of FonF pedagogical procedures, have been effective, with findings of both experimental (Long, Inagaki, and Ortega, 1998) and quasi-experimental, classroom (Doughty and Varela, 1998) research converging on the interpretation that the implicit negative evidence provided to learners by recasts contingent upon their interlanguage utterances is noticed and used in SLA (see Long, forthcoming, for an overview). The mechanism evoked in this explanation is cognitive comparison (Doughty, 2001). While precisely what the range of elements is that can effectively be brought into attentional focus during input processing is yet to be determined, how *many* should be attended to at once is clear. Learners benefit most from concentrated simple recasts (of one or two elements) of aspects of language for which they are developmentally ready to benefit from instruction.

Thus, the preliminary indication is that attention-oriented instruction is effective. However, it must be reiterated that most effects-of-instruction studies, even many that have ostensibly been operationalized in terms of attention to form, have been plagued by research bias, as discussed at length above (see section 3.3). In particular, pedagogical procedures, as well as the measures used to assess the L2 ability of subjects after instruction, have tended to be overly explicit, and in many cases excessively metalinguistic and decontextualized in nature (i.e., focus on forms, declarative knowledge). This has resulted in a false impression that explicit instruction is the most effective for SLA. In reality, what the evidence has shown is that explicit instruction involving decontextualized, declarative knowledge leads to an accumulation of metalinguistic knowledge. That FonF instruction has also been demonstrated to have a relatively large effect, even in the face of extreme research bias, suggests the robustness of attentional focus within implicit learning. However, since this type of instruction has, in practice, rarely, been properly investigated, modes of L2 processing that enable focus on form must now be prioritized in the research agenda.

5.3 The "what" and "how" of the Noticing Hypothesis

What must adults pay attention to in the L2 input, if not the kind of declarative knowledge offered up by explicit instruction? We have already seen that, during primary language acquisition, in a highly efficient manner, children initially notice regular and prosodically salient boundaries, and then, within this delimited processing space, begin to notice less salient details that provide cues to linguistic organization. Furthermore, we reviewed evidence that adults are somewhat, if not entirely, disabled by this tuning of their input processing mechanisms, such that they no longer notice cues in the input *per se*, but through the filter of the linguistic organization of their first language. To understand what adult learners need to notice to be successful in SLA, we now must address two issues that have largely been ignored by instructed SLA researchers: (i) the adequacy of conceptualizations of what learners pay attention to, and (ii) the nature of the default L2 processing mode and how it might be enhanced by instruction to promote noticing.

In specifying the Noticing Hypothesis beyond its general formulation, Schmidt has claimed that learners *must* pay attention to what he terms "surface elements" in order to acquire them. More specifically, he states that: "the objects of attention and noticing are elements of the surface structure of utterances in the input – instances of language, rather than any abstract rules or principles of which such instances may be exemplars" (Schmidt, 2001, p. 5). Noticing structural regularities, forming hypotheses, and making comparisons is a level beyond. Precisely what these "surface" elements of language input are is, as yet, little understood. However, Schmidt is clear about how these elements should *not* be construed: "Noticing is therefore used here in a restricted sense, as a technical term roughly equivalent to 'apperception' (Gass, 1988), to Tomlin and Villa's (1994) 'detection within selective attention' . . . My intention is to separate 'noticing' from metalinguistic awareness as clearly as possible" (Schmidt, 2001, p. 5).

The key point is that metalinguistic awareness and noticing are to be considered separate mental processes. The second crucial issue is *how* learners should be assisted through pedagogical procedures in noticing the "surface elements." Whereas explicit instruction (of the kind typical in studies to date) carves up the L2 for the learner, noticing enables learners to segment the input for themselves and, as such, is a mental process akin to segmentation in primary language acquisition. In the case of the former, metalinguistic approach, it is not at all clear how such declarative knowledge should be divided up for presentation to learners, or how the learner could reassemble the component parts of the L2. Although proceduralization of declarative knowledge through practice is sometimes invoked as a viable learning mechanism, it will become clear in the next section that exactly the opposite is closer to an accurate characterization of how complex knowledge is acquired. We shall see that implicit knowledge leading directly to procedural ability is first internalized, and, if the conditions require it (e.g., practice), declarative knowledge develops afterwards. If this is true, then instructional procedures that begin with declarative knowledge are putting the cart before the horse. Moreover, if complex L2 knowledge is primarily acquired implicitly, but through the filter of developmentally sharpened input-processing mechanisms, then all the more critical are precise conceptualizations of elements to which L2 learners must attend, particularly if instructional enhancements are to, in a sense, *reorganize* the processing space so that learners may overcome the effects of primary language acquisition.

5.4 Modes of L2 processing

Basic processing research thus far suggests that, to be successful, SLA must involve two modes of processing, a default implicit mode, and an available (and perhaps necessarily explicit) mode to be engaged only when implicit processing is insufficient. Modes of L2 processing are properly considered in the context of a debate that has been controversial in cognitive psychology for three decades. At issue is the question of how complex knowledge is learned from the available input – that is to say, whether implicitly or explicitly – and how such knowledge is represented in memory and accessed for use, typically in tests involving discrimination or generation and verbalizations of knowledge. Central to the discussion is how to characterize the memorial representations that arise immediately (during processing) and long-term (storage) in the learning of complex systems; whether such learning proceeds with or without awareness and with or without intention; and whether there is any interaction of the two types of knowledge. A version of this debate is embodied in Krashen's learning/acquisition distinction and non-interface position, and their counter-positions, as discussed earlier in the consideration of the case against L2 instruction (see section 2).

The view that the learning of complex knowledge is fundamentally explicit in nature underpins the three complete-shift-of-processing explanations of child–adult differences in language acquisition discussed in section 4. The underlying premise of such positions is that, since studies have failed to show a purely implicit learning mode for the processing complex input, the default mode must, therefore, be explicit. For instance, DeKeyser (this volume, p. 321), concludes that "a thorough reading of the literature on implicit learning . . . must leave one very skeptical about the possibility of implicit learning of abstract structure, at least by adults."

In contrast, following a growing consensus among implicit learning researchers (Stadler and Frensch, 1998), the view taken in the present chapter is that, indeed, the default processing mode in SLA, as in other types of complex learning, *is* implicit (Cleeremans and Jimenez, 1998). However, this need not and certainly does not rule out the occasional switch to explicit processing, which, in adult SLA – particularly instructed SLA – appears to be necessary to overcome the disabling influence of primary language learning. As a matter of fact, implicit learning studies have consistently shown evidence of concurrent explicit learning, such that researchers have all but abandoned the notion of a "pure" implicit learning processing mode (and, hence, the requirement that one be demonstrated).[11] In this light, the discussion will now turn to the evidence for implicit learning of complex systems, and to a consideration of the role of explicit processing therein.

5.4.1 Methodological entanglements and a solution

In general terms, the implicit view in cognitive psychology holds that learning of complex knowledge proceeds, in the main, without extensive understanding of the underlying system, either at the moment of learning or afterward (in the sense that the newly learned knowledge cannot be verbalized). Put more simply, people learn about the structure of a complex system without necessarily intending to do so, and in such a way that the resulting knowledge is difficult to express. Although the default implicit view is generally accepted by many cognitive psychologists (Berry, 1997; Berry and Dienes, 1993; Stadler and Frensch, 1998), a number of researchers have argued forcibly against it (e.g., Dulany, Carlson, and Dewey, 1984; Perruchet and Amorim, 1992; Perruchet and Pacteau, 1990; Shanks and St John, 1994). Typical points of contention have included what is noticed in the input at the time of learning, and how that noticed information is encoded into short-term and, ultimately, long-term memory representations. A related question is a methodological one: to what extent do the tests used in implicit learning studies themselves involve learning opportunities? Moreover, if such test effects operate, then is the newly acquired knowledge rendered different from that which resulted only from implicit learning? As we have seen, all of these are crucial considerations for the methodology of future instructed SLA studies as well, in terms of both the design of psycholinguistically appropriate instruction, and valid measurement.

Much of the controversy concerning implicit learning originally stemmed from these methodological entanglements, from the ensuing difficulty of interpreting findings of implicit–explicit learning experiments, and from the expectation that learning of complex systems proceeds *either* implicitly *or* explicitly, that is, the classic dissociation paradigm (Jacoby, 1991). After a fruitless period of research that sought to establish unequivocally that implicit learning occurs and is independent of explicit processing, recent assessments by cognitive psychologists have produced a consensus that (i) implicit and explicit learning occur simultaneously (Stadler and Frensch, 1998);[12] and, consequently, that (ii) implicit and explicit learning can never be disentangled empirically where the evidence for learning gathered is behavioral.[13] Accordingly, it appears reasonable that, in addition to being in the main implicit, SLA necessarily involves more than one mode of processing; that is to say, at times, explicit learning takes place alongside default implicit learning. What is important to determine is when and for what reason explicit learning mechanisms do, or perhaps should be encouraged to, override the default, somewhat disabled implicit processing mode in SLA. Such an understanding ultimately can inform the design of effective enhancements in instructed SLA.

5.4.2 Evidence for implicit learning of complex systems

Since a case for explicit learning has already been made by SLA researchers holding the complete-shift-of-processing view of child–adult differences in SLA (see section 4 and DeKeyser, this volume), we will now evaluate the evidence for the alternative view that instructed SLA processing should be in the main implicit, and only at times explicit. Assuming that implicit learning occurs, and that the nature of encoding at the time of learning is important, it is of great interest to cognitive psychologists to determine how complex learning differs qualitatively in aware (explicit) and unaware (implicit) conditions. To this end, the learning of at least four types of complex information has been investigated: artificial (finite-state) grammars (AGL); repeating patterns, either visual (e.g., lights) or auditory (e.g., tones, music sequences); complex systems (e.g., metropolitan traffic control); and invariant characteristics (e.g., analog and digital clock faces).

Studies of the first two types have often been criticized on the grounds that what is actually learned is not anything complex, but rather a set of bigram or trigram relations that enable successful discrimination at time of testing. Moreover, it is suggested that subjects often can (explicitly) verbalize these relations, even if they cannot state the entirety of the rules underlying the system (Perruchet and Pacteau, 1990; Shanks and St John, 1994). These criticisms are only valid in arguing against the pure implicit learning view of complex knowledge acquisition. More to the point when drawing implications for SLA, AGL experiments have also rightly been criticized as not representative of language systems because they are devoid of meaning (Mathews et al., 1989). To remedy this, Mathews and colleagues (Mathews et al., 2000) have embedded the AG learning task into a game that involves identifying food labels (some of which encode meaning about location and delivery routes of the items), as well as a form of feedback based on parental recasting. Subjects were assigned to either of two conditions: (i) an explicit "spy" condition, where they were told about a plot to poison the public, which they were to uncover via the code labels the spies used to keep themselves informed about the movement of food cans, or (ii) a second implicit condition in which they were instructed to memorize the known poison labels simply in order to identify them whenever they appeared. Findings from a series of experiments indicated overall that the contextualized, complex AG knowledge was acquired better implicitly from exposure to instances than by trying explicitly to induce rules.

When the underlying system involves complex rules, it may be that the time needed for learning (in both implicit and explicit modes) is lengthy, and learners may require some guidance. Decontextualized AGL experiments have also been criticized for not providing ample time, sufficient explicit information (in explicit conditions), or tools to assist in processing the input. In the third of their contextualized AGL experiments, Mathews et al. (2000) gave one group explicit instructions on what types of rules to look for, gave them plenty of time to do so, and allowed them to use pencil and paper ("model builders"). The memory group were given the same ample time and pencil and paper ("memorizers"). Practice on tasks was interspersed with practice-identify or practice-generate tests such that, when subjects reached the criterion on the practice tests, they did the final tests. What is critical to note is that these were optimal conditions for explicit model building.

Findings were analyzed in terms of how well subjects could classify as grammatical or could generate strings. Furthermore, since they were allowed to generate as many strings as they wished, "hit-rate," a sort of efficiency measure (i.e., the percentage of strings generated that were accurate), was calculated.[14] This replicated the standard implicit learning finding: the implicit mode led both to substantial knowledge of the set of grammatical strings and to more efficient generation of good strings. The researchers interpret the findings to mean that explicit model builders, much as they liked the explicit activities (and memorizers did not), relied on implicitly learned instances during tests. Thus, where complex knowledge is learned in context, implicit learning is more successful.

Much recent consideration has been given to what to make of verbalizable (i.e., declarative) knowledge of complex systems. The consistent empirical finding is that verbalizable knowledge of rules underlying complex systems is incomplete or absent. However, the absence of verbalized knowledge cannot be taken as evidence of the absence of explicit learning, and conscious accessibility of fragmentary knowledge does not necessarily constitute evidence *only* of explicit learning (Mathews and Roussel, 1997). This state of affairs prompts the following questions: what comes first, procedural or declarative knowledge? And how are the two related?

Stanley, Matthews, Buss, and Kotler-Cope (1989) investigated the relationship of verbalizations to the entirety of the knowledge that subjects have by examining whether verbalizations given to yoked subjects are sufficient for succeeding at complex tasks. If so, then it could be said that the subjects were able to verbalize the knowledge they had acquired. However, findings show that the hallmark of implicit learning is fragmentary knowledge. Subjects have explicit knowledge of fragments from the input, but, although they have the ability to recombine these fragments in accurate task performance, they cannot verbalize the rules underlying the recombination. After much practice, however, they then can verbalize this information such that others can follow it, indicating that, ultimately, it is possible for subjects to verbalize complex knowledge. These findings point to the conclusion that declarative knowledge is a by-product of practice during implicit learning.

In fact, in a series of studies described in more detail below, Berry and Broadbent (1984) and Stanley et al. (1989) have shown that improvements in performance *always* appear before participants are able to verbalize to any degree of completeness. Also, the declarative knowledge revealed does not appear at the moment of insight (where the performance improves), but much later in the set of trials. Evidence comes from studies of control tasks in which subjects receive input and target levels for variables, and then must interact in or observe a task. Performance improvements are measured, and then subjects are asked to verbalize in different ways. The types of knowledge tapped in these studies are (i) objective knowledge, measured in terms of performance, such as in accuracy of judgment (exemplar vs. string completion vs. patterns), reaction time, prediction, or generation; (ii) accessibility of knowledge in free recall or forced-choice recall (the latter intended to lessen the burden of articulating knowledge or to increase the sensitivity of the measure); and (iii) subjective knowledge operationalized as metaknowledge.

In all the studies, practice has the effect of performance improvement, but not improvement in articulating the basis for making decisions. Moreover, advance verbal instructions about how to do the task have no effect on performance (but do improve ability to answer questions). Finally, only when subjects practice a task in order to explain to someone else how to control it do findings show that extended practice increases verbalizable knowledge. That notwithstanding, performance always improves before subjects can tell someone how to control the task. And, consistently, individual learning curves show sudden improvements not accompanied by increased verbalizable knowledge, that is, insight. Taken together, the findings of control task studies suggest a very limited role, if any, for declarative knowledge in complex learning.

An important recent claim is that information which is processed in the unaware or implicit mode is more sophisticated than that which is processed explicitly (the so-called "smart unconscious") (Bornstein and Masling, 1998). In other words, implicit processing is more powerful than explicit thinking for learning complex systems involving many task variables (Mathews et al., 1989). This, of course, might explain why implicitly learned knowledge is so difficult to articulate. To cite an interesting example, in the case of neurological disorders such as prosopagnosia ("face blindness"), more information is processed in the unaware mode than explicitly. Whereas prosopagnosics can perceive faces and describe their component parts, they claim not to recognize who the people are. However, as shown by the fact that their galvanic skin responses are normal in the unaware mode (i.e., increased for familiar faces), they are able to do both.

To understand in some qualitative sense the nature of the elements in the input to which learners might be attending as they acquire the ability to control variables in complex systems, let us consider an example – city traffic management, that is, controlling the number of passengers using buses and the number of empty car parking spaces available by varying the parking fees and the time interval between buses. The underlying system algorithm is as follows: bus load increases linearly with time interval between buses, and number of parking spaces increases linearly with parking fee. There is also crosstalk between variables such that bus load increases linearly with parking fee, and parking space availability decreases linearly with time interval between buses. Subjects are given starting inputs and told to reach targets for the two variables. Scores on performance increase with practice, but ability to answer questions does not. In fact, verbalization of crosstalk decreases, even though to improve in performance one has to take that information into account (Broadbent, Fitzgerald, and Broadbent, 1986). The only clear interpretation of these findings is that subjects track and learn the relationships among variables implicitly.

With respect to concurrent explicit processing during the acquisition of control of variables in complex systems, Berry and Broadbent (1984) have examined experience, verbal instruction, and concurrent verbalization during sugar production and person interaction tasks (these two tasks involving the same underlying algorithms). In these complex systems, sugar output depended upon number of workers, and the computer–person interaction responses depended upon input of the subjects. As with the traffic control task, practice improved performance but not ability to verbalize, and detailed verbal instructions improved ability to verbalize, but not performance. Practice only helped performance when combined with a requirement to give a reason for each input *during* the task. Likewise, in the city transport system task described above, when a practice session on the individual relationships (e.g., time interval on bus load) was introduced, there was improvement in performance and in verbalization (Broadbent et al., 1986).

Stanley et al. (1989) also asked subjects to practice a complex task, and then explain it to someone else. Subjects in this study could choose their own words, quality of verbal instructions having been criticized in earlier studies. This time, their instructions were somewhat useful for yoked subjects, but still their own performance was better and improved before they were able to develop the explanation. Individual learning curves again showed sudden bursts of improvement that were not accompanied by similar increases in verbalizable knowledge. Finally, in a control task study using a talk-back method, subjects were told to verbalize for someone else, but then those instructions were actually used to develop a computer model (McGeorge and Burton, 1989). The more practice the subjects had, the better the verbalizations succeeded in the modeling.

Thus far, it is evident that, since increases in verbalization ability always appear after performance increases, explicit knowledge develops as a *result* of task experience. Moreover, providing explicit knowledge in advance of task practice is not helpful (even if generated by yoked subjects doing the tasks rather than by researchers), although providing actual task practice with relevant variables is. Thus, it is important to note that learning on the basis of declarative knowledge concerning the intricate relationships among complex system variables is much less efficient than implicit learning during actual task performance.

To explore the latter notion of practice with task variables further, researchers have asked whether making the underlying relationships more salient causes performance and variable knowledge to become associated (Berry and Broadbent, 1988). In a follow-up to the computer–person interaction study, the salient condition revealed the output to subjects immediately, while in the non-salient case, the computer person's output appeared after the next input (recall that output is contingent upon subjects' input). Results were in line with earlier practice studies. Berry and Broadbent then added an explicit instruction to the subjects: "The computer person's responses are determined by your inputs, and it helps to figure out how." Findings suggest that this information helps in the salient condition, but actually is detrimental in the non-salient condition.

To interpret these findings, Berry and Broadbent postulate two modes of processing: an implicit and unselective mode (i.e., store all contingencies), and a selective, explicit one (i.e., when relevant variables are obvious, selectively attend to these). The latter is only efficient if there are a few clear-cut variables, that is to say, if the variables selected are the right ones to which to attend. Otherwise, the non-selective mode is more effective, presumably since cases with many or unrelated variables might lead to attending to the wrong variable (but task experience ameliorates this). Next, because salience was confounded with task difficulty in the earlier studies, another was carried out combining the two modes into one task with salient and non-salient relationships (i.e., a sugar factory control task involving interaction with a union representative). The findings were the same as those of the independent studies (Berry and Broadbent, 1987). Finally, a further experimental modification revealed that watching someone do the salient person interaction task helps, but watching someone do the non-salient one does not (Berry, 1991).

Taken together, the findings on modes of processing during control of complex systems show five things: (i) without extensive or targeted practice, subjects learn to control the variables in the systems successfully, but they cannot articulate the bases for their decisions; (ii) with time and practice, they gain the ability to describe their mental models; (iii) improvement in performance always *precedes* the ability to explain how to control the complex system; (iv) explicit, declarative information is only helpful in improving performance in cases where complex tasks involve few and obvious variables; and (v) implicit practice at the relationships underlying the algorithms is beneficial. In sum, the findings of a pervasive implicit mode of learning, and the limited role of explicit learning in improving performance in complex control tasks, point to a default mode for SLA that is fundamentally implicit, and to the need to avoid declarative knowledge when designing L2 pedagogical procedures.

6 Conclusion

The difficulty for children in primary language acquisition is that they seemingly start from nothing, that is, they must bootstrap their way into language structure. Nonetheless, they are somehow able to rely upon the language which they hear for cues to segmentation. Their processing mechanisms appear to be constrained such that the approach they take is incremental and, consequently, efficient. In contrast, the difficulty for adults is that their special bootstrapping abilities have been altered by this experience. Left to their own devices, adults rely not upon signals in the language in the input, but on their native-language-processing strategies. That this happens is inevitable because developmental sharpening is a prerequisite to native listening ability. That is to say, what they have acquired is the ability to predict, on the basis of a few processible cues in rapid articulation, and in the face of a tremendous variation in the everyday speech of human beings, what the utterance is going to be. Moreover, research has generally shown that developmentally sharpened processing mechanisms are no longer tuned to the details of the input, that is, those "elements of surface structure" that are so critical to language acquisition. However, it is not clear that adult L2 learners are doomed to this fate, since something of their perceptual acuity remains.

What I have argued in this chapter is that the goal of L2 instruction should be to organize the processing space to enable adults to notice the cues *located in the input*, as they did when they were infants first breaking their native language code. A challenge for SLA researchers is to determine how the organization of L2 processing space might be implemented in pedagogical procedures. A guiding principle in this regard is to engage perceptual processes during implicit learning, rather than to promote metalinguistic awareness. Accordingly, "elements of surface structure" should be construed as prosodic packages, at least in the first few passes by the incrementally ordered mechanisms. Another suggestion is that, whereas processing-oriented instructional types, such as those in PI and FonF studies, have tended to target recalcitrant learning problems, organizing the input processing space early on in instructed SLA may help learners to revert sooner from their predictive adult comprehension mode to a more efficient acquisition mode.

A second challenge for researchers is to develop psycholinguistically relevant measures of SLA processing. For instance, if adults are to be guided to process efficiently and incrementally, then it becomes important to be able to measure the attainment of implicationally ordered processing preferences. For example, it appears to be important to develop a prerequisite sensitivity to salient, reliable prosodic cues to word boundaries in lexical acquisition, and to prefer pauses at phrasal and clausal boundaries. Only once these sensitivities have emerged should the processing space be organized such that learners focus attention on difficult-to-decipher input. Within this narrower processing space, learners can utilize less reliable, but nonetheless informative, cues to structure, such as distribution of syllables following weak stress or the position of function words with respect to content words in phrases. This is another instance of the phenomenon of developmental readiness, already discovered in the domain of SLA routes, now uncovered in the SLA processing domain.

Every day, adults, like children, must pay attention to cues in the language they hear. Operating in their L1, they are accustomed to using their acquired knowledge to predict utterance structure during comprehension. Acquiring a second language, however, requires a return to a discovery mode of processing, that is, perceiving clues to L2 structure found in the input. Thus, L2 learners must focus on elements of language. However, since L2 declarative knowledge can never be matched to the exacting needs of processing mechanisms, learners must so focus *themselves*. Nonetheless, L2 instruction, if conceived in SLA processing terms, can assist learners by organizing the processing space, hence perhaps re-enabling mechanisms that depend upon perceptual acuity.

APPENDIX: SPECIFIC MEASURES OF L2 ABILITY TYPICALLY EMPLOYED IN INSTRUCTED SLA

Constructed by the present author consulting (nearly all) the studies cited by Norris and Ortega (2000) and included in their final cohort.

Constrained, constructed responses (CCR)

Written "production":

- Cartoon task: unscramble words to make a sentence about a cartoon
- Cloze tests: missing verbs with infinitives provided below blanks
- Correct sentences

- Correction task: read a question, determine accuracy, reorder
- Fill in blank, given full translation
- Fill in blanks, given the English translation for blank filler and list of verb infinitives and translations
- Fill in blanks, given verb in its infinitive and told to use direct object pronoun
- Fill in the blank, given infinitive and the English translation
- Given a sentence and then expected to produce the dative alternate, if one is possible
- Given a situation, and told what to say in English, enter into a computer an L2 version
- Picture-based fill-in-blank sentence completion
- Picture-based sentence production, with patient given in prompt
- Rewrite sentences from active to passive
- See a picture and type in a sentence about it
- See a picture and type in or complete a sentence of two to three words, six to nine morphemes (reaction times and error rate)
- Sentence completion, verb infinitive provided
- Sentence combination, given two sentences; fill in the blank of new sentence combining two sentences
- Sentence completion, given the base form of a verb to use in the blank and its English translation
- Sentence completion: view pictures and using the second one, complete S, first part of which is the first picture

Oral "production":

- Structured interview with questions providing contexts for contrasting tense/aspect
- Oral picture description task, cued by cards with adverb to be used in sentence
- Shown a slide, and then asked to perform five named speech acts to that person
- Recall of isolated sentences
- Translation

Metalinguistic judgment responses (MJR)

- Judge sentences as correct or incorrect, untimed (accuracy)
- Judge correctness of sentences, timed (accuracy and RTs)
- Judge a sentence as correct or incorrect, giving a reason and circling errors (accuracy)
- Judge sentences as correct or not, timed (RTs) then later untimed with correction

Selected responses (SR)

"Comprehension":

- See four pictures and choose the one that matches the sentence (reaction time and error rate)
- Read or hear a sentence in L2; circle all possible referents from a list of English pronouns

- Read a dialog and select among four choices (by circling) for clitic pronouns
- Interpretation: hear a sentence and choose one of two pictures that matches meaning
- Interpretation: listen to a sentence and circle "past," "present," or "don't know"
- Look at a picture; hear a sentence and circle T/F to indicate match of picture to sentence
- Interpretation: choose one of four, given context, a dialog, and a question concerning implicature

"Production":

- Choose from a list the word to complete a sentence (past, present participials, and bare verbs)
- Circle "a," "an," "the," "0" for each blank in a list of unrelated sentences; same for a cloze paragraph
- Circle "a," "an," "the," "0" for each blank in a cloze paragraph
- Cloze test with missing verbs: circle one of two alternate forms provided under each blank
- Complete S by choosing among verbs and put in preterit, given infinitive and English translation
- Given a context, choose among three utterances which would be the appropriate one

Other:

- Recognize word: yes, no? (RTs)
- Semantic priming: see two words and decide whether the second one is a word (RTs)
- Translation: English–L2 pairs – same or different (RTs and accuracy)
- Word recognition: pairs of words: same or different (RTs)
- Read two sentences; decide whether one, the other, or both are correct (accuracy)

Free responses (FR)

Comprehension:

- Translate an L2 narrative into English

Production:

- Composition about a cartoon strip with prompt "Era diciembre del ano pasado . . ."
- Composition with prompt "Si j'etais . . ."
- Identify 10 differences between a set of pictures
- Interview: free conversation (R interviews S), role play (S interviews R) with prompt to be (more) polite
- Look at four pictures and ask questions until one of the four can be matched to an unseen picture
- Narration: describe video clip which has not been seen by the person who will read the description
- Production: picture description

- See pictures of four people; answer "who is number 1?"; see park scene and answer "Who is number X?"
- Write a narrative on a given topic
- Write a note from Mom to you about not cleaning room vs. note from you to landlord on having a dog

NOTES

1 While a discussion of the technique of meta-analysis is beyond the scope of this chapter, it is important to note that such an approach not only takes into account reported group differences, but also assesses effect size, thus enabling a more trustworthy level of scrutiny.

2 This excellent piece of research, carried out while the authors were doctoral students in the Ph.D. program in SLA at the University of Hawai'i, has won two awards: ACTFL's Pimsleur Award and the TESOL research prize.

3 A number of factors contribute to this bias: (i) that only published studies were included, excluding the so-called fugitive literature (e.g., unpublished doctoral research); (ii) that among the published studies, there were virtually none that reported null findings (suggesting that such manuscripts may not have been accepted for publication); (iii) only English-language journals were consulted, resulting in a research pool of studies of adult, university-level, mostly L2 English acquisition.

4 It is important to make two observations at the outset of the discussion of Norris and Ortega's findings: (i) the meta-analysis is a data-driven procedure, and so any problems with conceptualization of L2 instruction are due, at least in part, to the body of research being examined itself; (ii) their report of the meta-analysis includes far more than can be considered in this synopsis, so readers are urged to consult the original publication.

5 Another term sometimes appears in the effects-of-instruction literature: *form-focused*. Spada (1997), for instance, uses this term to encompass both focus on forms and focus on form. The difficulty with this notion – that is, that all types of attention to form be grouped – is that the psycholinguistically relevant distinction made clear here by Doughty and Williams is lost.

6 This order should not be interpreted as involving statistically significant differences between contiguous combinations. The only real difference was between all explicit and all implicit instructional types.

7 Like any other type of memorized knowledge, L2 knowledge learned in this way would be expected quickly to be forgotten. While not enough studies included delayed post-tests, a few studies have shown that explicitly learned knowledge, indeed, is forgotten, unless the feature is subsequently encountered in the input for a period of time (Lightbown, Spada, and White, 1993; Spada and Lightbown, 1993).

8 For example, L2 learners throughout the world are faced with an enormous amount of non-native input.

9 This impressive body of research includes a wide range of cross-linguistic comparisions. For the sake of simplicity, I will limit the discussion to studies of English, French, and Japanese.

10 A number of other language-specific processing strategies have been identified. English speakers have more difficulty discriminating word-medial vowels than word-medial consonants, even when listening to non-native languages with small inventories of clear vowels. The explanation for this is one of an effect of acquisition: since vowels are unreliable cues in English, the ability to detect them is not developed (Cutler and Otake, 1994). Similar findings for other language-specific strategies include vowel co-occurrence restrictions in Finnish and phonotactic constraints in Dutch, German, and Cantonese (see Cutler, 2001, for details).

11 This view is now held by the pioneer in implicit learning research, Arthur Reber.

12 In addition to the disentanglement offered by starting from the assumptions that implicit learning exists and coexists with explicit learning, a further advance is made by separating implicit learning from implicit memory. Frensch (1998, p. 49) argues persuasively that the following definition of implicit learning – one that is restricted to learning (as opposed to learning and retrieval) – is the scientifically most valid: "The non-intentional, automatic acquisition of knowledge about structural relations between objects or events" (see also Segalowitz, this volume).

13 Advances in cognitive neuroscience may enable separate observation of the two types of learning.

14 Results were as follows: for the explicit model builders with discrimination practice: 83 percent on classification, 45 percent generation, hit rate = 43 percent; and for those model builders with generate practice: 85 percent on classification, 45 percent generation, hit rate = 50 percent. For the memorizers with discrimination practice: 74 percent on classification, 38 percent generation, hit rate = 59 percent; and for those memorizers with generate practice: 90 percent on classification, 64 percent generation, hit rate = 71 percent.

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