Perspectives from Formal Linguistics on Second Language Acquisition

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The Oxford Handbook of Applied Linguistics (2 ed.)

Edited by Robert B. Kaplan

Abstract and Keywords

The importance of formal linguistics on second language acquisition is the basis of this article. Before considering the contributions of formal linguistics to the study of second language acquisition, a definition of formal linguistics is necessary. Linguists disagree on the scope of formal linguistics, so any definition of the field will be controversial. For clarity, this article understands formal linguistics to be a theory of natural language that meets the requirements of explanatory adequacy. Linguistic theories have an “essential but not exclusive” role to play in studies of language acquisition. Their position is adopted in this overview—formal theories have a major role to play in one sub domain of a general theory of SLA. Linguistic competence is the tacit knowledge of the abstract properties of the language(s) we speak. Formal linguistics does not address issues of language use directly. Formal linguistic theory has a crucial role in the explanation of second language linguistic competence.

Keywords: formal linguistics, second language acquisition, applied linguistics, linguistics, natural language, linguistic competence

1. Introduction

Before considering the contributions of formal linguistics to the study of second language acquisition (SLA), a definition of formal linguistics is necessary. Linguists disagree on the scope of formal linguistics (even within a theory of syntax; R. Van Valin and La Polla, 1997: 12-15), so any definition of the field will be controversial. For clarity, this chapter understands formal linguistics to be a theory of natural language that meets the requirements of explanatory adequacy (Chomsky, 1981, 1986; Van Valin and La Polla, 1997). A formal grammar is an explicit description of a speaker’s knowledge of his or her
language(s); it means that all the properties are specified fully and precisely as a system of operations on linguistic categories (C. Hall, 1995: 171). The grammar will achieve explanatory adequacy if it can account both for how the semantics, morphosyntax and phonology of language derive from the grammar and how the grammar might have arisen in the mind of the speaker (Van Valin and La Polla, 1997: 8). Formal linguistics, then, seeks the answers to two main questions: “What is the content of linguistics knowledge?” and “How does that knowledge arise in the mind of the speaker—in other words, how is it acquired?”

Many researchers have written on the relationship between formal linguistics and second language acquisition; this review owes much to previous work, which readers should also consult (Cook and Newsom, 1996; Epstein, Flynn, and Martohardjono, 1996; Gregg, 1989; Lightbown and White, 1987; L. White, 2003). Lightbown and White (1987: 483) wrote that (formal) linguistic theories have an “essential but not exclusive” role to play in studies of language acquisition. Their position is adopted in this overview—formal theories have a major role to play in one subdomain of a general theory of SLA: the development and ultimate attainment of linguistic competence. Linguistic competence is the tacit knowledge of the abstract properties of the language(s) we speak. Formal linguistics does not address issues of language use directly; that is, it does not claim to be a comprehensive theory of communicative competence (Canale and Swain, 1980; Hymes, 1972a) but of only one subcomponent of communicative competence. Performance on language-related tasks is of great interest for what it reveals about underlying competence. It is worth emphasizing, as others have, that formal approaches neither deny the importance of pragmatics and sociological constraints in language use and learning, nor do they underestimate their importance in a unified theory of SLA; they simply do not claim to address them (Schwartz, 1999).  

Formal linguistics has contributed to SLA in the following ways:

First, it has provided a detailed description of principles underlying human languages, particularly in the area of sentence-level morphosyntax and phonology. With these descriptions, researchers can make falsifiable claims about the nature of second language (L2) competence. Formal theory also provides a framework for investigating how that knowledge is related to native language (L1) competence and to linguistic universals.

Second, through various detailed linguistic descriptions, researchers have been able to discover facts about second language grammars that had not previously been described, much less explained.
Third, research that is grounded in formal linguistics has created an evolving methodology for evaluating L2 grammar and enabled the field to adopt methods from such other disciplines as psychology.

Finally, in some cases, questions in formal linguistics have led to the development of materials and interventions in instructed second language acquisition (Toth, 2000, 2008; Trahey and White, 1993; L. White, 1991a, 1991b).

2. Morphosyntax

Most formal linguistic research in second language acquisition has been conducted within the principles and parameters paradigm (Chomsky, 1981, 1986) and its successor theory, minimalism (Chomsky, 1995; Marantz, 1995). I focus on three main areas. The first area concentrates on the development of a class of grammatical categories called functional categories and the relationship between the development of these categories, the acquisition of morphology, and word order. The second area focuses on second language learners' knowledge of constraints on wh-questions. These two areas are only examples, and interested readers should consult L. White 2003 for recent summary research concerning formal theories of syntax and morphology.

2.1 Functional Categories and the Development of Morphosyntax

In principles-and-parameters (P&P) syntax, the morphosyntactic system consists of principles that determine the order and combination of syntactic categories into sentences and constrain reordering operations and possible interpretations. In addition to these principles, the theory includes a lexicon in which words are divided into two basic types: open-class, lexical categories (noun, verb, adjective, adverb) and closed-class, functional categories (FCs). One can think of the lexical categories as the “bricks” of a sentence and the functional categories as the “mortar” that holds the bricks together.
and affects how they are interpreted. More specifically, functional categories have been proposed as the hosts for such free and bound grammatical morphemes as determiners (the, a), complementizers (whether, that, if), negation, tense, aspect, agreement and so on. Early formulations of P&P syntax contained two important functional categories. The first one is the complementizer phrase (CP), which is the outer “shell” of the clause; in English it is a position to which auxiliaries and question words can move in interrogative sentences. The second is the inflectional phrase (IP), which was the host of tense, number, and agreement. Pollock 1989 and Chomsky (1991) proposed that IP be split into separate categories of tense, agreement, and even aspect. Hence, the formal description of a clause for English will appear as in figure 10.1 (Marantz, 1995: 364), where AgrS = subject agreement, and Agr O = object agreement:

(p. 146) Functional categories, and the “split” INFL categories in figure 10.1, are important because, by the mid-1990s, they had become the part of universal grammar where constrained variation among languages was accounted for. For some researchers, these functional categories are assumed to exist in all languages, even when those languages do not have overt morphemes to show that they exist. The claim is that they form the common core of the syntactic computational component of the language module.

In order to understand the role of functional categories in word order variation, consider first the sentences from French and German in (1) and (2). The descriptive generalization to be made is that the verb “eat” is not next to the object NP, “beef,” in sentences with questions, negation, and with an adverb.

(1)  
   a. Mange- t-il le boeuf?  
      eats he the beef  
      “Does he eat beef?”  
   b. Il (ne) mange pas le boeuf.  
      He (ne) eats not the beef  
      “He doesn't eat beef.”  
   c. Il mange souvent le boeuf.  
      he eats often the beef  
      “He often eats beef.”  
   d. Il a mangé le boeuf  
      he has eaten the beef  
      “He has eaten the beef.”

(2)  
   a. Ist er Rindfleisch?
eats he beef?
“Does he eat beef?”

b. *Er ißt nicht (kein) Rindfleisch
he eats not (no) beef
“He doesn’t eat beef.”

c. *Er ißt oft Rindfleisch
he eats often beef
“He often eats beef.”

d. *Er hat das Rindfleisch gegessen
he has the beef eaten
“He has eaten the beef.”

Although both French and German permit the verb to be separated from the object, note that in German the verb phrase is head-final; this means that in the abstract representation of all clauses, the verb comes after the direct object NP in German. This is clear in the “surface” structure of some clauses: note that “eaten” appears after the object NP “the beef” in (2d). I will say more about this directly.

(p. 147) In contrast, languages like English require the finite verb to be next to the object. The English glosses and translations of the examples in (1) and (2) show that English employs “do” support for questions and negation. The examples in (3) through (6) show that Chinese behaves much like English with respect to the placement of the main verb and the object. However, Chinese uses no auxiliary for negation or “yes/no” questions.

(3)

a. Bao Yu xihuan Dai Yu ma?
Bao Yu like Dai Yu Question Part?
“Does Bao Yu like Dai Yu?”

b. *Xihuan Bao Yu Dai Yu
like Bao Yu Dai Yu
Intended: “Does Bao Yu like Dai Yu?”

(4) Zhang San bu xihuan niurou.
Zhang San not like cow-meat
“Zhang San does not like beef.”

(5)

a. Li Si changchang chi júzi.
Li Si often eat orange
“Li Si often eats oranges.”
b. *Li Si chi changchang jüzi.*
Li Si eat often oranges.
Intended: “Li Si often eats oranges.”

(6) Huangdi zuotian qu le Nanyue
emperor yesterday go ASP South Mountain
“The Emperor yesterday went to the South Mountain.”

The theory of functional categories explains these differences in word order as follows. Functional categories are the host of syntactic features such as [±wh] for questions in CP and [±PAST] in TP. Functional category features may be “strong” or “weak” in different languages (Chomsky, 1995: 348–354). In French and German the functional category TENSE is [+ STRONG]; in English and Chinese it is [-STRONG]. The specific tense value—for example, [±PAST]—on the verb must agree with the [±PAST] tense value of the functional category TP; otherwise the representation will be ungrammatical. This agreement occurs through a process of “checking” in which the verb “moves” up to the functional category. Features in [+ STRONG] functional categories must be checked before the representation is encoded in the phonology. The result is that the finite main verb appears in a position that is not next to its NP arguments in questions and in negative sentences. Weak features are checked after phonological processing, so the verb usually cannot appear in a position that is not directly next to the object in a sentence. Hence, the difference between French and German on the one hand and English and Chinese on the other can be represented schematically in (7) and (8). In French, V raises to C for yes/no questions, as shown in (1a). In German, the finite verb always moves to C, even in declarative, finite main clauses. This property of German explains the requirement that the verb is always the second constituent in a finite main clause.

\[
\begin{align*}
\text{Strong:} & \quad [\text{CP} [\text{C} [\text{TP} [T: [\text{TV}_1] [\text{ADV/NEG}] [\text{VP} [V' [V \text{[NP]]}]]]])] \\
\text{Weak:} & \quad [\text{CP} [\text{TP} [T: [\text{TV}_0] \text{ADV/NEG}] [\text{VP} [V' [V \text{[NP]]}]]]])
\end{align*}
\]

This theory has several strengths for SLA researchers: It describes structure with details that can handle a range of unrelated languages. The theory provides precisely defined categories and a single operation carried out on those categories to explain cross-linguistic variation in word order. It reduces several superficially unrelated structures (word order in question formation, negation and declarative clauses) to one simple property of the grammar, [±STRONG] functional category. The grammar is learnable based on existing knowledge of the categories provided by UG and the binary values of
the categories. In addition, the data available to the learner—for example, exposure to sentences such as those in (1) through (6) in the appropriate language—will trigger the correct strength value.

Not surprisingly, these proposals have formed the basis of intense debate in SLA about the status of such categories in second language development and the relationship of such knowledge to the acquisition of inflectional morphology and the position of the verb in the clause. The theory permits questions such as the following:

- Do second language learners show evidence of acquiring the correct strength value(s) of features in language they are learning across a range of structures?
- Do strength values of FCs transfer from the L1 to the L2 (L. White, 1991a, 1991b; Schwartz and Sprouse, 1996)?
- Does the acquisition of tense and agreement morphology coincide with the correct placement of verbs (Lardiere, 2000, 2006; Prévost and White, 2000; Sprouse, 1998)?
- Is there an advantage for native speakers of a language with a strong or a weak functional category system?

Note that such questions are more precise than a range of similar, but theoretically simpler, questions—“Are second language learners able to acquire tense and agreement?” or “Can second language learners acquire new word orders?”

A significant finding of research on the knowledge of functional categories in SLA since the work of L. White (1991a, 1991b, 1992) is that second language grammars seem to exhibit an optionality that first language grammars do not always show, at least in the end state (Sorace, 2000). For instance, it appears that learners of English as a second language permit the verb both to appear adjacent and nonadjacent to the verb. This behavior violates the expected pattern if learners know that weak features must be checked after phonological processing. Violations even occur with learners whose L1—for example, Chinese,—is also a weak feature language (Eubank et al., 1997).

The acquisition of German has been the focus of intense scrutiny because of its variable word order, richer (than English) inflectional morphology, and the availability of a large corpus of data from a variety of learners (Eubank, 1993; Schwartz and Sprouse, 1994). As pointed out already, in German the verb raises to the head of the CP (complementizer) in German main clauses but not in subordinate clauses. The finite verb must be the second constituent, but infinitives remain in the verb phrase, which is head-final. At the beginning stages, second language learners of German often fail to “raise” finite verbs; moreover, these verbs appear to lack inflectional morphology. To account for these facts, Vainikka and Young-Scholten (1994, 1996, 1998b) have proposed that the gradual
emergence of functional categories is the best account for the developmental facts both for morpheme order development and knowledge of L2 word order. They claim that L2 learners begin by building a grammar of the L2 that has only the lexical VP in figure 10.1. The initial acquisition of agreement would trigger the development of a functional projection and permits optional raising of the verb; this initial FP is not specified in terms of type but provides a position to which a verb may move and is the source of initial agreement marking. The acquisition of full inflectional paradigms would result in fully specified functional projections and obligatory raising if that is required by the language. Zobl (1998) adopts a similar proposal in his account of the acquisition order of morphemes in English by two Russian speakers.

In contrast, Schwartz and Sprouse (1994, 1996) argue that all functional projections, which are present in the L1, are transferred and available in the L2; in other words, the final state of the L1 serves as the basis for the beginning of the L2 grammar. Development is based on restructuring of the values of the functional categories or adding new ones from UG to cope with the new demands of the L2 input data.

Eubank (1993/1994), Eubank et al. (1997), and Beck 1998 adopt a third position: Knowledge of the functional categories exists, but the values [±STRONG] and [±TENSE] are somehow impaired. Eubank's claim seeks to account for the variability in the interlanguage data—in other words, sometimes morphemes are supplied correctly, sometimes the verb is in the correct position with regard to its complements; at other times learners make errors. Eubank does not attribute these errors to performance but instead claims that variability is inherent in the grammar and therefore must be accounted for in terms of the system of categories and features.

More recently, Hawkins and Chan (1997) and Hawkins and Liszka (2003) argue that abstract features [±wh] in CP and as tense in the L1 can be transferred and learned appropriately, but features that are new in the L2 cannot be acquired. This position is known as the failed functional features hypothesis. An example would be English-speaking learners of L2 French; tense is acquirable for them in French because their English L1 has tense, but noun class (gender) and adjective agreement marking in determiner phrases is not acquirable because English does not have masculine and feminine classes of nouns as French does, nor does it have noun-adjective agreement.

Hence, the issue of current interest is the knowledge learners have of the overt morphology associated with features such as tense and agreement. In other words, formal linguists see a difference between a representation of the syntactic functional category and the morphemes that represent the category. This is so because the morphophonological forms of tense and agreement vary and thus must be learned for each language (e.g., -ed in English, -te in German), and even within one language—for
example, the regular past “walk-walked” and irregular past “dive-dove.” Therefore, if learners do not produce them correctly, it does not necessarily mean that the knowledge of the abstract categories *themselves* is deficient. L. White 2003 points out that research in this area of the grammar is critical to the debate on whether adult L2 grammars (1) are fundamentally different in nature from L1 grammars (e.g., Bley-Vroman, 1989; Clahsen and Muysken, 1986), (2) show local impairment (e.g., Beck, 1998), or (3) are essentially the same in terms of the computational mechanism, but show either L1 influence or surface failure at the morphophonological level (e.g., Haznedar and Schwartz, 1997; Lardiere, 2000, 2006). This latter position is called *missing surface inflection* (MSIH).

One example of research in MSIH is Prévost and White 2000. Based on data from two Arabic-speaking learners of French, they argue that if the $\pm$strong values in functional categories are missing or “impaired” in some way, the position of finite and nonfinite verbs should be random and not predictable on the basis of the type of morphophonological inflection they carry. Their data show that “finite verb forms are associated with finite features and appear in raised positions. Nonfinite forms appear correctly in nonfinite contexts and also as a default in finite positions” (Prévost and White, 2000: 119). The lack of random placement suggests a syntactic system that is unimpaired.

Recall that Hawkins (Hawkins and Chan, 1997; Hawkins and Liszka, 2003) has suggested that if these abstract features are available in the first language of the learner, then acquisition should be easier than if they are absent. However, in a recent paper, Spinner and Juffs 2008 compare a Turkish learner of German (no gender in the L1) to an Italian learner (gender in the L1). They show that the acquisition of grammatical gender in German as a second language is not helped by having gender marking on nouns in the first language. Spinner and Juffs suggest the need to consider a range of other issues where functional category acquisition is involved. These factors include inadequate lexical learning, mapping difficulty, processing pressure, and parsing errors that cause inflectional paradigms to be inadequately learned.

Although no consensus on the exact status of the development of functional categories yet exists, the framework nevertheless permits research on what learners know and when they know it. It is worth reemphasizing that such theories permit researchers to ask questions about second language development in general and not just questions concerning the acquisition of a specific language or a specific structure. Global questions are made possible because functional category theory constitutes a theory about all human languages, not just about English or Indo-European languages. As such, the use of the theory had been a significant step toward a general theory of SLA for this domain.
Hawkins (in press) concludes his overview of research in this area by drawing attention to the results that these formal approaches have produced: (1) It is clear that the forms learners use when they speak is not a direct reflection of their underlying morphosyntactic system, and (2) it is not the second language input alone that contributes to the development of their systematic knowledge. He suggests that future research will continue to tackle the question of whether L2 grammars suffer from an underlying deficit (failed functional features), or whether there are more superficial problems of lexical learning of the correct forms (missing surface inflection). Future questions will be driven by an exploration of what relationship exists in L2 grammars between the different levels of abstract syntactic categories and more overt morphophonological representation.

2.2 Wh-Movement: An Enduring Source of Theory Development and Empirical Research

The study of the syntax of human languages has focused to a large degree on clause structure and the constraints governing the interpretation and the ordering of constituents within and across clause boundaries. It has been argued that some of the constraints must be part of a specific linguistic endowment—namely, universal grammar (UG; Chomsky, 1981, 1986, 1995; papers in Hornstein and Lightfoot, 1981). This claim is based on the finding that adult speakers know more about the clause structure and meanings of their native language than they could possibly have induced from the input they receive. This argument is now well known as the “poverty of the stimulus” or the “logical problem of language acquisition.”

Hence, the second question that formal theories of morphosyntax have sought to answer is whether learners of a second language have knowledge of constraints on representation that native speakers of that language have (L. White, 2003, 2007). One example is represented by knowledge of possible and impossible forms of wh-questions. A wh-question is a question that involves “who,” “what,” “why,” “how,” and so forth. This program of research on questions has endured for over 40 years, since the publication of Ross’s (1967/1974) work on constraints on wh-questions that evolved into a principle that has become known as subjacency (Chomsky, 1977). Ross showed that speakers know that sentences such as “Who does Mary know the doctor examined __ in the hospital?” are grammatical, whereas sentences such as “Who did the nurse meet the patient who the doctor examined __ in the hospital?” are not. The assumption is that the wh-word moves from the position indicated by a dash in each example to the front of the clause. Ross (1967/1974) pointed out that there must be something about the structure of the second ungrammatical sentence that prevents this movement. Children are never
taught the difference between sentences such as this, and in fact even the grammatical sentences of this type are very rare. Given the absence in the input for this kind of knowledge, Chomsky and other researchers have assumed that knowledge of constraints derives from built-in limits on the computational system. In other words, constraints on wh- movement are neither learned nor acquired but rather are part of universal grammar (de Villiers and Roeper, 1995).

The question in second language acquisition has focused on whether L2 learners know the same restrictions on wh- questions as native speakers do. A particularly interesting question has been whether speakers of languages such as Chinese, Indonesian, and Japanese, which do not “move” a wh- word to the front of the clause to create a wh-question, also know constraints on wh- questions in English. In general, a consensus has emerged that they do know such restrictions and therefore UG is available to L2 learners, at least in this domain of grammar (Hawkins and Chan, 1997; Schachter, 1989). However, a question has remained concerning the acceptance of correct long-distance movement. In particular, learners were observed to be better at correctly accepting sentences such as (9), containing an object moved from an embedded clause, than (10), containing a subject moved from an embedded clause:

(9) Who does the nurse think the doctor saw __ in the hospital?
(10) Who does the nurse think __ saw the patient in the hospital?

If the learners have no knowledge of long-distance wh- movement, they should reject both. This finding led some researchers to consider whether the problem with sentences such as (10) was related to processing. Schachter and Yip 1990 first pointed out that there was a tendency for learners to reject subject extraction in (10) and that this might be a processing problem. This view was supported by White and Juffs' 1998 data. However, given that learners were reading whole sentences, it was unclear where the problem in processing might be. Juffs and Harrington 1995—in a study that was published before, but actually carried out after the White and Juffs 1998 study—used a technique from mainstream psycholinguistics to look at this issue. Specifically, they asked learners to read sentences word by word. They found a similar pattern of accuracy in acceptance of grammatical wh- movement, with subject extraction being more difficult. More important, they found that the Chinese speakers in their experiment had greatly increased reading times on the embedded verb (e.g., “saw” in [10]).

Juffs and Harrington 1995 attributed this difference between native speakers of English and Chinese speakers to a lack of familiarity with “wh- movement” in surface syntax. In addition, given the assumptions concerning reading, in which each word is integrated into a sentence word by word, with revisions in structure being made only when
necessary, subject extraction involves manipulating both case and semantic role features. In other words, a subject extraction required the reader to switch from an analysis of “who” as the object of the verb “think” to “who” as the subject of the verb “saw” in (10). However, Juffs and Harrington did not have learners whose first language was one that did in fact have wh- movement with which to compare. Consequently, Juffs 2005 recruited participants whose language did have wh-movement. These learners read and judged sentences such as these:

(11)

a. *Who did Tom believe the claim that Ann saw __ at school? (noun complement)
b. *Who did Tom hear the woman who saw __ on television? (relative clause)
c. *Who did Ann meet the teacher after she saw __ last week? (adjunct)
d. Who does the nurse know __ saw the patient at the hospital? (finite, subject)
e. Who does the nurse know the doctor saw __ in his office? (finite, object)
f. Who does the boss expect __ to meet the customers next Monday? (nonfinite, embedded subject)
g. Who does the boss expect to meet __ next Monday? (nonfinite, object)

Juffs found that the learners all knew that sentences in (a)-(b) were not possible. This confirms previous findings. However, once again, the sentences containing a subject wh-word from an embedded clause proved to be more challenging. This fact is clear from the reading times for each word. Figure 10.2 provides an illustration of subject extraction that can be compared to the object extraction sentences in figure 10.3.

The spike in reading time on the embedded verb that can be observed in figure 10.2 is similar to that found in Juffs and Harrington 1995; however, the Japanese subjects also show an increase in reading time on the head noun of the object in figure 10.2, whereas all other learner groups show a decrease in reading time. Results such as these suggest that all learners, regardless of L1, have problems with subject extraction. In other words, it is not the presence or absence of wh- movement in the L1 that is the principal problem.
Juffs (2004, 2005, 2006) and Rodríguez 2008 propose that similarities between L1 and L2 processing indicate that L1 and L2 processing share some similar features such as structure dependency. However, Clahsen and his colleagues (e.g., Marinis et al., 2005; Silva and Clahsen, 2008) have argued strenuously against this view. They have suggested that second language learners have only “shallow” processing both in syntax and morphology. In other words, L2 learners do not use structural principles that are used by L1 speakers to process language. Clahsen and Felser (2006a) summarize a range of experiments with different structures in which second language learners fail to process in a way that is predicted by linguistic theory. Regardless of the outcome of these debates, it is formal linguistics, together with methods from mainstream psycholinguistics, that permits researchers to ask detailed questions about representation and processing in a second language. 

One potential drawback to all of these findings is that linguistic theory evolves as formal linguists develop and abandon models of competence. L. White (2000: 4) does not believe that such changes are always detrimental; however, Schwartz and Sprouse (2000) point out that analyses of interlanguage data that rely only on theory internal analysis cannot show conclusively that learners' grammars are, or are not, constrained by
principles that constrain first language acquisition. Instead, they advocate concentrating on the logical problem of acquisition in SLA: that is, showing that the learners' knowledge of the L1 either does, or does not, go beyond the input data they receive from data concerning wh- movement and interpretation. For example, recent work by Dekydtspotter and colleagues (e.g., Dekydtspotter, 2001; Dekydtspotter and Sprouse, 2001) has sought to show that very subtle semantic interpretations of quantifier phrases, described as formal operations in logic and constrained by syntax, are available to second language learners. In this case, a formalism is also needed to describe the grammar that is the target of acquisition and that permits researchers to ask sophisticated questions about L2 knowledge.

3. Semantics and the Lexicon

It is uncontroversial that the links between sounds and concepts is completely arbitrary, and that new words have to be learned from the linguistic environment. However, recently some researchers have argued that not all aspects of lexical knowledge are entirely arbitrary (Gleitman, 1990; Pinker, 1989; see Juffs, in press, for a complete review of lexical issues in SLA). Hale and Keyser (1993), Pinker 1989, and Jackendoff 1990 have proposed that the number of noun phrases and prepositional phrases that are permitted in a clause, as well as their position within the clause, are in part predictable from the underlying semantic representation of the main verb. They propose that a verb's meaning can be broken down into semantic concepts. They developed formal representations for “decomposing” the meaning of verbs, as well as operations on those representations that express the relationship between different sentence types. For example, English has a well-known alternation between some, but not all, locative verbs. Locative verbs describe the movement of an object to a destination or location. The issue with locative verbs is that some allow one syntactic pattern, in which only theme (the moving object) can be the direct object in the syntax (12), whereas others allow only the goal (the destination of movement) to be the direct object (13).

(12)

\begin{itemize}
  \item a. John poured the soup into the bowl.  
  \qquad [X ACT + effect [Y GO [PATH]]]
  \item b. ⋆ John poured the bowl with soup.
\end{itemize}

(13)

\begin{itemize}
  \item a. John covered the bed with the blanket.
\end{itemize}
[X ACT + effect [Y GO [STATE]]]

b. • John covered the blanket onto the bed.

(14)

a. John sprayed insecticide onto the tree.
   [X ACT + effect [Y GO [PATH]]]
   b. John sprayed the tree with insecticide.

(15)

a. John loaded the hay onto the truck.
   b. John loaded the truck with hay.
   [X ACT + effect [Y GO [STATE]]]

Underneath each sentence, a proposed semantic decomposition is provided. Verbs that have the decomposition structure [GO [PATH]] in (12) allow only theme direct objects; those with meaning components in (13) [GO [STATE]] allow only goal direct objects. Verbs of both classes may allow alternations that are expressed as a rule that changes semantic structure from the type in (12) to the type in (13) or vice versa. This is possible only if verbs belong to narrow classes within the main semantic classes of (12) and (13), in which the movement of a specific type of theme is specified. For example, *spray* in (14) belongs to a class that specifies ballistic motion in a specified trajectory; *load* in (15) belongs to a class that involves a mass that is put onto/into an object intended for that use. Pinker maintains that verb learning involves acquiring these narrow range classes and that once these classes are established errors will cease.

Recently, knowledge of semantic constraints of this type has been investigated by researchers in SLA (Juffs, 1996; Montrul, 1998, 1999). An overview of this research and the results that have been achieved so far is available in Juffs (2000) and, more recently, in L. White 2003. A full account of the details is not possible in this chapter, but it appears that language learners are able to acquire new semantic structures in the L2 lexicon, even if they are not instantiated in the first language grammar. The important point in the context of this chapter is that these developments show the clear role theory plays in SLA research—until a theory of a certain type of linguistic knowledge develops, researchers have no way of asking interesting or important questions in the relevant domain. Formal theories are not merely useful; they are a requirement for investigation of the nature of SLA.
4. Phonology

Studies of L2 phonology have not been as numerous as studies of morphosyntax. However, with new developments in theories of the internal structure of the segment and new theories of prosody, together with developments in acoustic recording and analysis, the field of second language phonology is rapidly developing (Archibald, 1998; Eckman, 2004; Hansen-Edwards, Zampini and Zampini, 2008). The Hansen-Edwards and Zampini volume is an important recent collection of articles on theory, and includes chapters on the increasingly important role of technology in L2 perception and production research. Several proposals concerning L2 phonology have been made in the past 20 years based on both perception and production data from learners. These proposals include Best's (1995) perceptual assimilation model, Flege's (1995) speech learning model (see Flege et al., 2005, for a recent paper), Major's (2001) ontogeny model, and Hancin-Bhatt and Bhatt's (1997; Hancin-Bhatt, 2008) model based on optimality theory. Finally, as in syntax studies, processing and frequency in phonology is becoming a focus of attention (e.g., Trofimovich, Gatbonton, and Segalowitz, 2007). This section highlights three areas in which recent advances have been made.

4.1 Segments

It is well known that some languages employ certain (sounds) segments as part of the system of contrasts (i.e., the segments are phonemes), whereas these same sounds in other languages are merely phonetic variants of an underlying phoneme (allophones). For example, the sound [t] and aspirated [tʰ] are allophones of the phoneme /t/ in English, but they are separate phonemes in Thai and Chinese. French only has the plain phoneme /t/ and phone [t]. This formal distinction has been important in explaining L2 phonological development, and versions of it remain of interest in SLA to this day (e.g., Eckman, 2004, 2008). Standard generative theory, for example, the sound pattern of English (SPE; Chomsky and Halle, 1968), proposed that segments consisted of bundles of unorganized features, for example, [± voice], [±coronal]. This view of the segment was challenged because some features influence other segments beyond the specific segment with which they are associated and those immediately adjacent to it; for example, [+ nasal] and [+ round] can spread in predictable but constrained ways across multiple segments in nasal and vowel harmony, yet SPE theory provided no principled way of accounting for these phenomena (Goldsmith, 1976).
In the 1980 and 1990s, a segment's features were said to have an internal organization, known as feature geometry (e.g., Clements, 1985; Piggott, 1992). For example, one proposal is that features are organized into groups, as indicated in Figure 10.4. Like the schematic of functional categories in Figure 10.1, such geometry is assumed to be a part of universal grammar (UG) that limits the range of possible phonologies in human languages. It is meant as a constraint on the hypothesis space and a guide to interpreting the data from the language that the learner hears. However, not all languages will make use of all nodes in their representation of segments. For instance, C. Brown (1998, 2000) suggests that Japanese does not make use of the coronal node anywhere in its feature geometry. The absence of this node has implications for the acquisition of a second language that does make use of this node.

This theory of the internal structure of the segment has been particularly useful in giving precision to such problematic concepts as Flege's (1990, 1995) “old” versus “new” sounds (cf. Leather and James, 1996: 276, n. 1). For example, C. Brown (2000) uses feature geometry to discuss how the theory defines new sounds. She describes three experiments in which she claims to show that it is not the segmental level, but rather at the level of the node in features in which some more satisfying explanations can be reached concerning L1 phonological effects. For example, Brown shows that the well-known difficulty that Japanese speakers have with the [l] versus [r] contrast in English is due to the absence of the coronal node in the phonological representation of their L1. Although Chinese speakers do not have segments that are exactly similar to English [l] and [r], they are nevertheless more successful than Japanese speakers because the coronal node is present in the phonology of Chinese.

4.2 Suprasegmentals

Suprasegmental phenomena have also seen some considerable advances recently. In addition to Archibald's (1993) work on metrical parameters, there have been other developments in approaches to suprasegmental phonology (see papers in Hannahs and Young-Scholten, 1997; Hansen-Edwards, Zampini and Zampini, 2008). In their wide-
ranging and thorough review of L2 phonology, Young-Scholten and Archibald 2000 investigate knowledge of syllable structure in second language acquisition. They demonstrate that a theory of the syllable that includes internal structure (illustrated in figure 10.5) allows for interesting cross-linguistic comparisons and predictions to be made. The independence of syllable onsets from syllable rhymes has been especially relevant to SLA research.

Young-Scholten and Archibald 2000 explain that segments are associated with positions in syllable structure by two principles: (1) segments must attach to onset first; (2) other segments must attach to the onset until the vocalic peak is reached. This attachment must be in compliance with a segment sonority hierarchy (highest: stops-fricatives-nasals-liquids-glides VOWEL -glides liquids-nasals-fricatives-stops). Languages vary with respect to principle 2 in the number of consonants they allow in the onset. For example, Mandarin Chinese does not allow complex onsets (other than some restricted to glides), nor does it allow consonants in coda position other than alveolar and velar nasals.

Interestingly, Young-Scholten and Archibald 2000 link syllable structure with a theory of feature geometry of the type discussed in section 4.1. It is impossible to do justice to the sophistication of their analysis in this chapter, but a sketch of their ideas follows. They suggest that the acquisition of a contrast between liquids ([l] and [r]) at the level of feature geometry, and the presence of such a contrast cross-linguistically, is related both to the acquisition of complex onset clusters and to the presence of such onset clusters in a particular language. In other words, the nodes used in the feature geometry of a language for phonemic contrasts have implications for syllable structure.

This fact about languages has implication for second language acquisition. Korean, like Japanese, does not make the [l]/[r] distinction and also does not allow complex onsets such as that for [pl] in figure 10.5. Finnish, however, does make the [l]/[r] contrast and like Korean does not allow complex onsets. Now, Korean-speaking learners of English make syllabification errors in speaking L2 English with complex onsets containing liquids; for example, in producing the words floor and plate, they insert a schwa [´] between the [f] and the [l] (and the [p] and the [l]), creating two syllables (e.g., floor is...
pronounced [f´lçr], and plate is pronounced [p´lejt]). However, the Finnish learner that Young-Scholten and Archibald 2000 report on does not do this even though complex onsets are disallowed in Finnish as they are in Korean. According to this analysis, then, the errors of Korean learners are attributable more to the structure of the segment inventory than to the phonotactics of syllable onsets. The analysis that Young-Scholten and Archibald 2000 make here is not possible with simple accounts of cross-linguistic phonetic contrasts; rather, they claim that an explanation is possible only with a formal phonological representation.

The third area involved in the explanation of Ls data formal phonology is described by Hancin Bhatt and Bhatt (1997) and Hancin Bhatt (2008). They make the case for the role of the current dominant theory in phonology, optimality theory, in second language phonology studies. Optimality theory, like most current generative approaches, sees universal grammar as a set of constraints on possible human languages. The theory of constraints is grounded in acoustic and articulatory phonetics as well as in frequency and typological data from a variety of languages. As Hancin-Bhatt (2008) points out, optimality theory consists of two basic forms of constraints. The first type concerns markedness constraints that describe universal tendencies. For example, two markedness constraints are (a) the onset constraint, which stipulates that syllables must have onsets, and (b) the no coda constraint, which stipulates that syllables may not have codas. The second family of constraints is the so-called faithfulness constraints, which are constraints on how input is processed and represented. Two faithfulness constraints are (a) MAX-10, which states that the output must preserve all segments in the input (i.e., no deletion), and (b) DEP-10, which states that all output segments must have counterparts in the input (i.e., no insertion—for example, epenthesis is not permitted). In this theory, all constraints can be violated, and in general the markedness constraints have more force than the faithfulness constraints. Language variation is captured by the degree to which each language can violate these constraints and in the ranking of the importance of the constraints within a particular language. For example, Chinese and English obviously vary with respect to the coda constraint, with English being more marked than Chinese because it allows highly complex codas that can contain voiced stops.

This approach makes interesting predictions for second language acquisition that appear to be supported by the data. For example, Chinese-speaking learners of English as a second language have difficulty with complex syllable codas. Syllable codas in English violate a markedness constraint; one way for the Chinese learner to handle this is to violate a lower ranked faithfulness constraint, DEP-10, “no epenthesis.” This conflict in constraint ranking leads to the well-known errors of Chinese learners who will say [bQg´] instead of [bQg] for bag: the voiced coda [g] violates markedness in the L1 and is resolved by violating DEP-10, which prohibits epenthesis.
Overall, Hancin-Bhatt (2008) suggests that a progressive reordering of constraint rankings can explain the developmental patterns in L2 phonology. Initially, the L2 is represented by the L1 constraint rankings, with beginning stages being dominated by markedness constraints and reranking (= reordering of constraints) from the L1 to the L2 input. As L2 phonological development progresses, the L2 input is represented more precisely, and faithfulness constraints assume greater importance than markedness constraints.

5. Methodological Contributions

In addition to production data, the standard tool for investigating competence has been the grammaticality judgment task. However, it is well known that there are several problems with using such tasks out of context (e.g., Birdsong, 1989). In response to these difficulties, researchers have developed the use of pictures to give context to the sentences that they are investigating. In this way, they can be more certain that learners’ intuitions are the relevant ones. Researchers have also developed narrative contexts that force certain interpretations on the sentences that learners are supposed to judge (L. White et al., 1997). Bley-Vroman and Loschky (1993) suggest that this type of task may be used in developing pedagogical materials because they force learners to pay attention to both form and meaning.

The past 10 years have seen the increasing use of methods from psycholinguistics in L2 acquisition (Juffs, 2001; Marinis, 2003). The methods include eye tracking and self-paced reading, event-related potentials (ERP) that monitor brain activity during grammaticality judgments or processing of linguistic stimuli (e.g., Tokowicz and MacWhinney, 2005), and increasingly sophisticated truth-value judgment tasks in semantics. In phonology, acoustic phonetics technology that measures formant structure and ultrasound technology that measures tongue position and laryngeal activity (e.g., Gick, Bernhardt, Bacsfalvi, and Wilson, 2008) are being used to evaluate second language phonetic and phonological systems.

6. Conclusion

Formal linguistic theory has a crucial role in the explanation of second language linguistic competence and performance. Without it, researchers cannot hope to ask sophisticated questions about what it means to know and use a second language. Formal
theory captures generalizations about the structural properties of languages and makes it possible to ask whether these generalizations hold in the development of second language grammars as well (Schwartz, 1999). As linguistic theory develops and incorporates more views from alternative perspectives (e.g., Jackendoff, 2002), it is becoming possible to map more and more aspects of a learner's interlanguage grammar(s) and to ask more precise and more nuanced questions. The field has reached the stage at which dialogue between frameworks such as generative linguistics and more functional perspectives is possible as Juffs 2004 and Ellis 2005 have suggested. Moreover, linguistic theory provides the constructs that can be exploited by new technologies and experimental techniques. Although the results of this research often do not have immediate pedagogical applications, the results can inform an understanding of the process of second language acquisition and provide a background for teachers to understand the progress or lack of progress learners make in the classroom.

Acknowledgments

The research for this article was supported in part by a grant to the Pittsburgh Science of Learning Center from the National Science Foundation, award number SBE-035442, for which I am grateful.

Notes:

(1.) It is possible that pragmatics and semantics cannot be completely excluded from a theory of grammar, even in the narrowest sense of constraints on formal operations on linguistic categories (e.g., Van Valin and La Polla, 1997).

(2.) Other candidate theories are lexical-functional grammar (Bresnan, 2001) and head-driven phrase structure grammar (Pollard and Sag, 1994). See Borsley 1998 for a comparative treatment of generative theories.

(3.) However, it is not the case that all languages have all FCs. For example, L. White (1996: 341) assumes that French has functional projections that host clitic pronouns, but that English does not.

(4.) See articles in P. Robinson and Ellis 2008 for alternative views of the issue of innateness.

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