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A UNIFIED APPROACH TOWARD THE DEVELOPMENT OF SWEDISH AS L2

A Processability Account

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This paper has two main objectives: (a) to put the vast body of research on Swedish as a second language (SSL) into one coherent framework; and (b) to test the predictions deriving from processability theory (Pienemann, 1998a, 1998b) for Swedish against this empirical database. We will survey the 14 most prominent research projects on SSL covering wide areas of syntax and morphology in longitudinal and cross-sectional studies. This survey is the first to be carried out for Swedish, and it will bring the body of two decades of research into one unified framework. We proceed in the following steps: First, a brief summary of processability theory is given. Then the theory is used to generate a unifying framework for the development of the specific L2 grammatical system (Swedish). Finally, the new framework is tested in the above-mentioned empirical studies.

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Research on Swedish as a second language has been conducted for about 20 years. There is a large body of studies, longitudinal as well as cross-sectional, that are based on hundreds of informants from a wide variety of first language backgrounds. Many of these studies address issues related to the development of morphosyntactic forms.

Although these studies, which are mostly descriptive, represent a very large body of research, they have never been compiled and presented in one unifying framework. In other words, at the descriptive level they have not been used to establish an overview of the development of Swedish grammar in the second language context. Neither have these very extensive databases been utilized in the construction of components of a theory of SLA. This is quite surprising, considering the prominence of some of the work on German as a second language in the international arena throughout the 1980s and 1990s.

In this paper, we show that the large body of research on Swedish as L2 is a very useful empirical point of reference for theory construction in the SLA field. The objective of this paper is to paste together as much as possible of the picture of developing Swedish as L2 and to use this empirical base to test the predictions made by processability theory (Pienemann, 1998a, 1998b) about the development of morphosyntactic forms. Through this test, processability theory will be confronted with a large set of data in a new L2 with a varied set of L1 backgrounds.

A BRIEF SKETCH OF PROCESSABILITY THEORY

For reasons of limited space, it is not possible to lay out in detail the mechanics of processability theory in this paper. Instead, we confine ourselves to a brief summary. The core of processability theory is a hierarchy of language-processing procedures. That hierarchy, in turn, can produce predictions for the processability of linguistic structures when it is implemented in a Lexico-Functional Grammar (LFG) treatment of the target language grammar. A full exposition of processability theory is available in Pienemann (1998b) and a detailed summary can be found in Pienemann (1998a).

The Wider Context of Processability Theory

Learnability is defined as a purely logico-mathematical problem (e.g., Berwick & Weinberg, 1984). Such a perspective ignores the fact that this problem has to be solved, not by an unconstrained computational device, but by a mind that operates within human psychological constraints.

In this paper we utilize a theory that adds to learnability theory the perspective of processability—that is, processability theory (Pienemann, 1998a, 1998b). In Pienemann's view, the logico-mathematical hypothesis space in which the learner operates is further constrained by the architecture of human language processing. Formally possible structures will be produced by the language learner only if the necessary processing procedures are available that are needed to carry out, within the given minimal time frame, those computations required for the processing of the structure in question. Once one can spell out the sequence in which language-processing routines develop in the learner, one can delineate those grammars that are processable at different points of development.

The architecture of human language processing therefore forms the basis for processability theory. In this perspective, the language processor is seen with Kaplan and Bresnan (1982) as the computational routines that operate on (but are separate from) the native speaker's linguistic knowledge. Processability theory deals primarily with the nature of those computational routines and the sequence in which they become available to the learner. It will be argued that language acquisition incorporates as one essential component the gradual acquisition of those very computational routines. In other words, the task of acquiring a language includes the acquisition of the procedural skills needed for the processing of the language. It follows from this that the sequence in which the target language (TL) unfolds in the learner is determined by the developmental sequence of processing routines that are needed to handle the TL's components.

In the rationalist tradition, learnability analyses have in the past been based on four components that must be specified in any learnability theory (e.g., Pinker, 1979; Wexler & Culicover, 1980): (a) the target grammar, (b) the data input to the learner, (c) the learning device that must acquire that grammar, and (d) the initial state.

The idea behind this is that a learnability theory must specify how a learner develops from an initial state to the target grammar with the available input and the given learning device.[1]

The rationale for assuming these components is rooted in the way in which learnability theory has been formulated in response to the logical problem in language acquisition (see Wexler, 1982). The logical problem basically describes the following paradox: Children acquire the basic principles of their native language in a relatively short period of time and on the basis of limited linguistic input, although many of these principles are considered impossible to infer from the observations made by the learner.

It has been noted by several rationalist researchers (e.g., Clahsen, 1992; Felix, 1984, 1991; Gregg, 1996) that, besides linguistic knowledge, a theory of language acquisition must also explain what causes the development of the TL to follow a describable route. This explanatory issue has been referred to as the "developmental problem" (Felix, 1984).

Pienemann's fundamental point is that recourse needs to be made to key psychological aspects of human language processing in order to account for the developmental problem because describable developmental routes are, at least in part, caused by the architecture of the human language processor. For linguistic hypotheses to transform into executable procedural knowledge (i.e., a certain processing skill), the processor needs to have the capacity to process the structures relating to those hypotheses.

In other words, processability theory focuses solely on the developmental problem as an explanatory issue; it is not designed to contribute anything to the question of the innate or learned origin of linguistic knowledge or the inferential processes by which linguistic input is converted into linguistic knowledge. Instead, it is the sole objective of processability theory to determine the sequence in which procedural skills develop in the learner.

The fundamental point of viewing language acquisition as the acquisition of procedural skills has been made by several authors (Hulstijn, 1990; Levelt, 1978; McLaughlin, 1987; McLaughlin, Rossman, & McLeod, 1983; Schmidt, 1992). One might characterize the perspective of the above authors as the "procedural skills approach" to language acquisition.

The basic logic of this approach is as follows. The real-time production of language can only be accounted for in a system in which word retrieval is very fast and in which the production of linguistic structures is possible without any conscious or unconscious attention, because the locus of attentive processes is short-term (or immediate) memory, the capacity of which is limited to fewer operations than are required for most of the simplest utterances. Such language-production mechanisms therefore have to be assumed to be highly automatized. Given these psychological constraints on language production, second language development entails the process of automatization of linguistic operations. Processability theory represents an attempt at going beyond a general commitment to a procedural skill approach and at spelling out in a testable manner some of the key procedures of such an approach.

The Core of Processability Theory

Processability theory is based on a universal hierarchy of processing procedures that is derived from the general architecture of the language processor. This hierarchy is related to the requirements of the specific procedural skills needed for the TL. In this way, predictions can be made for language development that can be tested empirically.

The view on language production followed in processability theory is largely that described by Levelt (1989), which overlaps to some extent with the computational model of Kempen and Hoenkamp (1987). This model emulates much of Merrill Garrett's work (e.g., Garrett, 1976, 1980, 1982) and the corresponding section of Levelt's model is also based on it. The basic premises of this view are the following.

Premise 1. Processing components, such as procedures to build NPs, are relatively autonomous specialists that operate largely automatically. Levelt (1989) describes such grammatical procedures as "stupid," because their capacity is strictly limited to the very narrow but highly efficient handling of extremely specific processing tasks (e.g., NP procedures, VP procedures). The automaticity of these procedures implies that their execution is not normally subject to conscious control.

Premise 2. Processing is incremental. This means that surface lexico-grammatical form is gradually constructed while conceptualization is still going on. One key implication of incremental language processing is the need for grammatical memory. For the next processor to be able to work on the still incomplete output of the current processor and for all of this to result in coherent surface forms, some of the incomplete intermediate output has to be held in memory.

Premise 3. The output of the processor is linear, although it may not be mapped onto the underlying meaning in a linear way. This is known as the "linearization problem" (Levelt, 1983), which applies to the mapping of conceptual structure onto linguistic form as well as to the generation of morphosyntactic structures. One example is subject-verb agreement as illustrated in the sentence *She gives him a book*. The affixation of the agreement marker to the verb depends, among other things, on the storage of information about the grammatical subject (namely, number and person), which is created before the verb is retrieved from the lexicon.

Premise 4. Grammatical processing has access to a grammatical memory store. The need for a grammatical memory store derives from the linearization problem and the automatic and incremental nature of language generation. Levelt (1989) assumes that grammatical information is held temporarily in a grammatical memory store that is highly task specific and in which specialized grammatical processors can deposit specific information (e.g., the value of diacritic features). In Kempen and Hoenkamp's (1987) Incremental Procedural Grammar, the locus of the grammatical buffer is the specialized procedures that process NPs, VPs, and so on. Pienemann (1998a, 1998b) presented evidence from online experiments and aphasia in support of these assumptions.

The process of incremental language generation as envisaged by Levelt (1989) and Kempen and Hoenkamp (1987) is exemplified in Figure 1, which illustrates some of the key processes involved in the generation of the example sentence *A child gives a cat to the mother*. First of all, the concepts underlying this sentence are produced in the Conceptualizer. We will ignore the internal structure of this component of language generation for the purpose of this paper, except for several features of the output produced by the Conceptualizer.

In the example in Figure 1, the conceptual material produced first activates the lemma CHILD in the lexicon. The lemma contains the category information N, which calls the categorial procedure NP. This procedure can build the phrasal category in which N is head (i.e., NP). The categorial procedure inspects the conceptual material of the current iteration (the material currently

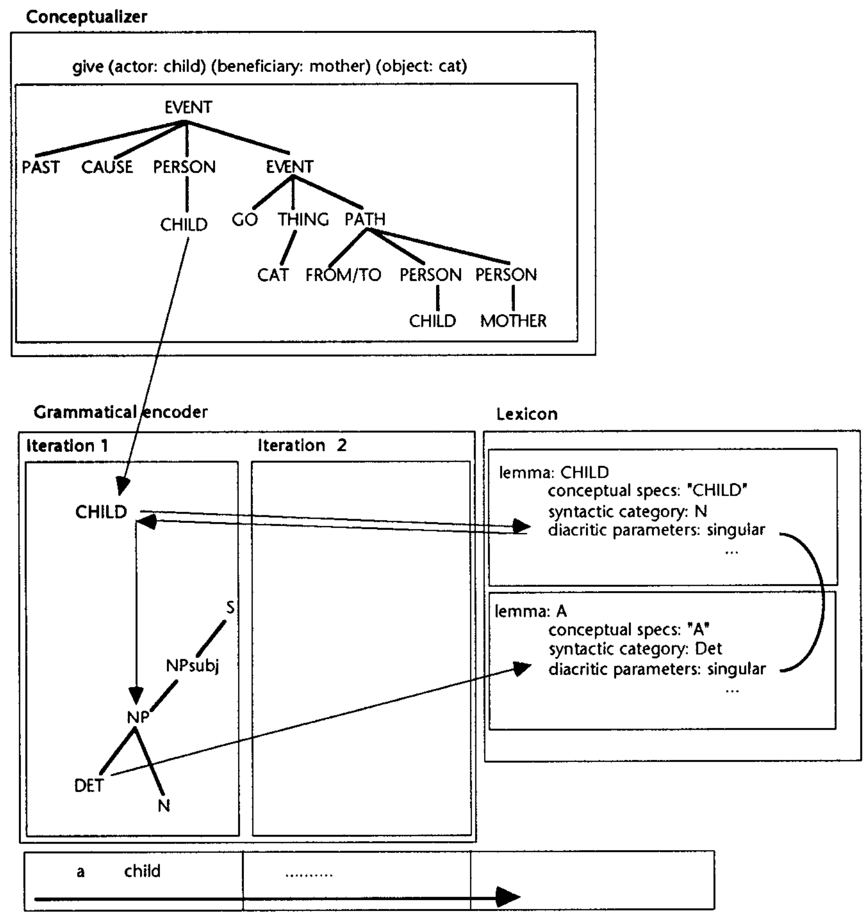

Figure 1. Incremental language generation.

being processed) for possible complements and specifiers and provides values for diacritic features, including those from the head of phrase. We will assume that the first referent is marked [–accessible]. This ensures that the branch Det is attached to NP, that the lemma A is activated, and that the lexeme *a* is inserted. Functorization Rules instigate the activation of free grammatical morphemes and the insertion of bound grammatical morphemes.

In the example in Figure 1, the attachment of Det to the NP node illustrates a key feature of the language-production process, which is crucial in the context of language acquisition: The selection of the lemma A depends partly on the value of a diacritic feature (singular) of the head being checked against that of the targeted lemma. The value of the diacritic feature is stored by the categorial procedure until it is checked against that of the modifier.

Our production process has proceeded to the point where the structure of a phrase has been created and the associated lemmata are activated. What is missing to make this the beginning of a continuous and fluent utterance is the establishment of a relation between the phrase and the rest of the intended message. This is accomplished by assigning a grammatical function to the newly created phrase. In fact, it is the categorial procedure itself that chooses its functional destination. This highlights the active nature of syntactic procedures.

Possible functional destinations are defined in a set of so-called Appointment Rules, which are also language-specific. The default for NP procedures is "subject of S." However, this does not quite solve the problem of allowing the tree created so far to grow into a sentence and to make the production of the sentence continuous. What is missing is the attachment of the NP to a higher node. In the example in Figure 1, NP_{subj} calls the procedure S, which accepts the calling NP as its subject and stores the diacritic features deposited in the NP, namely the values for person and number.

The outcome of all of this is depicted in a tree structure in Figure 1. While this structure is produced and the associated lemmata are activated, the next conceptual fragment would be processed in parallel and the output of the Formulator would be delivered to the Articulator. This means that new conceptualization occurs while the conceptual structure of the previous iteration is being produced. The whole process then moves on from iteration to iteration. This is what Kempen and Hoenkamp (1987) and Levelt (1989) mean by incremental production.

In the above summary of the process of grammatical encoding, one aspect was left aside—namely, word order. The definition of the acceptable set of word-order constellations for configurational languages is carried out by Word Order Rules, which coordinate the assembly of phrasal subprocedures. We assume that for nonconfigurational languages grammatical roles can be specified directly from the semantic roles specified in the conceptual structure.

To summarize, in the incremental process of language generation, the following processing procedures and routines are activated, among other things, in the following sequence: (a) lemma access, (b) the category procedure, (c) the phrasal procedure, (d) the S procedure, and (e) the subordinate clause procedure, if applicable.

Pienemann (1998b) hypothesized that this set of key grammatical encoding procedures is arranged according to its sequence of activation in the language-generation process and that this sequence follows an implicational pattern in which each procedure is a necessary prerequisite for the following procedures. The basic thesis of processability theory is that, in the acquisition of language-processing procedures, the assembly of the component parts will follow the above-mentioned implicational sequence. The hierarchical nature of this list arises from the fact that the procedure of each lower level is a prerequisite for the functioning of the higher level. A word[2] needs to be added to the target language lexicon before its grammatical category can be assigned. The grammatical category of a lemma is needed before a category procedure can be called. Only if the grammatical category of the head of a phrase is assigned can the phrasal procedure be called.[3] Only if a phrasal procedure has been completed and its value is returned can the function of the phrase (subject, object, etc.) be determined. Only if the function of the phrase has been determined can it be attached to the S node and sentential information be stored in the sentence procedure. For a more explicit exposition of the psycholinguistic evidence in support of the proposed hierarchy and a more detailed explanation of its internal mechanics, we refer the reader to Pienemann (1998a, 1998b).

It is important to note that the above processing procedures are operational only in mature users of a language, not in language learners. Although even beginning second language learners can make recourse to the same general cognitive resources as mature native language users, they have to create language-specific processing routines. In this context it is important to ensure that Levelt's (1989) model (and the relevant section from Kempen & Hoenkamp, 1987) can, in principle, account for language processing in bilinguals because second language acquisition will lead to a bilingual language processor. De Bot (1992) adapted Levelt's model to language production in bilinguals. Based on work by Paradis (1987), he showed that information about the specific language to be used is present in each part of the preverbal message and that this subsequently informs the selection of language-specific lexical items and of the language-specific routines in the Formulator. Drawing on Paradis' research, de Bot concluded that:

> the speaker who speaks two closely related languages will for the most part use the same procedural and lexical knowledge when speaking either of the two languages, while in the case of languages which are not related an appeal is made to much more language-specific knowledge. (p. 9)

De Bot (1992) demonstrated that the extended version of Levelt's model accounts for the majority of the additional requirements a language production model has to meet in a bilingual context. These include the following requirements: The two language systems concerned may be used quite separately from each other or in varying degrees of mixing (code switching), the two systems may influence each other, neither system will necessarily slow down in speech rate in comparison with a monolingual speaker, and the bilingual speaker may master the two (or more) systems to differing degrees.

The key assumption from de Bot's (1992) work for the present context is that in all cases in which the L2 is not closely related to the L1, different (language-specific) procedures have to be assumed. Therefore most of the above processing procedures have to be acquired by the L2 learner. Let us illustrate this with three examples:

1. Even though the set of lexical categories may be universal, the lexical category of specific lemmata may vary from language to language. The language learner is only

fit to acquire any of the world's languages if he or she tests the lexical category for every new lexical item.

2. Diacritic features contain such items as tense, number, gender, and case. The set of diacritic features associated with lemmata in specific lexical categories varies among languages.
3. Similarly, syntactic procedures that build constituent structures and temporarily store specific grammatical information, such as diacritic features, are not the same across languages. Given that diacritic features are language-specific and that these are stored in syntactic procedures, L1 procedures are not equipped to handle the specific storage task required by the L2.

What happens when an element is missing in this implicational hierarchy? Pienemann (1998b) hypothesizes that the hierarchy will be cut off in the learner grammar at the point of the missing processing procedure and that the rest of the hierarchy will be replaced by a direct mapping of conceptual structures onto surface form as long as there are lemmata that match the conceptually instigated searches of the lexicon. In other words, it is hypothesized that processing procedures will be acquired in their implicational sequence as depicted in Table 1.

At this point, it may be useful to illustrate the predictive power of the hierarchy in Table 1 by highlighting a basic distinction of three types of morphemes that can be inferred from the implicational relationship in Table 1 of processing procedures.

A lexical morpheme minimally requires the corresponding diacritic feature to be part of the lemma and the lexical category to be listed in the lemma. This will allow the category procedure to be called for the corresponding lexical item.

For phrasal agreement to occur, phrasal procedures have to be in place so that the diacritic and other features of the head can be exchanged with the modifier. For interphrasal agreement (e.g., subject-verb agreement) to be processable, two other processing procedures also have to be in place. Grammatical functions need to be identified through Appointment Rules and the S procedure has to be in place to store the relevant phrasal information needed for the agreement process.

The hierarchy of processing procedures thus predicts the structural target language outcomes as shown in Table 2. If this hierarchy is to be universally applicable to language acquisition, then it needs to be interpretable in relation to grammatical structures in individual languages. This is achieved by interpreting the processability hierarchy through a theory of grammar that is typologically and psychologically plausible. The theory of grammar Pienemann chose for this purpose is LFG, which shares two key features with Kempen and Hoenkamp's (1987) procedural account of language generation—namely, (a) the assumption that grammars are lexically driven and (b) the functional annotations of phrases (e.g., "subject of"), which assume the status of primitives.

Similarly to Pinker (1984) and Levelt (1989), Pienemann (1998a, 1998b) uses

Table 1. Implicational sequence of processing procedures

Procedures	Order of development 1	2	3	4	5
Subordinate clause procedure	–	–	–	–	+
S-procedure	–	–	–	+	+
Phrasal procedure	–	–	+	+	+
Category procedure	–	+	+	+	+
Word or lemma access	+	+	+	+	+

Table 2. Processing procedures and their structural outcome

Processing procedures	Structural outcome
Subordinate clause procedure	Main and subordinate clause
S-procedure	Interphrasal information exchange
Phrasal procedure	Phrasal information exchange
Category procedure	Lexical morphemes
Word or lemma access	Words

LFG as a convenient reference point that has been demonstrated to be psychologically and typologically plausible. Pienemann (1998b) utilizes in particular the process of lexical feature unification, which captures the essence of the IPG mechanisms relating to the processability hierarchy. In other words, key aspects of LFG are used as a shorthand description of key IPG mechanisms.[4]

Implementing a Processing Hierarchy into LFG

Before we show how the processability hierarchy can be implemented into an LFG-based description of a target language (and the developing interlanguage), it may be useful to provide a brief outline of LFG. LFG belongs to the family of unification grammars, the most prominent characteristic of which is, as the name suggests, that of the unification of features. Put simply, the process of feature unification ensures that the different parts that constitute a sentence actually fit together.

LFG consists of three parts: (a) a constituent-structure (c-structure) component that generates surface structure constituents and c-structure relationships, (b) a lexicon, whose entries contain syntactic and other information relevant to the generation of sentences, and (c) a functional component that compiles for every sentence all the grammatical information needed to interpret the sentence semantically. The interaction of these three components is subject to a set of well-formedness conditions, which are basically very general rules constraining the process of feature unification, ensuring that all

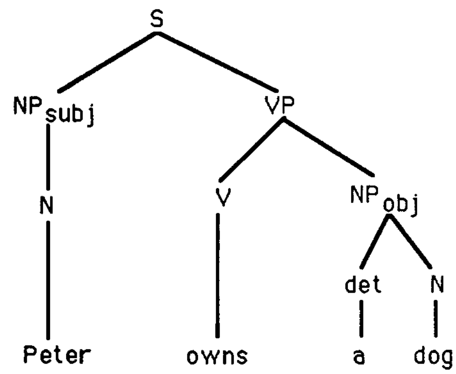

Figure 2. C-structure of *Peter owns a dog.*

properties of a functional structure (f-structure) are compatible with each other.

The c-structure component of LFG is similar to the phrase-structure component of the Standard Theory of transformational grammar (Chomsky, 1965). The similarity is, however, only superficial. In contrast to the Standard Theory, all c-structures are generated directly by phrase-structure rules without any intervening transformations. Thus the mapping of predicate-argument structures onto surface forms is achieved without any intervening levels of representation. Another major difference is that in c-structure rules, grammatical functions (e.g., subject) are not represented by the geometry of phrase structure as is the case in the Standard Theory. Instead, grammatical functions assume the role of grammatical primitives, and major constituents are annotated for their grammatical function. For instance, the c-structure of the sentence *Peter owns a dog* is shown in Figure 2. This can be generated by the annotated phrase structure rules shown in example (1).

(1) S $\rightarrow$ $NP_{subj}VP$
NP $\rightarrow$ (Det) N
VP $\rightarrow$ V (NP_{obj})

A simplified account of the lexical entries relating to Figure 2 is given in Table 3.

As is obvious from these simplified examples, lexical entries specify a number of syntactic and other properties of lexical items by assigning values to features (e.g., NUM = SG). In most cases, such equations define the value of features. In some cases, they may also demand certain values elsewhere in the functional description of a sentence. One example for such a constraining equation would be V-COMP INF $=_c$ ge. This equation applies to some German auxiliaries that require the lexical verb to form a particular infinitive.

The f-structure of a sentence is a list of those pieces of grammatical infor-

Table 3. Lexical entries

Lemma	Category	Features	Value
Peter	N	PRED	*Peter*
owns	V	PRED	*own* (SUBJ, OBJ)
		TENSE	PRES
		SUBJ PER	3
		SUBJ NUM	SG
a	Det	SPEC	*a*
		NUM	SG
dog	N	PRED	*dog*
		NUM	SG

Table 4. F-structure

Feature	Value	Arguments
PRED	"own"	(SUBJ, OBJ)
TENSE	present	
SUBJ PRED	"Peter"	
OBJ	SPEC	"a"
	NUM	SG
	PRED	"dog"

mation needed to semantically interpret the sentence. It is generated by the interaction between c-structure and the lexicon. The f-structure of the sentence in Figure 2 is given in Table 4.

The predicate entry [PRED "own" (SUBJ, OBJ)] is taken from the lexical entry of the verb. Listing the stem of the verb in quotation marks (e.g., "own") is simply a shorthand convention for a semantic representation of the word. The slots to the right of the verb, which are filled by SUBJ and OBJ in Table 4, list the arguments of the predicate: first the owner, then the item owned. In Table 4, these slots are occupied by grammatical functions. This means that the functions listed in those places mark the semantic relations associated with the slots they occupy.

The PRED entry of the f-structure therefore makes it possible to relate the different constituents to the roles described by the sentence (actor, patient, etc.). This forms the link between the syntactic form and its underlying predicate-argument relations.

Let us now briefly look at how the processability hierarchy can be implemented into an LFG-based description of a target language (and the developing interlanguage). The main point of the implementation is to demonstrate the flow of grammatical information in the production of linguistic structures. We will demonstrate this with the example of two word-order rules and two morphological rules, both relating to English.

One of the basic points in relation to the definition of word-order rules in LFG is that this theory of grammar contains only one level of c-structure, and no intervening representations occur, or, in other words, no actual linguistic material is moved from one place to another. This means that word order is defined through c-structure. In Bresnan's (1982) and Pinker's (1984) account of English word-order constellations, c-structure allows a range of different word-order constellations. In order to achieve the correct constellation in a given context these authors make c-structure on control equations as in Rule 1 (R1):

(R1) $S'' \rightarrow XP_{\left\{\begin{smallmatrix} wh=_c+ \\ adv=_c+ \end{smallmatrix}\right\}} S'$

(R1) describes the occurrence of *wh*-words and adverbs in focus position. Note that this position (XP) can only be filled by *wh*-words and adverbs because this is defined in the constraint equations. English inversion can be accounted for by (R2).

(R2) $S' \rightarrow (Aux)_{SENT\ MOOD = inv}\ S$

It is the interaction of (R1) and (R2) that creates the correct word order. A lexical entry for adverbs such as *seldom* or a lexical redundancy rule for *wh*-words ensures that the filling of the focus position creates the information "sentence MOOD = inv." This information then feeds into the equation in (R2), which licenses a verb in a position left of NP_{subj}. In other words, grammatical information is created through the processing of one constituent, and that information is being utilized during the processing of another constituent. In terms of exchange of information, then, inversion is an example of exchange into sentence internal position—that is, level 5 of the processability hierarchy.

The second word-order example is canonical word order, which in LFG is expressed simply through c-structure rules:

(R3) $S \rightarrow NP_{subj}\ V\ (NP_{obj1})\ (NP_{obj2})$

(R4) $S \rightarrow NP_{subj}\ (NP_{obj1})\ (NP_{obj2})\ V$

(R3) accounts for an SVO language, whereas (R4) accounts for an SOV language. Because grammatical functions are assigned at the level of c-structure, a strict canonical order obviously does not involve the unification of any features across major constituent boundaries, at least not for reasons related to the position of elements and the proper assignment of grammatical functions. It is quite possible to produce canonical sentence schemata without phrasal categories and the assignment of grammatical functions by using a flat c-structure and by mapping semantic roles directly onto c-structure in the initial stage of syntactic development. In other words, canonical word order can be produced with a minimum of processing prerequisites, and it is for this reason that it occurs early in SLA—more precisely, at level 2 of the hierarchy in Table 1.

However, canonical word order is not the only possible organization princi-

Table 5. Lexical entries for *A man owns many dogs*

Lemma	Category	Features and values
a	Det	SPEC = "A" NUM = SG
man	N	PRED = "MAN" NUM = SG PERS = 3
owns	V	PRED = "OWN" (SUBJ) (OBJ) SUBJ NUM = SG SUBJ PERS = 3 TENSE = PRES
many	Det	SPEC = "MANY" NUM = PL
dogs	N	PRED = "DOG" NUM = PL

ple of early syntax. A parallel type of organization principle is based on the morphological marking of semantic roles. This would involve an affixation process driven directly by the conceptual structure and based merely on the lexical class of the lexical material. Such affixes could be inferred directly from c-structure and would not involve any agreement marking. Slobin (1982) supplied evidence in support of this prediction. His data show that in the acquisition of Turkish, a nonconfigurational language, children acquire morphological markers of grammatical functions at the same developmental point in time as fixed word order is acquired in configurational languages.

In LFG, the morphological component operates on the basis of a functional description of the sentence. The following sentence may illustrate this: *A man owns many dogs*. Note that lexical entries contain schemata that are relevant here. These are listed in Table 5. The well-formedness of sentences is guaranteed, among other things, by ensuring that functional descriptions of the sentence and lexical entries match—that is, the phrase *a man* is functionally well formed because, among other things, the value for NUM is SG in the subsidiary function NUM = SG under SUBJ as well as in the lexical entry for *man*. In the same way, *many dogs* is well formed because of a match of the feature NUM.

The actual structure of the morphological component is not crucial to the present line of argument. The central point here is that morphological processes are informed by feature unification. One can now see that the unification of the NUM value in noun phrases is an operation that is restricted entirely to the NP. Pienemann calls this type of affixation *phrasal,* because it occurs inside phrase boundaries (Pienemann, 1998a, 1998b).

An example of a lexical morpheme is English or German past tense marking (*-ed* or *-te*), the information for which can be read off the lexical entry of the verb, as can be seen in Figure 1.

Subject-verb agreement, in contrast, involves the matching of features in two distinct constituents, namely NP_{subj} and VP. The insertion of the *-s* affix for subject-verb agreement marking requires the following syntactic information:

(2)	S-V affix	TENSE	=	present
		SUBJ NUM	=	sg
		SUBJ PERS	=	3

Although the value of the first two equations is read off the functional description of sentences as illustrated in (2), the values for NUM and PERS must be identical in the f-structure of SUBJ and the lexical entry of V. Hence this information has to be matched across constituent boundaries from inside both constituents. One may informally describe this process as in example (3).

(3)	[*a man*]$_{NP_{subj}}$	[{*holds*} . . .]$_{VP}$ (present, imperfective)
	PERS = 3	PERS = 3
	NUM = sg	NUM = sg

The reader will recall that, from a processing point of view, the two morphological processes—plural agreement in NPs and SV agreement—have a different status. Although the first occurs exclusively inside one major constituent, the second requires that grammatical information be exchanged across constituent boundaries. Pienemann (1998a, 1998b) terms this type of morphological process *interphrasal affixation.*

Summing up, the processing differences between lexical, phrasal, and interphrasal affixation can be expressed in LFG through the process of feature unification, which is a formal account of the exchange of grammatical information. Because feature unification at the level of c-structure is the basic process that drives LFG, the implementation of levels of processing defined in processability theory makes it possible to formally relate a large and potentially open number of grammatical structures to the hierarchy of processing resources in Table 1. This approach is therefore a principled and universally applicable course for the generation of hypotheses on the processability of specific structures.

GENERATING PREDICTIONS FOR SWEDISH

What we presented in the previous section is a sketch of a principled approach to the interface between linguistic theory and the acquisition of language-processing procedures. This section will deal with the application of this approach to Swedish interlanguage (Swedish as a Second Language [SSL]). In other words, predictions for SSL development will be derived from processability theory. This process of translating the universal framework into the specific set of grammatical conditions of the target language is an important aspect of demonstrating the cross-linguistic validity of processability theory.

Table 6. Processing procedures applied to Swedish morphology

Processing procedures	L2 structure	Swedish morphology
Clause boundary	Main and subordinate clause	—
S-procedure or word order rules	Interphrasal information	Adjective agreement in predicative constructions
Phrasal procedure	Phrasal information	Definiteness agreement, markings in NPs, compound tense markings in VPs
Category procedure	Lexical morphemes	Plural, definiteness on nouns, past or present tense on verbs
Word or lemma access	Words	Invariant forms

In the final section of this paper, these theoretical predictions will be tested in empirical studies of SSL acquisition. The reason for this is to allow us to test the validity of the proposed theory with the vast amount of data available on SSL. In other words, processability theory will be tested at two levels: (a) its cross-linguistic translatability and (b) its empirical validity.

Our test of processability theory will focus on morphological and syntactic structures in SSL. First we will describe a number of frequent inflectional morphemes and word-order regularities that the learner has to acquire, and we will characterize these rules within LFG. This characterization then serves as a basis for the analysis of the exchange of grammatical information required for the production of these rules. The analysis of information exchange then allows a prediction of the processability of these structures by L2 learners.

Morphology

Before we list the morphological structures that form part of our test, it will be useful to remember that it is not the morphological process itself that our predictions are concerned with but certain pieces of grammatical information that the morphological process has to rely on. Therefore, we will be looking specifically for morphology that can be used to test the predicted differences between lexical, phrasal, and interphrasal morphology. Table 6 lists the relevant morphological rules for Swedish in relation to Pienemann's (1998a, 1998b) hierarchy of processing procedures. Each of these rules will be justified in the text of this article.

The Noun Phrase. Before we detail the morphological forms of Swedish noun phrases, we would like to point out that the constituent structure of Swedish NPs is similar to that in English. The major contrast to English NPs is the morphological structure of their constituents. Basically, a full noun phrase

Table 7. Swedish indefinite and definite articles

	Indefinite		Definite	
Gender	Singular	Plural	Singular	Plural
Uter	*en*	—	*den*	*de*
Neuter	*ett*	—	*det*	*de*

Note. The term *uter* refers to what is sometimes called *common* gender, which represents a historical merger of masculine and feminine.

Table 8. Swedish adjectival morphology

	Indefinite		Definite	
Type	Singular	Plural	Singular	Plural
Attributive				
Uter	∅	*-a*	*-a*	*-a*
Neuter	*-t*	*-a*	*-a*	*-a*
Predicative				
Uter	∅	*-a*	∅	*-a*
Neuter	*-t*	*-a*	*-t*	*-a*

may consist of the following constituents: (Det) (AP) N. This highly simplified account ignores multiple embedding of adjectival phrases, embedded clauses, and adverbials and the nature of the optionality of some of these constituents. Instead, it concentrates on more basic structures that are relevant to the studies discussed below. In Swedish NPs, articles and adjectives agree with the head noun. There are several dimensions of agreement that involve the diacritic features of gender, number, and definiteness.

There are five different forms of the article: *en, ett* "a" (indefinite, singular), *det, den* "the" (definite, singular), and *de* "the" (plural). The form system is summarized in Table 7.

In its attributive function, the adjective agrees with the head noun of the noun phrase. In its predicative function, the adjective agrees with the subject. The diacritic features gender, number, and definiteness are simultaneously marked by one affix that can take three forms: a zero morpheme, the suffix *-t,* and the suffix *-a*. The contexts for these markings are given in Table 8.

In addition to morphological marking for gender, number, and definiteness, nouns can also be marked for genitive. However, we will disregard the latter for the purpose of this paper because it has not figured in any SLA studies. The suffixes used to mark these diacritic features agglutinate in some cases:

(4) *hund-ar-na*[5]
dog-UTER/PL-DEF
"the dogs"

Table 9. Swedish nominal morphology

	Indefinite		Definite	
Gender	Singular	Plural	Singular	Plural
Uter	∅	∅, *-or, -ar, -*(*e*)*r*	-(*e*)*n*	*-na*
Neuter	∅	∅, *-n, -*(*e*)*r*	-(*e*)*t*	-(*e*)*n*, -(*n*)*a*

In many cases, two or three diacritic features are expressed by the same suffix:

(5) *hund-ar*
dog-UTER/PL/INDEF
"dogs" (as in *dogs are smart*)

Suffixes on nouns agglutinate only if they express the following combination of diacritic features: (a) plural + definite (+genitive) or (b) definite + genitive.

The morphemes that mark the different diacritic features possible on nouns are listed in Table 9. The reader will notice that in some cases there is a choice of different morphemes—for example, a zero morpheme, *-or,* or *-ar* to mark uter, indefinite, and plural. The choice of the form of the marker depends on the declension class of the noun. There are five classes and a set of irregular nouns.

Lexical Morphemes. We can now proceed to analyze the morphological structures in Table 9 in terms of their processability. Morphological plural marking on nouns is based on the lexical entry. When no other constituent of the NP has to agree with the head, this is an example of a lexical morpheme. For instance, the relevant lexical entry for the word *hund-ar* "dogs" is as in (6).

(6) *hundar*: N PRED = HUND "dog"
NUM = PL

Lexical morphemes also occur in the marking of definiteness and gender. As mentioned above, these two diacritic features are marked by one morpheme. There are two different genders, uter and neuter, with different morphemes, -(*e*)*n* and -(*e*)*t,* for the definite form.

(7) *hunden*: N PRED = HUND "dog"
SPEC = DEF
GENDER = UTER

(8) *huset*: N PRED = HUS "house"
SPEC = DEF
GENDER = NEUT

Again, on its own, this marker is lexical (according to processability theory).

Phrasal Morphology. A particular feature of Swedish is the simultaneous marking of definiteness on the article and the noun. Unlike in German and English, definiteness has to be marked on the article and the noun when a noun phrase contains an adjective. In this context, the article is obligatory and the adjectival ending is weak. This is illustrated in (9).

(9) [[*den*] [*stor-a*]$_{Det}$ [*hund-en*]$_{N}$]$_{NP}$
UTER/DEF/SG DEF UTER/DEF/SG
"the big dog"

This example illustrates phrasal morphology in Swedish. Here the features for gender, number, and definiteness must be unified across constituents within the phrase.

Interphrasal Morphology. Some of the same morphological markers that are used in phrasal agreement in the NP can also be used interphrasally, when the features are unified across phrases with predicative adjectives: that is, in sentences with copular verbs. This is illustrated in (10).

(10) [*Hus-et*]$_{NP_{subj}}$ [*är*]$_{V}$ (Pres) [*stor-t*]$_{Adj}$
NEUT/SG NEUT/SG
"The house is big"

In this example, the gender and number features are unified across the different phrases and, therefore, it belongs to level 4 in the processability hierarchy. Adjectival agreement in predicative adjectives is interphrasal only if one can be certain that the learner language has developed equational sentences. In simplified interlanguages, noun-adjective sequences that may be structurally ambiguous can occur:

(11) *hund-en stor*
dog-DEF big
"the big dog"

which could be analyzed as [[[*hunden*]$_{N}$]$_{NP}$ [∅] [*stor*]$_{A}$]$_{S}$ or as [[*hunden*]$_{N}$ [*stor*]$_{A}$]$_{NP}$.

To assign an interphrasal status to noun-adjective sequences, there has to be distributional evidence that equational sentences are part of the interlanguage system. This can be decided on the basis of the presence of the copula and on the basis of the adjectival morphology in definite contexts. In the latter case, the distribution of the morphological form of the marker for definiteness, gender, and number is complementary in attributive and predicative contexts:

(12) *den stor-a hund-en*
the big-UTER/DEF dog-DEF
"the big dog" (attributive)

Table 10. Swedish verbal morphology

Category	Suffix	Finiteness
Present	*∅, -r, -er*	+
Past	*-de, -dde, -te*	+
Infinitive	*∅, -a*	–
Supine	*-t, -it*	–

(13) *hund-en är stor-∅*
dog-DEF is big-UTER/DEF
"the dog is big" (predicative)

(14) *det stor-a hus-et*
the big-NEUT/DEF house-DEF
"the big house" (attributive)

(15) *hus-et är stor-t*
house-DEF is big-NEUT/INDEF
"the house is big" (predicative)

This complementary distribution can be used to test the presence of equational sentences in the interlanguage system in question.

Verbal Morphology. Like English, the Swedish verb phrase may consist of one or many verbs. One of the verbs in a clause is marked [+finite]. The others are marked [–finite]. Only one verb can be marked [+finite], and this verb has to be marked for TENSE.[6] The morphological forms of these markers are shown in Table 10. They vary according to verb classes. The morphemes that mark the two types of infinitives are also shown in Table 10. They, too, vary according to verb classes. Examples (16)–(19) illustrate the use of the morphemes displayed in Table 10.

(16) *de prata-r*
they talk-PRES
"they talk"

(17) *de prata-de*
they talk-PAST
"they talked"

(18) *de ska prata-∅*
they will talk-INF
"they will talk"

(19) *de har prata-t*
they have talk-SUPINE
"they have talked"

In examples (16)–(17) the diacritic features PRES and PAST are located in the lexical entry. No exchange of grammatical information is needed. This type of tense marking can therefore be classified as lexical morphology.

Examples (18)–(19) show morphological markers of tense for which feature

Table 11. Lexical entries for *har pratat* ("have talked")

Verb	Category	Features and values
pratat	V	PRED = *prata* "talk" (SUBJ, OBJ) TENSE = PAST INF = t AUX = –
har	V	PRED = *har* "has," V-COMP (SUBJ) TENSE = PAST AUX = + V-COMP TENSE = PAST V-COMP INF $=_c$ +

values have to be unified between the auxiliary and the main verb. To inform the morphological component, the feature values for INF and SUPINE have to be unified with an auxiliary before any verb can be selected for the verb positions. The lexical entries for verbs would contain, among other things, the features listed in Table 11.

In example (19) the constraint equation V-COMP INF $=_c$ + listed under the entry for *har* is checked against the INF value in the entry for *pratat*. This ensures that the complement does not define any tense. In other words, this provision rules out sentences such as (20) and (21).

(20) **han* *ha-r* *prata-r*
he has-PRES talk-PRES
"he has talks"

(21) **han* *ha-r* *prata-∅*
he has-PRES talk-INF
"he has talk"

Such errors do, however, occur in SSL data. When this happens, it means that not all the necessary features are listed in the entries to the learner's lexicon or they are not matched. When the features are matched across the two verbs, this feature unification defines the underlying process as phrasal morphology, located at level 3 of the processability hierarchy. Table 2 gives an overview of the hierarchy of processability for all the Swedish morphological structures discussed above.

Syntax

In the area of syntax we will concentrate on word order in main and subordinate clauses and on the position of the negator. The phenomena we will look at in this section are listed in Table 12.

Before going into detail, it might be useful to take another look at the schema presented in Table 12 and see how Swedish syntactic structures fit

Table 12. Swedish word-order rules

Situation	Rule
Canonical word order	Neg + verb
Adverb fronting (=ADV)	(Aux) neg + verb
wh-Fronting	Verb + neg
yes/no inversion	Neg + verb in subclauses
INV	Cancel inversion

Table 13. Processing procedures applied to Swedish word order and negation

Processing procedures	L2 structure	Swedish morphology	Swedish syntax	Swedish negation
Clause boundary	Main and subordinate clause	—	Cancel INV	(b) neg Aux_f V_i (a) neg V_f
S-procedure or word-order rules	Interphrasal information	Predicate agreement	INV	V_f neg
Phrasal procedure	Phrasal information	NP agreement, VP agreement	ADV, *wh*-fronting	—
Category procedure	Lexical morphemes	Plural, definiteness on nouns, past or present tense on verbs	Canonical	(Aux) V neg (Aux) neg V
Word or lemma access	Words	Invariant forms	Single constituents	Neg X

into the general pattern. Table 13 displays these structures in relation to the level of processing procedures by adding two columns to Table 6.

Word Order. Canonical word order can be found in most affirmative sentences in Swedish. In LFG, canonical word order follows directly from c-structure rules such as (R3).

(R3) $S \rightarrow NP_{subj}\ V\ (NP_{obj1})\ (NP_{obj2})$

In other words, canonical word order requires no exchange of grammatical information. It is therefore positioned at level 2.

ADV refers to the occurrence of adverbs and adverbials in sentence-initial position. ADV requires the addition of one constituent to the given set of c-structure rules in initial position: $S' \rightarrow (ADV)\ S$.

Note that in the target grammar, this structure must be accompanied by the verb in second (INV) position to be grammatical. Nevertheless, ADV without INV is frequent in interlanguage.

(22) **igår* *han* *reste* *till* *Stockholm*
yesterday he went to Stockholm
"yesterday he went to Stockholm"

In terms of processability, this structure is a modification of the serial order principle, which allows the learner to map conceptual structures directly onto linguistic form:

(23) agent action patient
N V N

The new structure (ADV S) modifies the seriality principle and allows the canonical order principle to apply after initial adverbs:

(24) [INITIAL] agent action patient [FINAL]
PP/*wh*/adv NP V NP

These additional word-order options allow the learner to produce a range of L2 syntactic phenomena without acquiring the full range of L2 word order. Also note that, in this treatment of the canonical schema, the constituents of the canonical sequence are described as phrases. This is because phrasal procedures are operational at this stage. This makes it possible for the canonical schema to allow a definition of position in terms of phrases rather than words.

By "*wh*-fronting" we refer to the position of question words in sentence-initial position. As with ADV, the structure in (25) can be canonical order in learner language, but is ungrammatical in Swedish.

(25) **var* *du* *bor?*
where you live
"where do you live?"

INV refers to subject-verb inversion in declaratives with an adverb or object in initial position and to inversion in interrogatives:

(26) *igår* *reste* *han* *till* *Stockholm*
yesterday went he to Stockholm
"yesterday he went to Stockholm"

English subject-verb inversion was discussed above where we noted that (R1) and (R2) can account for this syntactic phenomenon. We also noted that a lexical redundancy rule for *wh*-words ensures that the filling of the focus position creates the information "sentence MOOD = inv," and this information then feeds into the equation in (R2), which licenses a verb in a position left of NP_{subj}.

Swedish subject-verb INV can be accounted for by some variation on (R1) and (R2). For this purpose, c-structure has to be modified somewhat. The modifications suggested here are adaptations from Kaplan and Bresnan's

(1982) and Pinker's (1984) treatment of inversion in English, which assumed that there is an optional verb to the left of S as illustrated in (R5).

(R5) $S' \rightarrow (V)\ S$

Pinker adds the constraining equation ROOT $=_c +$ to the verb position in this rule to ensure that inversion only applies to matrix (i.e., root) sentences (i.e., the feature ROOT is constrained to be [+] in matrix and [−] in embedded clauses). This distinction is also relevant to the analysis of Swedish, in which INV is blocked in embedded clauses.

Pinker (1984) further adds the constraining equation SENT MOOD $=_c$ INV to the verb position in order to be able to allow the rule to constrain INV lexically in elements that can occur in topicalized position; compare (R2). The resulting rule is given in (R6).

(R6) $S' \rightarrow (V)_{\left\{\begin{array}{l}\text{ROOT} =_c + \\ \text{SENT MOOD} =_c \text{Inv}\end{array}\right\}} S$

Similar to Pinker, we suggest that the equation SENT MOOD $=_c$ Inv is checked against a set of lexical redundancy rules that operate on (R6) so that INV can be triggered by the application of (R7).

(R7) $S' \rightarrow (XP)_{\left\{\begin{array}{l}\text{wh} =_c + \\ \text{adv} =_c + \\ \text{N} =_c +\end{array}\right\}} S$

In effect, the elements listed in the constraining equation and the associated lexical redundancy rule now ensure that the equation SENT MOOD = INV feed into the constraining equation SENT MOOD $=_c$ Inv, appended to V in (R5). In English the elements that trigger inversion include *wh*-words and adverbs, although in Swedish the class of these words is much larger. (R7) now allows INV to occur with topicalized *wh*-words, adverbs, PPs, and NPs.

For reasons of space, this account of Swedish verb-second placement is somewhat simplified. For a more detailed account, see Pienemann (1998a, 1998b).

Because the process described above for Swedish subject-verb inversion involves the exchange of information across constituent boundaries into sentence-internal position, it corresponds to level 4 of the processability hierarchy.

It is possible to account not only for structures that occur in mature Swedish, but also for the dynamics of the learning process, that is, for structures created by the learner on the way to acquiring target structures. For instance, it is known that INV is first acquired in the context of a limited number of preposed question words and preposed adverbs. The formalism used here can express this through an alteration of the constraint equations appended to XP.

"Yes/no inversion" refers to the syntactic pattern found in a direct yes/no question in which the subject and the verb are inverted, as in:

(27) *bor du här?*
live you here
"do you live here?"

This structure can be produced by (R6), and the constraint equation appended to V would be satisfied when one assumes a mechanism that creates the equation SENT MOOD = INV for all questions. Because of the similarity of information distribution, this rule is to be positioned at the same level in the hierarchy as INV.

"Cancel inversion" describes the fact that the word order phenomena observed in direct questions do not apply in the context of indirect questions. This phenomenon is illustrated by adding a matrix clause to example (27). The resulting sentence is given in example (28).

(28) *jag undrar om du bor här*
I wonder if you live here
"I wonder if you live here"

Cancel inversion can be accounted for by assuming a linear c-structure for subordinate clauses similar to that of stage 1 clauses.

(R8) $S' \rightarrow (COMP) ROOT = -S$

(R3) $S \rightarrow NP_{subj}\ V\ (NP_{obj1})\ (NP_{obj2})$

This ensures that ADV and INV are blocked in subordinate clauses. In this way, it is also possible to account for the overapplication of this position to subordinate clauses (i.e., indirect questions). In the latter case, the distinction [+/–ROOT] has not been appended to (R6).

Placement of Negation. To account for the position of the negator, we amend (R3) as follows:

(R9) $S \rightarrow NP_{subj}\ V_f\ neg\ (V_i)\ (NP_{obj})\ (PP)$

In other words, the negator is positioned to the right of the finite verb in noninverted sentences.

In subordinate clauses the negator always occurs in preverbal position: NP_{subj} neg V_f (V_i) (NP_{obj}) (PP).

There are several nontarget negation constructions that occur in learner Swedish and that conform to a canonical order pattern. One example is the structure neg + X, which is ungrammatical in Swedish main clauses in the context neg + V, as in example (29).

(29) **jag inte bor här*
I no live here
"I don't live here"

A second learner construction is (AUX) neg + V. In other words, here neg + V has been complemented by an optional auxiliary. As long as the tense marking is not coordinated between AUX and V, this structure requires no exchange of information and can occur at level 2. Tense marking that is coordinated between AUX and V occurs at level 3 (cf. example [29]).

A third interlanguage variant of Swedish negation is quite similar to the previous one. In this case the negator is placed after the lexical verb: X AUX V neg. This structure is ungrammatical in Swedish.

Even this superficial error analysis demonstrates that the main problem of the learner is to differentiate between finite and nonfinite verbs. None of the above interlanguage forms is sensitive to finiteness. Once finiteness is acquired, the correct position of the negator can be described by one simple c-structure rule (see R9).

Processability theory predicts that the structure neg + X will appear at level 1 of the processability hierarchy because it merely requires element X to be a lemma, and no transfer of grammatical information is needed. The structures (AUX) V neg and (AUX) neg V can both be read off c-structure without transfer of grammatical information because, at this stage, the AUX and the V do not agree for tense. The structure AUX_f neg V_i does require tense agreement between the verbs. This is an example of interphrasal information exchange—that is, level 4 of the processability hierarchy. When the structures neg V_f and neg AUX_f V_i occur in subordinate clauses only, they require level 5 processes. One can predict that neg V_f will be acquired before AUX_f V_i (in subordinate clauses) because the latter requires a transfer of the tense agreement procedures from main to subordinate clause structures, whereas neg V_f does not. In other words, we argue that the transfer of this specific procedure constitutes a separate developmental step.

In summary, we discussed five structures relating to Swedish negation that occur in interlanguage data. According to the implementation of processability theory they are predicted to emerge in the sequence depicted in Table 12. From a processing point of view, the structures listed under level 2 are equivalent to each other. Nevertheless, we will see in the following section that they emerge in two substages.

TESTING THE PREDICTIONS

As mentioned above, in this section we will paste together as much as possible of the picture of developing Swedish as L2 and use this empirical base to test the predictions made by processability theory (Pienemann, 1998a, 1998b) about the development of morphosyntactic forms. For this purpose, we will review the 14 major empirical studies on the acquisition of Swedish morphosyntax.[7] In doing this, it will soon become clear that the many studies involved

Table 14. Possible IL sequences

Sequence type	Sequence order		
Hypothesized	SVO	ADV	INV
Found in data			
Type 1	ADV	INV	SVO
Type 2	—	ADV	INV

were designed with different research questions in mind. Therefore, the empirical methods employed are rather diverse and many authors, although interested in related issues, have not addressed some of the questions pursued in this article. The overarching organizational principle of this paper is, of course, that of developmental grammars.

In other words, we will compile whatever evidence is available to construct as coherent a picture as possible of developmental patterns in the acquisition of SSL morphosyntax. In this context, we will keep three things in mind:

1. Different studies may produce contradictory findings.
2. The acquisition criteria are not the same in different studies. There are considerable differences between studies in this respect. Some researchers have applied a target perspective and used correctness as the criterion; others have used a learner perspective and looked at occurrences of structures (see Meisel, Clahsen, & Pienemann, 1981, for a discussion of acquisition criteria).
3. In some studies the structures in question may be absent from the corpus. When this is the case, it will be important to establish whether the absence of these data is due to a lack of opportunity to produce the structure or whether the context for the structure is present and the learner failed to produce it. In other words, we have to be mindful of how to falsify the hypothesized developmental patterns of SSL.

The issue of falsifiability of processability is discussed in detail by Pienemann (1998b). Here we merely want to state the principle we will apply. A hypothesized sequence will be falsified if empirical evidence shows a different sequence containing all the original elements. The idealized sequences in Table 14 illustrate this principle (using examples of word-order rules from ESL).

If sequence 1 is found in the data, then this will falsify the hypothesis. However, sequence 2 does not contradict the hypothesis. Depending on the circumstances, the lack of structure A may well reflect a limitation of the data collection.

Morphology

Several studies of SSL deal with the acquisition of morphology, especially the acquisition of noun-phrase morphology, which is known to present difficulties for L2 learners of Swedish. There are studies focusing on how learners assign gender to the noun (e.g., Andersson, 1992), studies on acquisition of definite-

Table 15. Studies of SSL morphology

Study	Design	Period	Data collection	Subjects	L1
Andersson (1992)	Longitudinal	1–3 years	Conversation	12 children	8 different
Andersson (1992)	Longitudinal	1–3 years	Interviews, retellings	4 adults	Finnish, Spanish
Axelsson (1994)	Longitudinal and cross-sectional	5 months	Interviews, picture description	60 adults	Finnish, Polish, Spanish
Hammarberg (1996)	Longitudinal	1–5 years	Interviews	6 adults	Chinese, Greek, Portuguese
Lahtinen (1993)	Cross-sectional		Compositions	342 adults	Finnish
Noyau (1992)	Longitudinal	1–3 years	Interviews, retellings	4 adults	Finnish, Spanish
Salameh et al. (1996)	Cross-sectional		Retellings, conversation	18 children	Arabic
Viberg (1991)	Longitudinal	4 years	Interviews, retellings	30 children	Various

ness (e.g., Axelsson, 1994), and studies on the acquisition of agreement in noun phrases between article, adjective, and noun (e.g., Hammarberg, 1996; Lahtinen, 1993; Salameh, Håkansson, & Nettelbladt, 1996). These studies provide a rich testing ground for processability theory.

Studies on the acquisition of verbal morphology are less pertinent to the issues discussed in this paper because they focus on the acquisition of tense from a semantic or pragmatic aspect, rather than on the form of morphological markers (e.g., Noyau, 1992; Viberg, 1991).

Table 15 summarizes the empirical basis of the major studies on the acquisition of Swedish morphology. The studies listed in Table 15 vary greatly in design, data-collection methods, age, and L1 of the learners. These studies also differ with respect to the research questions that are posed and the theoretical framework they are based on. In some studies, L2 acquisition is compared to child L1 acquisition. Other studies are based on L2 error analysis, and yet another group of studies is aimed at describing developmental patterns found in interlanguage data.

The Noun Phrase

Table 13 displays the predictions of processability theory in relation to some morphological structures of Swedish. Lexical morphology is predicted to be acquired before phrasal and interphrasal morphology. In the following survey

Table 16. Development of NP morphology

Recording clusters	Type	Token
3	N (invariant form)	*docka* "doll"
4–5	N + definite suffix	*dockan* "doll-DEF"
6–7	N	*docka* "doll"
	N + definite suffix	*dockan* "doll-DEF"
8	Det + N + suffix	*den dockan* "that doll-DEF"
9	N + definite suffix	*dockan* "doll-DEF"
	Indefinite article + N	*en docka* "a doll"
10	N	*docka* "doll"
	N + definite suffix	*dockan* "doll-DEF"
	Indefinite article + N	*en docka* "a doll"

Note. Data from Andersson (1992).

of empirical studies on L2 Swedish, we will therefore specifically look for examples of lexical (i.e., plural and definite suffixes on nouns), as well as phrasal and interphrasal morphology (i.e., agreement marking).

Most studies on SSL noun phrases do indeed provide empirical evidence against which these hypotheses can be tested. The only exception is Axelsson's (1994) study on semantic aspects of definiteness. Because of her focus on semantics, the morphological form of the constituents of the NP was not studied. Nevertheless, this study does show that there is an initial stage devoid of morphological markers. This lends support to Stage 1 in the Swedish processability hierarchy.

Andersson's (1992) study examined the acquisition of gender assignment in L1 children, early L2 children (under 3 years of age), late L2 children (over 3 years), and L2 adults. For the purpose of the present discussion, it is important to keep in mind that Andersson was not interested in the morphological process per se, but in morphology as a marker of gender. However, in his analysis of gender, he also captured aspects of the acquisition of noun morphology. He argued that:

> the acquisition of gender is closely linked to the acquisition of the Swedish system of definiteness/indefiniteness, notably the suffixed definite article. . . . The learner who acquires nouns with definite suffixes gets an entrance into the Swedish gender system as part and parcel of the bargain. (p. 208)

Apart from his major study of group levels of accuracy in gender assignment, Andersson (1992) also described the development of noun phrase morphology in terms of learner language in an in-depth study of one L2 child, Lien. Andersson observed the development of noun phrase morphology, based on the first emergence of forms. He based his analysis on clusters of recordings as set out in Table 16. The summary in Table 16 shows that there is an early stage (recording cluster 3) that contained no morphological marking at all. This is followed by a stage (recording clusters 4–5 and 6–7) at which Lien

Table 17. Combinations of morphological forms

Combination type	Number
Logically possible combinations	90
Used by early L2 learners	31
Used by late L2 learners	21
Used in the target language	8

Note. Data from Lahtinen (1993).

started using lexical gender marking on the noun, thus differentiating between base form and definite form. Then phrasal marking (agreement) started to appear. When these markers first appeared, there was a period of overgeneralization in which the indefinite article was used in combination with the definite suffix. Andersson's interpretation is that at this stage Lien used the noun marked for definiteness as an unanalyzed chunk. After this period, agreement between the article and the noun emerged.

Summing up, this study provides strong empirical support for the processability hierarchy as applied to Swedish NPs. The development of NP morphology follows exactly the predictions of the theory, starting with no morphology, then lexical morphology, and after that phrasal morphology.

Lahtinen's (1993) study focuses on plural and gender agreement marking on determiners, adjectives, and nouns by Finnish learners of Swedish in Finnish schools. Lahtinen analyzed over 14,000 noun phrases in the learners' written production. As a point of departure, she chose to compare the number of logically possible combinations of the morphological forms of article, adjective, and noun to the realizations in the target language and in the interlanguage. There are many combinations that are not used in the target language. However, L2 learners tend to use more combinations than native speakers, as shown in Table 17. Thus, the L2 acquisition of Swedish noun phrase morphology seems to proceed from large variation of forms to more and more restrictions on learner hypotheses.

Hammarberg's (1996) study was designed to test the predictions of processability theory for morphology. He compared the acquisition of adjective agreement in attributive position within the noun phrase to adjective agreement in predicatives. In other words, he compared phrasal morphology to interphrasal morphology. Interestingly, he found that in his data agreement markers for plural (*-a*) follow the order predicted by processability theory—that is, phrasal markers appear before interphrasal markers. However, the markers for neuter appear in a different order.

Hammarberg (1996) claimed that it is the notion of Perceived Communicative Value (PCV) of structural properties that overrides processability constraints. Neuter is first marked in predicative contexts. However, the examples of PCV given by Hammarberg are not examples of our notions of morphological agreement but of morphological nonagreement or disagreement (cf. Källström, 1990). Although the main rule for the Swedish adjective is to agree with its head (as in example [30]), there are also instances where there is no agreement but the neuter form is used instead, as in example (31).

(30) *blomm-or* *är* *vackr-a*
flower-PL are beautiful-PL
"flowers are beautiful"

(31) *blomm-or* *är* *vacker-t*
flower-PL are beautiful-NEUT
"flowers are beautiful"

The meaning of the first example is that each individual flower is beautiful, whereas the meaning of the second example is that each possible group of flowers is beautiful; that is, in a more general or circumstantial sense. Källström (1990, p. 240) described this difference as follows: "When the subject is in itself too delimited to be able to receive a dividuative interpretation, the non-agreeing adjective serves as a marker of the subject's circumstantial reference."

In other words, the reason for the neuter to appear in interphrasal contexts before its appearance in phrasal contexts is the fact that it does not agree with any other lexical item in this context. This claim is quite congruent with processability theory.

The study by Salameh et al. (1996) deals with the interaction between morphology and syntax. In this cross-sectional study, 18 Arabic-speaking children with Swedish as L2 were recorded in dyads performing various communicative tasks. The tasks were designed to elicit yes/no questions, topicalized declaratives, and agreement in noun phrases.

The distributional analysis of the data revealed that there are intermediate steps in the acquisition of agreement morphology. Instead of looking for error types, Salameh et al. (1996) searched for possible instances of agreement morphology. The reader will recall that Swedish definite NPs containing an adjective obligatorily need to contain a definite article as well as a morphological marker of definiteness on the noun. Salameh et al. found that learners sometimes mark definiteness on the noun only.

An implicational analysis of the 18 learners revealed that the structures in question are acquired in the following sequence: $Adj_{affix} + N_{affix} > Art + Adj_{affix} + N_{affix} >$ yes/no questions > INV. This sequence accurately follows the prediction of processability theory. In the structure $Adj_{affix} + N_{affix}$, the feature definiteness has to be unified between the head and the adjective (i.e., level 3), whereas $Art + Adj_{affix} + N_{affix}$ requires the unification of the same feature in three constituents (also level 3). INV in yes/no questions and declaratives is located at level 4 according to our analysis. In other words, these data support the Swedish processability hierarchy.[8]

Verbal Morphology

There are two studies that deal with the development of tense marking in verbs. However, they are not aimed at morphological markers per se. Instead, they study the development of reference to time irrespective of the rule system underlying morphological form. Although this procedure is perfectly legitimate, it limits the usefulness of these studies for the purpose of testing processability theory. However, because tense is expressed by morphological marking, one can still gain some information about morphology.

In his study of child SSL acquisition, Viberg (1991, 1993) quantified the morphological form of verbs and found that his informants first used invariant forms before they systematically used lexical morphemes. Verbal morphology was also studied in the ESF project (Noyau, 1992). In this study, too, the focus was on reference to time. Viberg and Noyau both seem to focus on the morphology of single words to capture the development of tense. This method is suitable when the purpose is to look at verbs with different suffixes, but it does not permit one to differentiate between lexical and phrasal morphology markers. Both authors mention that there are sometimes mismatches between auxiliary and main verb, but they do not discuss the reasons behind this. For this purpose, it would be necessary to analyze the whole verb phrase to gain information about agreement features. Nevertheless, these studies do provide weak support for the two basic levels of Swedish processability hierarchy in verbal morphology.

Syntax

Table 18 summarizes the main studies on the acquisition of Swedish subject-verb word order and negative placement. The first study on L2 acquisition of Swedish word order was carried out by Hyltenstam (1977, 1978), who identified a universal sequence in the acquisition of word order. The data for this study were collected by means of a cloze test that was designed to elicit a range of contexts for inversion and negation. An implicational analysis of the data revealed a clear pattern in the acquisition of word order: ADV > yes/no questions > INV.

The reader will recall that the last two steps in this sequence were also found in the study by Salameh et al. (1996) and that this sequence is predicted by processability theory. ADV is located at level 3 of the hierarchy and therefore also follows its predicted location in the sequence. Hyltenstam's study did not show clear results for Cancel inversion, which is located at level 5 of the Swedish hierarchy, and Hyltenstam stated that "there are no regular patterns in the way the learners invert or do not invert in embedded clauses when acquiring the inversion rule for the simple clauses" (1978, p. 42). Bolander's (1987, 1988) extensive analysis of a corpus of spoken data confirms Hyltenstam's sequence.

Håkansson and Nettelbladt (1993, 1996) compared L2 acquisition of sub-

Table 18. Studies of SSL word order

Study	Design	Period	Data collection	Subjects	L1
Bolander (1988)	Longitudinal	5 months	Interviews, picture description	60 adults	Finnish, Polish, Spanish
Colliander (1993)	Longitudinal	10 months	Interviews, story retelling	30 adults	Persian, Polish, Spanish
Håkansson & Dooley Collberg (1994)	Cross-sectional	—	Elicited imitation	19 children	Icelandic, Polish
Håkansson & Nettelbladt (1993, 1996)	Longitudinal	5 months	Conversation	5 children	Bulgarian, Karamandji, Romanian, Syrian
Hyltenstam (1977, 1978)	Longitudinal and cross-sectional	—	Written elicitation form	160 adults	35 different
Rahkonen (1993)	Cross-sectional	—	Compositions	999 adults	Finnish
Salameh et al. (1996)	Cross-sectional	—	Retellings, conversation	18 children	Arabic

ject-verb inversion to normal and impaired L1 acquisition. On the basis of a distributional analysis, they found that the sequences are different for L2 children and L1 children with normal language development, whereas the SLI (Specific Language Impairment) children follow the same sequence as L2 children. The development of the L2 children is approximately the same as was found by Hyltenstam (1978) with one exception: Håkansson and Nettelbladt found an early stage of canonical word order (stage 2 of the processability hierarchy) that was not captured by Hyltenstam's test. This adds further weight to the empirical support provided by this study for the processability hierarchy. To sum up, Håkansson and Nettelbladt's studies confirm most of Hyltenstam's findings, and all three studies (Bolander, 1988; Håkansson & Nettelbladt, 1996; Hyltenstam, 1978) lend further support to the processability hierarchy for L2 acquisition.

Rahkonen's (1993) study is based on written material from 999 Finnish high school students learning Swedish in their 10th year and 173 Swedish students learning Finnish. The study compares two typological scenarios: (a) the acquisition of inversion after topicalization in Swedish by Finns and (b) the acquisition of a canonical order after topicalization in Finnish by the Swedes. The analysis reveals that the level of accuracy is significantly higher in scenario (b). Rahkonen argues that this is so because in scenario (a) the learner has to move from an unmarked L1 word order to a marked L2 word order, whereas

Table 19. Development of negation

Hyltenstam's results	Predictions based on the processability hierarchy
Subordinate clause: neg AUX V	Level 5 step 2, subordinate-clause procedure
Subordinate clause: neg V	Level 5 step 1, subordinate-clause procedure
Main clause: V neg	Level 4, interphrasal procedure
Main clause: (AUX) neg V	Level 2, category procedure
Main clause: neg V	Level 2, category procedure

in scenario (b) the learner moves in the opposite direction, from a marked to an unmarked word order. Processability theory offers an alternative explanation. INV is located at level 4, whereas topicalization is located at level 3. All learners have to move through the hierarchy irrespective of their native language. Scenario (a) therefore corresponds to the longer stretch on the hierarchy that has to be covered by the learner.

Placement of Negation

In his work on the L2 acquisition of Swedish word order, Hyltenstam (1977, 1978) also found a universal sequence in the acquisition of negative placement. The developmental pattern consists of five stages and is the same for all learners irrespective of L1. It is described in Table 19. For the sake of comparison, the predictions from the processability hierarchy appear to the right.

1. In an initial stage the learners tend to use preverbal negation (*han inte kommer*, "he not comes"). This preference has also been found in studies of L2 acquisition of other languages with postverbal negation, such as English and German, and it is predicted to be the starting point for sentence internal negation in processability theory (i.e., level 2).
2. Hyltenstam's next stage in the development shows an auxiliary appearing in front of the negator (*han vill inte komma* "he wants not come"). This is another structure of level 2 of the processability hierarchy. In terms of processability there is no difference between neg V and (AUX) neg V as long as one disregards the matching of tense marking in AUX and V.
3. At Hyltenstam's stage 3, the learners master negative placement in main clauses, and place the negator after the finite verb (*han kommer inte* "he comes not"). This corresponds to level 4 of the processability hierarchy.
4. Once the negator is placed to the right of the finite verb in main clauses, the learners differentiate between main and subordinate clauses and place the negator before the verb in the latter type of clauses. This rule first occurs in main-verb contexts (*därför att han inte kommer* "because he not comes").
5. The last point in the development is reached when the learners place the negator before the auxiliary verb (*därför att han inte har kommit* "because he not has come"). The structures at Hyltenstam's stages 4 and 5 are predicted to occur at level 5 (steps 1 and 2) in processability theory.

Summing up, Hyltenstam's findings support our predictions extremely well. The only proviso on this is that the Swedish processability hierarchy currently does not differentiate between all of the stages he found. Instead, it conflates his steps 1 and 2 into Level 2.

The studies by Colliander (1993) and Bolander (1988) replicated Hyltenstam's study and further examined the linguistic contexts for the acquisition of the structures included in Hyltenstam's study. Colliander's and Bolander's studies were based on spontaneous data, and they fully confirm Hyltenstam's findings.

Håkansson and Dooley Collberg (1994) used an L2 perspective to study L1 acquisition of negative placement. Using Hyltenstam's sequences for L2 adults as a starting point, they looked at negative placement in L1 and L2 children. The sequences were found to be exactly the same as Hyltenstam's. All these replication studies lend strong support to processability theory.

SUMMARY AND FINAL REMARKS

In this paper, we sketched out processability theory (Pienemann, 1998a, 1998b) and applied it to Swedish morphology and syntax. We tested the Swedish processability hierarchy against 14 empirical studies that constitute an ideal testing ground for the hierarchy. Whenever a study produces findings that relate to the processability hierarchy, it confirms the predictions derived from the hierarchy. There is not a single piece of counterevidence to the predictions. The only limitation is that, even though we reviewed a very extensive database, not all structures contained in the Swedish processability hierarchy are covered in empirical studies and, conversely, not all structures covered in empirical studies are discriminated with the same resolution as in some of the highly refined implicational analyses.

In other words, the sizable body of SLA research produced in Sweden over the past two decades lends strong empirical support to processability theory. This theory spells out the assumption that SLA can be understood as the gradual construction of the computational mechanisms needed for processing the second language. However, this is by no means the last word on the acquisition of Swedish as a second language or about processability theory. The framework presented in this paper raises new questions for both research on Swedish and processability theory generally.

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NOTES

1. It has been noted that the potential components of a theory of learnability interact: The stronger the first, the weaker the second and vice versa or, in the words of Bates, MacWhinney, and Smith (1982):

> as Pinker (1979) and Braine (1978) both noted, the Wexler and Culicover conclusion is not the only one that can be reached with learnability analysis. The strength of

their (W & C's) fourth parameter (i.e., innate hypotheses) is required only because of the value they have assigned to the other three. (p. 15)

2. In this context, *word* is not defined as in the target language and may include chunks such as *how are you today?*

3. Not all phrases have lexical heads. However, all phrases have unique heads, some of which may be functionally controlled (Bresnan, 1982). For the purpose of this paper, we will simplify matters and exemplify the language generation process on the basis of phrases and clauses with lexical heads.

4. In this context, the reader may wonder what motivated Pienemann (1998b) to implement this hierarchy of processing resources into a theory of grammar rather than directly into IPG, which is a processing grammar. Pienemann decided against this option for several reasons. He demonstrated that feature unification, which is one of the main characteristics of LFG, captures a psychologically plausible process that involves (a) the identification of grammatical information in the lexical entry, (b) the temporary storage of that information, and (c) its utilization at another point in the constituent structure. He also demonstrated that feature unification is one of the key processes in morphology and word order, the two areas to be studied in the empirical sections of this paper. Every level of the hierarchy of processing resources can be represented through feature unification. In other words, the essence of that hierarchy can be captured through feature unification in LFG.

A proviso on this is that the procedures that underlie LFG cannot be understood to represent psychological procedures themselves. Instead, they can be considered a shorthand notation that contains the necessary elements to relate structures to a hierarchy of processability. The LFG formalism is designed to be highly noncommittal as to when unifications are performed. They can be done incrementally, as each phrase is built, or at the end, when an entire c-structure has been constructed (see Maxwell & Kaplan, 1995, for some discussion). Because processability theory assumes strict limits on grammatical memory, it would follow that unifications ought to be done as soon as possible.

The limitations on memory are relevant to a further feature of LFG, which is that the theory in its present form imposes no limitations on the amount or nature of information that can be transferred between constituents by unification. For example, arbitrarily complex substructures can be built in different constituents and checked for consistency. This possibility has been shown to lead to the possibility of writing LFG grammars for highly unnatural kinds of languages (Berwick & Weinberg 1984, pp. 107–114) and to computational intractability (Barton, Berwick, & Ristad, 1987, pp. 103–114). In processability theory, learners are assumed not to have an unlimited and unconstrained ability to unify information from different constituents but rather to have gradually acquired it. This suggests that the LFG theory should be modified so that information flow between constituents is inherently restricted. We will use the LFG system with the informal assumption that unification occurs at the lowest node shared by the source and the destination of the unification.

5. Note that the hyphenated morpheme breaks, as well as the zero morpheme ∅, do not appear in Swedish orthography but are included in the examples for ease of analysis.

6. The question of whether or not Swedish also has an aspectual system and how this is acquired (see Noyau, 1992) is not relevant here. Instead, our main concern is the morphological markings, for example, the phrasal morphology used in unification of the feature TENSE between verbs.

7. Within the set of studies that examine morphosyntactic development, we included those that are published, and for all researchers we chose the main exposition of their work.

8. The processability hierarchy developed in this paper for Swedish does not discriminate between the two contexts for INV because we chose not to utilize the saliency principle, which would indeed have allowed us to distinguish between these structures from a processing perspective.

REFERENCES

Andersson, A.-B. (1992). *Second Language Learners' Acquisition of Grammatical Gender in Swedish*. Gothenburg Monographs in Linguistics 10. University of Gothenburg, Sweden.

Axelsson, M. (1994). *Noun phrase development in Swedish as a second language: A study of adult learners acquiring definiteness and the semantics and morphology of adjectives*. Stockholm: Centre for Research on Bilingualism, Stockholm University.

Barton, G. A., Berwick, R. C., & Ristad, E. S. (1987). *Computational complexity and natural language*. Cambridge, MA: MIT Press.

Bates, E., MacWhinney, B., & Smith, S. (1982). Pragmatics and syntax in psycholinguistic research. In

S. W. Felix & H. Wode (Eds.), *Language development at the crossroads: Papers from the interdisciplinary conference on language acquisition at Passau* (pp. 11–30). Tübingen: Gunter Narr.
Berwick, R., & Weinberg, A. (1984). *The grammatical basis for linguistic performance: Language use and language acquisition*. Cambridge, MA: MIT Press.
Bolander, M. (1987). *"Man kan studera inte så mycke": Om placering av negation och adverb i vuxna invandrares svenska* ["One can study not so much": On placement of negation and adverbs in adult immigrants' Swedish]. Stockholm: Department of Linguistics, Stockholm University.
Bolander, M. (1988). Is there any order? On word order in Swedish learner language. *Journal of Multilingual and Multicultural Development, 9,* 97–113.
Bresnan, J. (Ed.). (1982). *The mental representation of grammatical relations.* Cambridge, MA: MIT Press.
Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge, MA: MIT Press.
Clahsen, H. (1992). Learnability theory and the problem of development in language acquisition. In J. Weissenborn, H. Goodluck, & T. Roeper (Eds.), *Theoretical issues in language acquisition: Continuity and change* (pp. 53–76). Mahwah, NJ: Erlbaum.
Colliander, G. (1993). Profiling second language development of Swedish: A method for assessing L2 proficiency. In B. Hammarberg (Ed.), *Problem, process, product in language learning. Papers from the Stockholm-Åbo Conference 1992* (pp. 32–47). Stockholm: Department of Linguistics, Stockholm University.
De Bot, K. (1992). A bilingual production model: Levelt's "speaking" model adapted. *Applied Linguistics, 13,* 1–24.
Felix, S. W. (1984). Maturational aspects of universal grammar. In A. Davies, C. Criper, & A. Howatt (Eds.), *Interlanguage* (pp. 133–161). Edinburgh, UK: Edinburgh University Press.
Felix, S. W. (1991). Accessibility of UG in second language acquisition. In L. Eubank (Ed.), *Point-counterpoint: Universal Grammar in the second language* (pp. 89–104). Amsterdam: Benjamins.
Garrett, M. F. (1976). Syntactic process in sentence production. In R. Wales & E. Walker (Eds.), *New approaches to language mechanisms* (pp. 231–256). Amsterdam: North Holland.
Garrett, M. F. (1980). Levels of processing in sentence production. In B. Butterworth (Ed.), *Language production: Vol 1. Speech and talk* (pp. 177–220). San Diego, CA: Academic Press.
Garrett, M. F. (1982). Production of speech: Observations from normal and pathological language use. In A. W. Ellis (Ed.), *Normality and pathology in cognitive functions* (pp. 19–76). San Diego, CA: Academic Press.
Gregg, K. (1996). The logical and developmental problems of second language acquisition. In W. C. Ritchie (Ed.), *Handbook of second language acquisition* (pp. 49–81). San Diego, CA: Academic Press.
Håkansson, G., & Dooley Collberg, S. (1994). The preference for Modal + Neg: An L2 perspective applied to L1 children. *Second Language Research, 10,* 95–124.
Håkansson, G., & Nettelbladt, U. (1993). Developmental sequences in L1 (normal and impaired) and L2 acquisition of Swedish syntax. *International Journal of Applied Linguistics, 3,* 131–157.
Håkansson, G., & Nettelbladt, U. (1996). Similarities between SLI and L2 children: Evidence from the acquisition of Swedish word order. In J. Gilbert & C. Johnson (Eds.), *Children's language* (Vol. 9, pp. 135–157). Mahwah, NJ: Erlbaum.
Hammarberg, B. (1996). Examining the processability theory: The case of adjective agreement in L2 Swedish. In E. Kellerman, B. Weltens, & T. Bongaerts (Eds.), *EUROSLA 6. A Selection of papers. Toegepaste taalwetenschap in artikelen 55.* Amsterdam: Anéla, The European Second Language Association.
Hulstijn, J. (1990). A comparison between the information-processing and the analysis/control approaches to language learning. *Applied Linguistics, 11,* 30–45.
Hyltenstam, K. (1977). Implicational patterns in interlanguage syntax variation. *Language Learning, 27,* 383–411.
Hyltenstam, K. (1978). Variation in interlanguage syntax. *Lund University Department of Linguistics Working Papers 18*. Lund, Sweden: Department of Linguistics, Lund University.
Källström, R. (1990). *Kongruens i svenskan* [Agreement in Swedish]. Unpublished doctoral dissertation. Gothenburg University, Sweden.
Kaplan, R., & Bresnan, J. (1982). Lexical-functional grammar: A formal system for grammatical representation. In J. Bresnan (Ed.), *The mental representation of grammatical relations* (pp. 173–281). Cambridge, MA: MIT Press.
Kempen, G., & Hoenkamp, E. (1987). An incremental procedural grammar for sentence formulation. *Cognitive Science, 11,* 201–258.
Lahtinen, S. (1993). Om nominalfrasens struktur och feltyperna *en* (*gul*) *bilen* och *det gula bilen* i

finska gymnasisters inläraresvenska [On noun phrase structure and the error types *en* (*gul*) *bilen* and *det gula bilen* in Finnish students' learner Swedish]. In V. Muittari & M. Rahkonen (Eds.), *Svenskan i Finland 2* (Meddelanden från institutionen för nordiska språk 9, pp. 85–98). Jyväskylä, Finland: Jyväskylä University.

Levelt, W. J. M. (1978). Skill theory and language teaching. *Studies in Second Language Acquisition, 1,* 53–70.

Levelt, W. J. M. (1983). Monitoring and self-repair in speech. *Cognition, 14,* 41–104.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

Maxwell, J. T., & Kaplan, R. M. (1995). The interface between phrasal and functional constraints. In M. Dalrymple, R. M. Kaplan, J. T. Maxwell, & A. Zaenen (Eds.), *Formal issues in Lexical-Functional Grammar* (pp. 571–590). Stanford, CA: CSLI Publications.

McLaughlin, B. (1987). *Theories of second language learning*. London: Arnold.

McLaughlin, B., Rossman, T., & McLeod, B. (1983). Second language learning: An information-processing perspective. *Language Learning, 33,* 135–157.

Meisel, J., Clahsen, H., & Pienemann, M. (1981). On determining developmental stages in second language acquisition. *Studies in Second Language Acquisition, 3,* 109–135.

Noyau, C. (1992). *La temporalité dans le discours narratif: Construction du récit, construction de la langue* [Temporality in narrative discourse: Construction of narrative, construction of language]. Unpublished doctoral dissertation, University of Paris VIII.

Paradis, M. (1987). *The assessment of bilingual aphasia*. Mahwah, NJ: Erlbaum.

Pienemann, M. (1998a). Developmental dynamics in L1 and L2 acquisition: Processability theory and generative entrenchment. *Bilingualism, Language, and Cognition, 1,* 1–20.

Pienemann, M. (1998b). *Language processing and second language development: Processability theory*. Amsterdam: Benjamins.

Pinker, S. (1979). Formal models of language learning. *Cognition, 7,* 217–283.

Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.

Rahkonen, M. (1993). Huvudsatsfundamentet hos finska inlärare av svenska och svenska inlärare av finska [The main clause foundation among Finnish learners of Swedish and Swedish learners of Finnish]. In V. Muittari & M. Rahkonen (Eds.), *Svenskan i Finland 2* (Meddelanden från institutionen för nordiska språk 9, pp. 199–225). Jyväskylä, Finland: Jyväskylä University.

Salameh, E.-K., Håkansson, G., & Nettelbladt, U. (1996). The acquisition of Swedish as a second language in a group of Arabic-speaking pre-school children: Word order patterns and phrasal morphology. *Logopedics Phoniatrics Vocology, 21,* 163–170.

Schmidt, R. (1992). Psychological mechanisms underlying second language fluency. *Studies in Second Language Acquisition, 14,* 357–385.

Slobin, D. I. (1982). Universal and particular in the acquisition of language. In E. Wanner & L. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 128–172). New York: Cambridge University Press.

Viberg, Å. (1991). *En longitudinall djupstudie av språkutvecklingen* [A longitudinal study of language development]. (Utvärdering av skolförberedelsegrupper i Rinkeby. Rapport 4). Stockholm: Centre for Research on Bilingualism, Stockholm University.

Viberg, Å. (1993). Crosslinguistic perspectives on lexical organisation and lexical progression. In K. Hyltenstam & Å. Viberg (Eds.), *Progression and regression in language* (pp. 340–385). New York: Cambridge University Press.

Wexler, K. (1982). A principle theory for language acquisition. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 288–315). New York: Cambridge University Press.

Wexler, K., & Culicover, P. (1980). *Formal principles of language acquisition.* Cambridge, MA: MIT Press.