A brief history of processing approaches to SLA: reply to Mellow

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Reply

A brief history of processing approaches to SLA: reply to Mellow

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In his article Mellow claims that the 'predictive model' is based on a transformational analysis of word formation. We will show that this is incorrect and that instead, the model is based on the psychological concept of exchange of linguistic information. Therefore, Mellow's evaluation of various types of transformational analyses is quite irrelevant for the model.

To demonstrate our point we will reproduce the full text of the original description of the 'predictive model'. We will show that the transformational connection should properly be traced to Clahsen's strategies which apply to syntax only. The strategies approach will then be described in contrast to the 'predictive model' in order to characterize the two approaches and their historical context. This will provide the background to a brief critique of the strategies approach. Theory formation in later processing approaches to SLA will then be sketched out briefly before addressing several points of detail in Mellow's article.

I Introduction

The focus of Mellow's article is stated very clearly: 'It is ... important to emphasize that this article critiques [*sic*] only the P&J analysis of developmental sequences in morphology.[1] The key point in Mellow's article is his claim that the 'predictive model' is based on the assumption that '... *morphemes may be moved by syntactic transformations in order to create multimorphemic words.*' (p. 311, emphasis added). In other words, Mellow believes that the 'predictive model' is based on a transformational analysis of word formation in English.

The main line of our response is as follows: Mellow misconstrues

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[1]Mellow, this volume, Footnote 1.

the 'predictive model' which is *not* based on a transformational analysis of word formation. Instead it is based on the psychological concept of transfer of linguistic information. This means that Mellow's evaluation of various types of transformational analyses is quite irrelevant for the model. The reader can verify this easily by consulting the original descriptions of the 'predictive model' (Pienemann and Johnston, 1987a; Pienemann, 1988; Pienemann *et al.* 1988). Because these descriptions are very brief we will repeat them below.

This article will thus be structured as follows: first, we will reproduce the full text of the original description of the 'predictive model'. We will then demonstrate where Mellow's interpretation goes off the track, particularly in relation to the transformational connection which should properly be traced to Clahsen's (1984) strategies. The strategies approach will then be described in contrast to the 'predictive model' in order to characterize the two approaches and their 'historical' context which will provide the necessary background to a summary of a critique of the strategies approach. Theory formation in later processing approaches to SLA will then be sketched out briefly before addressing several points of detail in Mellow's article.

II The predictive model

The 'predictive model' was conceived of as a revision and extension of the psycholinguistic dimension of the work on SLA by Meisel *et al.* (1981) and Clahsen (1984). This revision was situated in a specific context in SLA research and psycholinguistics. In SLA research the idea that language processing constrains language acquisition was discussed by several scholars (e.g., Levelt, 1978; McLaughlin, 1987; Hulstijn, 1990). At the same time some aspects of the psycholinguistic work on which Clahsen's strategies were based were being critically examined. The point of the 'predictive model' was to go beyond merely pointing out the possible connection between processing prerequisites and the development of grammar. It did this by hypothesizing testable mechanisms for the interaction between the two and by applying these mechanisms to new structural areas and new languages. We have described the 'predictive model' in Pienemann (1988), Pienemann *et al.* (1988) and, in a more peripheral way, in Pienemann and Johnston (1987a). Here is the full text of the description in Pienemann *et al.* (1988: 223[2]) which also appeared in Pienemann (1988).

[2]Reprinted with permission of Cambridge University Press.

In a recent paper Pienemann & Johnston (1987[b]) revised and extended ... [Clahsen's (1984)] processing approach to SLA and showed that certain aspects of the L2 grammar are initially not accessible to the learner, despite the fact that they may exist in the L1. This concerns especially the organization of lexical material into syntactic categories, which are crucial prerequisites for speech parsing. Categories are required for the insertion of local and non-local morphemes and most word order-alterations, thus for two important ways of expressing grammatical relations such as 'subject of'. It was demonstrated that initially the learner organizes his/her interlanguage around non-linguistic processing devices and gradually builds up language-specific and target language-specific processing devices.

Table 1 Prediction for stages of acquisition

Transfer of information	Morphology	Gramm. categories	Word order
[[w] [x] [y] [z]]	non-local	phrase structure accessible	sentence-internal operations
[w x [y] z]	local	lexical items from L2 indexed for some categories	internal-to-final/internal-to-initial operations
[w x y z]	none	lexical items from L2 not indexed (i.e. phrase structure not accessible)	initial-to-final/ final-to-initial operations
w x y z			
x	none		canonical order

Table 1 summarizes this approach. The strings in the left-hand column correspond to the word order rules outlined above, except that the line at the bottom of Table 1 has been added to represent single-constituent utterances. Table 1 illustrates that the *transfer of information* [emphasis added] in a sentence is constrained by the available processing prerequisites: since the lexical material has not been organized into categories, phrase structure rules are not accessible to the learner. Thus he/she would not be able to identify elements within the sentence from which information has to be taken or to which information has to be brought – as is the case in the parsing of mature language where such information as 'x is subject of y' or 'subject = third person' can be held in short term memory and utilized at a later point in the sentence for agreement marking etc.

Thus, the first operations which involve such re-organizations of information (e.g. ADV) are carried out on the basis of non-language-specific position markers, i.e. the salience of initial and final positions. Since the interlanguage grammar does not operate on categories at this point in time, there is no way morphemes can be inserted.

At the following stage the learner can identify elements in sentence internal position by use of category distinction. However, the grammatical information

> kept in short term memory is only transferred into the computationally easier salient positions. Since agreement markings potentially involve the transfer of information into sentence internal position, we find only local morphemes at this stage, but no agreement marking. The latter only appears at the subsequent stage where the transfer of information is no longer constrained.

This description makes it perfectly clear to the reader that the key concept of the 'predictive model' is that of *transfer of pieces of grammatical information* such as 'subject = third person', not the movement of constituents as it would be conceived of in a transformation analysis. The above text, which is the main expositional of the 'predictive model', does not contain any proposal for a morphological analysis, transformational or otherwise. At the time the exact nature of the morphological process was deliberately left open. Instead, the model was based on the grammatical information that fed into the morphological processor.

It is therefore quite incorrect to say that '. . . [P&J] developed a syntactic analysis of word formation' (Mellow, p. 306) and that '. . . P&J suggested that a sequence such as [Noun Verb+affix] (e.g., "Mary walk+s") is a linear sequence of virtual words which may be subject to the same type of *movement transformation* [emphasis added] that results in subject-auxiliary inversion in *wh*-questions' (Mellow, p. 306).

Given that we did not propose a syntactic analysis of word formation one wonders what purpose it serves to demonstrate in a critique of the 'predictive model' that such an analysis '. . . is not compatible with a syntactic approach to word formation' (Mellow, p. 311). The three pages of Mellow's article devoted to this topic which make up the thrust of his critique are quite irrelevant to the 'predictive model'.

One might wonder why Mellow missed the point by such a wide margin. One reason may be that he chose to base his critique primarily on the least explicit exposition of the 'predictive model' – that presented in Pienemann and Johnston (1987a). This appeared in a book designed as '. . . an introduction to the field of second language acquisition for classroom practitioners' and which '. . . does not assume specialized knowledge in the field' (book cover). Here is what we had to say about the morphological process in that publication:

> The third person '-s' marker contains information whose source is a noun phrase or a pronoun. In linear production the simplest place to put the information contained in the third person '-s' is right after the source of the information – that is, right after the pronoun or noun phrase. However, this is not what the rules of English require. Instead the marker has to be moved to

> the end of the finite verb following the pronoun or the noun phrase (Pienemann and Johnston, 1987a: 79–80).

Again, we refer to a '*marker [which] contains information*' and we discuss where the speaker places '*the information contained in the third person "-s"* '.

It may have been the last sentence in the above quotation which caused Mellow's misunderstanding about the transformational connection: '. . . the marker has to be moved.' The use of the word 'move' may have evoked a transformational connotation. However, given the nontechnical context of this book the metaphorical use of the word 'move' was felt to be appropriate. In fact, when the word 'movement' was used further on in the text we put it in quotation marks, and later we say 'It does not matter how one visualizes the operation [i.e., the production of third person "-s"]' (Pienemann and Johnston, 1987a: 80). In other words, in this publication too, *there is no explicit account of the morphological process.*

It would indeed be rather far-fetched to construe the mere metaphorical use of the word 'move' as a complete syntactic analysis of word formation based on syntactic transformations. This is how Mellow presents the 'predictive model'. In our view, the meaning of 'transfer of information' was quite clear in the 1987 publication. However, if Mellow had had any doubt he could have easily verified the proposed information processing perspective by consulting the more explicit 1988 publication, the relevant section of which we quoted in full above. After all, he does explicitly quote this publication.

Let us now move to a related point of confusion in Mellow's article, namely, our reference to Selkirk's (1982) book *The syntax of words*. Mellow (p. 311) states that: 'P&J (78–80) claimed that Selkirk's (1982) generative theory of word formation supported their view that morphemes may be moved by syntactic transformations in order to create multimorphemic words. However, Selkirk (1982: 69–71) claimed the opposite of what P&J suggested.' The reader will soon see that this is incorrect. However, before we demonstrate this, it is worth while noting that the alleged contradiction between analysis and quotation forms the basis for Mellow's eagerness to educate SLA researchers: '. . . L2 researchers must ensure that models of SLA are solidly grounded in foundational theories' (Mellow, p. 304). Let us look at what we did in fact say about Selkirk (1982). For this purpose, we will quote extensively from the 1987 study to give the reader a feel for the context of the Selkirk reference. We would like to add that the

quotation below represents the full extent to which we ever utilized her work:

> One of the concerns of research in speech processing has been to establish the psychological 'reality' (we prefer the less categorical term 'plausibility') of the various units which grammarians used in their descriptions of language, units such as 'clause', 'word', and so on. Amongst the units investigated in this way is the morpheme, the meaning unit represented in English by, for example, '-ed', '-ing', and '-s'. While the research done in this area has not been extensive, experiments involving such phenomena as the memorization and recall of contrasted pairs like 'see' and 'seen' versus 'see' and 'seed' seem to indicate quite strongly that, like the clause and the word, this traditional unit of grammar is a meaningful one in speech processing (Morton, 1981). This led to the hypothesis that the morpheme could be considered as a kind of word, restricted in certain ways that did not apply to lexical words, but nevertheless sharing many of their properties. Working from the perspective of syntactic theory, rather than speech processing, Selkirk (1982) comes to very similar conclusions; words themselves can be considered as 'mini-sentences' and while not all of the syntax of true sentences applies to them, a significant portion does. Selkirk's work thus helps to confirm our own hypothesis and Morton's speech processing findings (Pienemann and Johnston, 1987a: 78).

This quotation makes it clear that the context here is the question of the *psychological plausibility* of linguistic units. One has to remember that this publication was written for newcomers to SLA research. The above passage introduces the reader to the notion that units of linguistic analysis and units of speech processing do not have to be identical, and it makes the point – in a summative way – that there is experimental evidence to support the view that the unit 'word' is psychologically plausible. This is relevant because the psychological plausibility of units of speech planning is a prerequisite for the concept of transfer of grammatical information as a productive one in our model: grammatical information is transported from units to other units and across unit boundaries. These concepts form the basis of our mechanistic view of L2 processing prerequisites.

Why did we mention Selkirk (1982) here? It provided additional evidence from linguistic theory in support of the view that words have phrasal status. In other words, we did not refer to Selkirk (1982) to support an alleged transformational analysis of morphology. This interpretation is entirely Mellow's own extrapolation which was based on his incorrect assumption that we proposed a transformational analysis of morphology.

III The real transformational connection: Clahsen's strategies approach

The main reason which may have contributed to Mellow's misconception that the 'predictive model' is a transformational one is its historical relationship with other theoretical modules; the multidimensional model and Clahsen's (1984) strategies which are also utilized in the Teachability Hypothesis (Pienemann, 1981; 1987; 1989). We will therefore characterize the strategies approach below.

The reader will recall the stages in GSL word order acquisition found in the ZISA study (Meisel *et al.*, 1981):

x			canonical order
x	+	1	adverb preposing (ADV)
x	+	2	verb separation (SEP)
x	+	3	INVERSION (INV)
x	+	4	verb final (V-END)

This sequence was explained by Clahsen (1984) with reference to 'speech processing strategies'. Clahsen (1984) assumes a set of speech processing strategies which constrain the otherwise overly powerful grammar of the learner. These strategies are stated below:

1) Canonical Order Strategy (COS): 'In underlying sequences $[x_1 + x_2 \ldots X_n]_{Cx}$ [ ] $_{Cx+1}$ [ ] $_{Cx+m}$, in which each of the subconstituents contributes information to the internal structure of the constituent C_x, no subconstituent is moved out of C_x, and no material from the subsequent constituents C_{x+1}, C_{x+2}, C_{x+n} is moved into C_x' (p. 221).
2) Initialization–Finalization Strategy (IFS): 'In underlying sequences, [X Y Z]s permutations are blocked which move X between Y and Z or Z between X and Y' (p. 222).
3) Subordinate Clause Strategy (SCS): 'In subordinate clauses permutations are avoided' (p. 223).

This work was originally carried out in the late 1970s (Clahsen, 1979). Clahsen based these strategies on research into speech processing and language acquisition. COS was based on Bever's (1970) experiments on comprehension. IFS was based on findings from memory research. Last, SCS is based on the finding that subordinate clauses are processes in a different mode than main clauses. Table 1 shows schematically how the above strategies explain the observed order of acquisition.

In principle, the above strategies are understood as heuristic principles which allow the learner to short cut the comprehension-

production process. For instance, the COS, which is based on Bever's (1970) postulation of an NVN strategy, permits direct mapping of semantic structure on to syntactic forms.

Table 1 Order of acquisition

Stage	Rule	Strategies		
x	canonical order		+COS	+SCS
x + 1	adverb preposing	+IFS	+COS	+SCS
x + 2	verb separation	+IFS	–COS	+SCS
x + 3	INVERSION	–IFS	–COS	+SCS
x + 4	verb final	–IFS	–COS	–SCS

And here is the transformational connection. In the psycholinguistic discussion of the 1970s Bever-style strategies were conceptualized as 'performance shortcuts' of the derivational process. This view reconciled two seemingly opposed sets of facts, namely, 1) the validity of the transformational theory of the time as a property theory; and 2) its lack of psychological plausibility.

Clahsen (1984) related these strategies to the concept of *psychological complexity*. Following research into sentence comprehension, he assumed that the psychological complexity of a structure is dependent on the degree of *reordering and rearrangement* of linguistic material involved in the process of mapping underlying semantics on to surface forms. From this perspective he views the acquisition process as a process of *constraint shedding*. It is important to note that this approach made successful predictions not only for the above set of word order rules but also for a larger set of syntactic rules. However it was always limited to the domain of word order.

IV Critique of Clahsen's strategies

Given that Clahsen's approach was based on psycholinguistic concepts which were developed more than 20 years ago it is not surprising that his perspective is now at odds with more recent research. Quite naturally scholars pointed out the shortcomings of this approach. Within the limited space given it will be impossible to discuss these at length. A brief summary will have to suffice. The following points of criticism have been raised against Clahsen's paradigm. In fact, several of these points are our own criticism and they motivated us to revise and extend Clahsen's framework:

- The status of grammar in language acquisition remains unclear. Generally speaking, interlanguage grammars are under-

determined by the strategies available to the learner at any given stage of acquisition. To put this in bolder words: the learner does not have sufficient information to go by for the construction of interlanguage speech on the basis of strategies alone. Strategies can only operate as complements to a grammar, not as grammar substitutes.

- Strategies are stated in such a way that they are constraints on movement transformations as conceptualized in transformational grammar. This has a rather important side-effect: the strategies approach is set up to prevent the movement of 'materialized' subconstituents across the boundaries of major constituents. This view automatically limits the strategies approach to the domain of word order. In our own approach we attempt to overcome this limitation by interpreting processing constraints terms of *transfer of abstract grammatical information* across constituent boundaries.
- A further problem with the 'strategies' approach has been pinpointed by White (1989; 1991). This is that processing strategies are based on comprehension-related phenomena and formulated through the interpretation of empirical findings on comprehension, although it is clear that comprehension and production are not mirror images of each other. The NVN strategy (Bever, 1970), in particular, accounts for observational facts in speech comprehension.
- A final problem with the processing approach is its relation to learnability and extendibility (e.g., Pinker, 1984). We have noted above that the set of strategies given in Clahsen's framework are not sufficient prerequisites for the learnability of the structures in question. At the same time they serve to predict the order of complexity once the structures are described with recourse to an additional paradigm, namely, aspects of a grammatical formalism. Only in this latter sense is the processing approach predictive.

Despite all the criticism of the 'strategies' approach, and the way it has been applied to explaining language acquisition, it remains a fact that all its predictions about word order have turned out to be rock solid. One is therefore entitled to ask whether this is merely a coincidence or whether some part of the approach generated the predictions it was designed to generate.

In the light of Mellow's critique and given that he attributes some of the basic design features to the predictive model that hold for Clahsen's strategies but not for the model, we have to point out that the predictive model was designed with the above critique in

mind. In fact, our critique goes beyond the points made by White (1989; 1990). The motivation for the predictive model stems mainly from this critique of ours. In other words, the predictive model is a developmental step towards designing a psychologically more parsimonious model of language acquisition.

V The story after strategies

The first step in the attempt to overcome the limitation of the strategies approach was to go beyond the concept of constituent structure linearity for a definition of processing complexity. The latter concept was replaced by the explication of processing prerequisites which were spelt out in terms of transfer of grammatical information. These are concepts used in the predictive model for the reasons outlined above.

The fundamental point that language acquisition can be viewed as the acquisition of procedural skills has been made by several authors (Levelt, 1977; McLaughlin *et al.*, 1983; McLaughlin, 1987; Hulstijn, 1990; Schmidt, 1992). One might characterize the perspective of the above authors as the 'procedural skill approach' to SLA.

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 nonconscious attention, because the locus of attentive processes is short-term (or immediate) memory, and its capacity is limited to fewer operations than are required for most of the simplest utterances. Such language production mechanisms have to be assumed to be highly automated. Language acquisition therefore has to be viewed as the process of automation of linguistic operations.

This is where our own critique of the ten-year-old predictive model starts: to transform this global view of skill automation into a productive research perspective one has to give a principled account of those automated operations. In our view this is possible only by utilizing a theory or compatible set of theories that spell out those automated operations. 'Processability theory' (Pienemann, 1995; Pienemann and Håkansson, 1995) utilizes two theoretical components to achieve this goal: 1) Levelt's (1989) skill-based approach to language production; and 2) Bresnan's (1982) Lexical Functional Grammar. Following from Levelt's work, Pienemann develops a hierarchy of processing prerequisites for the acquisition of L2 grammar. He then implements this hierarchy

into a psychologically plausible theory of grammar, LFG. This last step makes it possible to apply the processability approach to typologically different languages and to a wide array of structural domains.[3]

This approach overcomes the limitations of the strategies approach pointed out above:

- *The role of grammar* Rather than assuming a set of strategies which operate on grammar, processes which create complexity are identified and implemented into a theory of grammar.
- *Restriction to movement* This limitation of the strategies approach was the result of the choice of grammatical theory, namely, transformational grammar. In Processability Theory, processing factors are implemented into Lexical Functional Grammar, a grammatical theory which is based on the systematic utilization of a psychologically plausible operation: feature unification. This process has implications for syntax and morphology.
- *Comprehension and production* Processing strategies were conceptualized as short-cuts within a full derivational process of TG. The features of language processing utilized in Processability Theory are far more general in nature. They are related to the linearity of speech production, the depth of processing and the transfer of grammatical information (for a detailed discussion of these points, cf. Pienemann, 1995; Pienemann and Håkansson, 1995).

VI Variation and acquisition criteria

Let us refocus on a number of details in Mellow's article. Our main intention was to address the key point he makes. However, he also

[3]Comparing the lexical entries for 'he' and 'talks'/'talked' in the sentences 'he talks' and 'he talked' illustrates the basic working of processability theory for morphology:

1)	$[he]_{NPsubj}$		$[\ [talk\text{-}s]\ \ldots]_{VP}$	(present, imperfect)
	PERSON	= 3	PERSON	= 3
	NUM	= sg	NUM	=sg
2)	$[he]_{NP}$subj		$[\ [talk\text{-}ed]\ \ldots]_{VP}$	(past, imperfective)
	talked: V		PRED = 'TALKED' <SUBJ, OBJ>	
			TENSE = PAST	

Sentences (1) and (2) contain examples of phrasal and interphrasal morphology. In 'talked' the information TENSE = PAST is accessible to the morphological processor upon accessing the lexical item 'talked'. In other words, this information is local to the phrase in which the morphological rule is applied. On the other hand, for the marking of agreement on the verb the features NUM (= SG) and PERS (= 3) have to be unified between NP_{subj} and verb, and major constituent boundaries have to be crossed in the process. In terms of information transfer it is now possible to hypothesize that phrasal morphemes require fewer processing prerequisites than interphrasal morphemes and that the first will therefore develop earlier.

makes numerous references to smaller points of detail, many of which are incorrect, and we would like to set the record straight on some of the more relevant points.[4]

Referring to Hudson (1993), Mellow (p. 310) claims that '. . . the empirical basis of the variational dimension of the MDM is seriously flawed'. Mellow claims further that 'This rejection of the variational dimension was acknowledged by Pienemann *et al.* (1993: 498)' (Mellow, p. 310). This is quite incorrect. We refer the reader to our response to Hudson (Pienemann *et al.*, 1993). The reader will see that Hudson confused the empirical evidence needed for the hypothesized interaction between variation and sociopsychological factors with the straightforward descriptive linguistic evidence for linguistic variation in interlanguage. There can be no doubt that interlanguage variation exists.

In view of this and our response to Hudson it is inexplicable what motivated Mellow to claim that the '. . . rejection of the variational dimension was acknowledged by' us. In this context it is worth noting that Mellow, despite our reply to Hudson, labels the variational dimension as 'sociopsychological' (p. 305). Our careful explanation of the purely linguistic nature of this dimension seems to have escaped Mellow's attention.

Mellow's failure to understand the nature of variation in the MDM would appear to lead to what he has to say about the acquisition criteria we employ. Mellow claims that the emergence criterion of the MDM constitutes a major limitation. He states (p. 310):

> The developmental dimension of the MDM is primarily concerned with the beginning of the acquisition of certain structures . . . Thus, it appears that the hypotheses of the MDM are . . . not concerned with . . . the acquisitional

[4] We would also like to draw the reader's attention to an ambiguous statement in Mellow's article concerning the evidence provided by us for the 'predictive framework'. Mellow (p. 307) states: '. . . the research reported in P&J was primarily theoretical and predictive, rather than empirical data supporting these English developmental sequences [*sic*] . . . However, P&J . . . did report that their prediction regarding third person singular *-s* was "borne out" in the data in Johnston (1985).' This is followed by a critical footnote. Does the 'however' and the 'borne out' suggest that there is a contradiction? Or is there doubt about the validity of Johnston (1985)? If not, why is this mentioned here? Either there is empirical evidence or there isn't. One cannot help wonder whether Mellow has actually read the SAMPLE material. To put it clearly on the record: the P&J findings for English were based on 700 pages of transcript and extensive computer-aided analysis. Subsequently, the same data were reanalysed in terms of the 'predictive framework', and an implicational analysis of the results for hypothesized developmental features appeared in Pienemann *et al.* (1988), a study quoted by Mellow, even though in a distorted context: 'Pienemann *et al.* (1988) appear to have used the P&J model to develop a procedure for English second language assessment' (p. 308). Not only did we *use* the P&J model in this publication, as we pointed out above, but it also contains the most explicit account of the model. One should note that this assessment procedure is based on no less than the extensive database in Johnston (1985) and draws its descriptive validity from the dynamic analysis of these data.

> process that occurs after first emergence ... or the accuracy with which a structure is used.

The reader only needs to consult Meisel *et al.* (1981) to see that this is incorrect. Rather than being a limitation the emergence criterion overcomes the arbitrary nature of quantitative criteria. At the same time a quantitative analysis is part of a wider dynamic analysis of the developing and varying interlanguage, and this analysis is naturally concerned with 'the acquisitional process that occurs after first emergence and the accuracy with which a structure is used'. The quantified distributional analysis to which the emergence criterion is applied describes the acquisition process after emergence in painstaking detail. In this context a quotation from Pienemann *et al.*'s (1993) reply to Hudson (1993) may be instructive:

> The two dimensions of the model are first and foremost a *linguistic framework* for the description of dynamic systems. Several of the original publications (e.g. Clahsen *et al.* 1983; Pienemann 1981) go into great detail in setting out the linguistic basis for the description of dynamic systems which utilize aspects of implicational scaling (Bickerton 1971; DeCamp 1973; Guttmann 1944) of Labov's (1972) probabilistically weighted rules and of Bailey's (1973) wave model. The purpose of this framework is to enable the researcher to represent grammatical development within a variable system. (pp. 495–96.)

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