

THE 'MICRO-STRUCTURE' OF A LEARNING PROBLEM: PROSODIC PROMINENCE, ATTENTION, SEGMENTATION AND WORD LEARNING IN A SECOND LANGUAGE

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1. Introduction: the Noticing Hypothesis

A critical component of a theory of language acquisition involves *input*, the name we give to the 'stuff' learners use as the building blocks of acquisition. There is no theory of input in language acquisition research, in general, or even a clear idea for a single learning problem of what the necessary and sufficient 'stuff' might be that learners have to be exposed to. Fundamental differences separate researchers on just about every facet of the topic. This is because one cannot determine what the input to a learning problem might be until one has a clear idea of the nature of what it is the learner has to learn, viz. mentally represent. Moreover, one must have a clear idea of what the acquisition mechanisms are. Assumptions about the nature of linguistic representation are, necessarily, assumptions about the nature of language processing (see Anderson 1978 for pertinent discussion in the domain of visual processing). In our case, representation and process are two sides of the same psycholinguistic coin, one where processes operate on environmentally available entities to create linguistic representations of some sort in memory. Much second language research (SLA) makes the mistake of assuming that models of language processing can serve as models of processing-in-acquisition. This is a mistake because language processors process speech (or written text), using what is known. A language acquisition mechanism must create *novel* representations (Fodor 1998a,b; Carroll 2001).

Consider in this regard, approaches to language acquisition which postulate that input-to-learning is necessarily something objective and observable in the speech environment.¹ Since there are an infinite number of things in the speech signal that might impinge upon our mental systems, many theories of acquisition invoke attention as a *selection mechanism* in perception and processing (Robinson 2003). Even scholars who do not explicitly invoke attention will claim that certain things are acquired (acquired early, acquired earlier) because they are 'salient' aspects of the input. To invoke salience is to invoke attention. The clearest version of this approach has been formulated by Dick Schmidt as the Noticing Hypothesis:

¹ Acquisition theories also assume support from the visual environment to support sound-meaning associations and inference. I will ignore the difficulties presented by the assumption that linguistic input has to be mapped to visual input.

- (1) The Noticing Hypothesis – Part 1
The noticing hypothesis claims that awareness at the point of learning (Time 1) is required for all learning. (Schmidt 1995: 27)

In this specific formulation, the Noticing Hypothesis is both unobjectionable and uninteresting; it claims merely that awareness is co-incident with learning. The Noticing Hypothesis becomes interesting when we construe it as a claim about attending to and noticing specific linguistic contrasts, features, or constituents in the input. This is because for specific linguistic contrasts, features, or constituents to be attended to and noticed in the input, they would have to constitute objective and measurable aspects of the speech signal. I take the quotes in (2) to provide some support for the claim that Schmidt believes that something like this might be true.

- (2) The Noticing Hypothesis – Part 2
The “noticing hypothesis” states that what learners notice in input is what becomes intake for learning. (Schmidt 1995: 20)

“SLA is largely driven by what learners pay attention to and notice in target language input and what they understand the significance of noticed input to be.” (Schmidt 2001: 3-4)

Seventy years of linguistic research provides considerable support for the claim that most of what constitutes the ‘stuff’ of linguistic knowledge does *not* occur in the input. I am referring here to such familiar and well-motivated constructs as phonemes, syllables, rhymes, accents, prefixes, suffixes, cases, gender marking, nouns, verbs, or grammatical functions like grammatical subject, as well as to more esoteric constructs like traces, *pro* or PRO. If the input is ‘out there’, then learners cannot be attending to and noticing these things.

One solution to this problem would simply be to deny the relevance of such talk about language. In other words, one might propose that this is nothing but the way linguists choose to talk about linguistic cognition, and the talk of linguists provides no adequate model of linguistic cognition. Certainly one can find much in the acquisition literature to lead one to conclude that many do believe precisely this.² This approach, however, does not save the Noticing Hypothesis; it renders it vacuous. Symbolic approaches to linguistic cognition are much more congenial to the Noticing Hypothesis in the sense that if learners are indeed noticing rhymes, nouns, or case marking as a prerequisite to learning these things, then the Noticing Hypothesis is claiming something profound about the human mind.

Now Schmidt is well aware that there is substantial evidence for *subliminal perception*, that is to say, detection of cognitive distinctions by information processors without awareness, but he rejects the significance of

² For some examples from a depressingly voluminous literature, see the papers in Rumelhart and McClelland (1986), Pinker and Mehler (1988), Niklasson and Bodén (1994) which model aspects of language acquisition.

relevant literature because it fails to show that subliminal perception and acquisition are causally related or even co-occur. Oddly enough, Schmidt has systematically refused in his various papers on attention and the Noticing Hypothesis to discuss the problem of *phonetic acquisition*, an important precursor for much phonological acquisition. This is not because he is unaware of the important problems lurking behind segmentation; in his 1995 edited volume (Schmidt 1995), Hae-Young Kim (1995) reviews some processing literature relevant to the question of what aspects of the speech signal L2 learners can attend to. However, Kim does not directly address the question of whether learners can notice the cues which are causally related to segmentation *prior* to learning how to segment in an L2. I want to argue that learning how to segment the L2 speech signal – a prerequisite for word learning since without a sound form of some kind, a learner cannot associate a meaning to it, acquire its distributional properties, or learn its internal structure – is a language learning problem which provides a *prima facie* case for learning without noticing.

I note too that this particular learning problem has an extremely complex *micro-structure*, much of which requires assumptions about the nature of linguistic structure. Investigation of this kind of problem reveals how much clarity can be brought to discussions of language learning processes when we apply the tools of linguistic analysis.

2. Language learning at the Initial Stage: the ‘wall of noise’ phenomenon

Schmidt takes self-report as an important source of evidence for the Noticing Hypothesis.³ I certainly agree that self-reports can provide useful information about the learner’s subjective experience. One of the advantages of learning another language as an adult the hard way – by total immersion in another culture and society – is that I was able to take notes of many of my subjective experiences. These are, of course, anecdotes but they are anecdotes which tend to elicit anecdotes of a similar sort and which, actually, could give rise to hundreds more in a multilingual city like Toronto or Vancouver, if only we would report on what we ‘hear’ around us. So here is my anecdote: I arrived in Germany in the summer of 1992 not knowing the language at all. I was exposed to German on a daily basis, both inside my home and outside. At the beginning, I experienced what I call a ‘wall of noise’ phenomenon. I could not ‘hear’ any recognisable sounds other than my name, *ja*, *nein*, *danke* and occasionally greetings like *Guten Tag*. It was not until the next spring, approximately 8 months later, that I began to detect recognisable sounds in the speech that I was being exposed to. During the 8 month period what I heard was an ephemeral, fleeting, unrecalable noise – I knew it was language, indeed, I knew it was German, but this knowledge made no difference to my perceptions. And then, suddenly, one day, while listening to the Tagesschau – the 8 o’clock evening news - as I set the dinner table, I heard the sounds [fas] plus something. I was

³ One of the criticisms that Schmidt makes of research claiming that learners learn things but are not aware of the ‘what’ that they are detecting is that researchers seldom ask learners what they are aware of. He therefore cannot reject my evidence about the first phase of acquisition.

not aware of what the ‘something’ was but it came to my mind, on reflection, that I might have heard either [ˈfasən] or [ˈfasuŋ] so I asked my husband what the word [ˈfasən] meant, and he said: “It doesn’t exist” (which is not quite true). He listened to the news report, which was about the German constitution, and reported to me that the newsreader had uttered the word: *Verfassung*.

There are all sorts of interesting linguistic hypotheses which one could formulate about the nature of this experience. What is important to note here is that this was the first time I had heard any of these sounds to the best of my knowledge, since I had no knowledge or recollection of anything I might have heard during the previous 8 months. My claim is that there was a certain type of acquisition which had to occur during that 8 month period to lead to this moment of creative segmentation. In other words, we can take the ‘wall of noise’ experience as one property of the initial stage of acquisition, and the ability to ‘hear’ discrete sounds as a property of a distinct stage, the two stages being related by processes of acquisition. I also want to claim that this acquisition is occurring below the threshold of awareness. In the absence of the ability to segment speech, there is nothing to be aware of except the perception of ‘noise’. Moreover, I want to claim that an L2 learner can find themselves repeatedly in this phase of acquisition if they are exposed suddenly to a new dialect. I find myself in this situation when listening to Bavarian dialect or to Sächsisch. L2 speech perception is not robust in the way that L1 speech perception; it takes more than a few minutes of listening to start recognizing familiar words in an unfamiliar dialect. In my case, knowing the phonology of German doesn’t help much – it is a lack of knowledge of the phonetics of these dialects which makes segmentation impossible for me. Finally, I want to claim that not all learners need go through this initial phase. In Scandinavia, it is reported that Danes, Swedes and Norwegians can converse each speaking his own language, without the others claiming to have learned the other languages (Braunmüller 2001). Systematic experimental study of the phenomenon remains to be done.

There is now considerable evidence and argumentation on behalf of pre-lexical processing based on language-specific properties of timing and rhythm (Buxton 1983; Cutler et al. 1983; Cutler and Norris 1988; Cutler 1988, 1992, 1996a,b; Cutler and Otake 1994; Boudelaa and Mehtah 1996). Given the differences in the timing units and systems of languages (moraic, syllabic, foot-based; mora-timed, syllable-timed, stress-timed), the ‘wall of noise’ phenomenon is actually quite surprising in this case of English L1-German L2 because the phonologies of English and German are, in this regard, quite similar. As mentioned, the learning problem exists, not at the level of phonology, but rather at the level of the phonetics. And here the problem for the Noticing Hypothesis appears to be intractable: Before the learner can segment, what is the ‘what’ that the learner might attend to and aware of, given that the phonetic cues which the learner must ultimately acquire are themselves continuous and variable, not discrete? It is important to understand this because such problems indicate quite clearly that there will be no resolving the problem of how L2 learners learn to

segment by claiming that the problems are outside of language (as Robinson 2003 wants to claim).

“... during the first stage of information processing pre-attentively processed sensory information is detected and held temporarily in the sensory register, where it is selected for perceptual encoding by attentional mechanisms” (Robinson, 2003: 634)

The truth of the matter is that at the moment we haven't a clue as to how L2 learners learn how to segment. I think we can show, however, that the problem is indeed a problem of language learning, and I think we can bring some clarity to the L2 discussion of the problem by showing that what L2 researchers appear to assume are universally salient properties of the speech signal actually reflect grammatical knowledge of abstract systems of Information Structure in particular languages (like English). The next section attempts to make this case.

3. Psycho-perceptual effects of speech processing vs. causes of segmentation in acquisition: 'Salience' and 'prosodic prominence'

As noted above, researchers often make assumptions about what is 'salient' in the input, salience being causally related to noticing:

“Learners do not selectively attend to and notice communicatively redundant, perceptually non-salient, or infrequent and rare forms in the input.” (Robinson 2003: 641)

For these researchers, what is salient or not salient appears to be a matter of common sense, rather than an empirically researchable question. Of course, nothing could be further from the truth. There is a substantial literature on speech processing which suggests quite clearly that salience is a psycho-perceptual effect. I shall limit my discussion here to only one type of salience, namely *prosodic prominence*.

The basic idea appears to be that learners will detect sound forms in the speech signal because they are prosodically prominent, i.e. salient. L2 researchers will sometimes talk about prosodic prominence as 'loudness', sometimes as 'stress' and/or 'accent' and they do so apparently in the belief that these descriptors correspond to something directly measurable in the speech signal which is independent of knowledge of the grammatical system of a given language and necessarily prosodically prominent. Not so. There is a considerable literature dealing with speech processing among users of Dutch and English, in particular, which reveals that the cues which cause this perceptual effect are complex and very abstract. Streefkerk (2002) in her doctoral dissertation asked respondents to mark prosodic prominence in a set of sentences they listened to. She found a variety of lexical, syntactic and prosodic correlates to the perception of prosodic prominence in Dutch. These included word length (longer words were perceived to be more prominent than shorter words), type of word category (which gave rise to the rank: Negation > Noun >

Adjective > Adverb > Numeral > Verb > Auxiliary Verb > Pronoun > Conjunction, Article; word length was controlled for when calculating this rank), and a variety of acoustic factors associated with focal accent. Focal accent is a phonological construct particular to only some languages (it is not universal, again something which L2 researchers do not seem to be aware of), and it is cued in the languages in which it occurs by a coalition of complex phonetic cues. Factors in determining the perception of focal accent in British English include: maximum pitch range, kinetic tone, loudness peaks, crescendo, decrescendo and combinations of these main factors (Wells 1986). Even closely related languages, which might be construed as phonologically identical, such as Dutch, English and German exhibit distinct phonetic exponents of focal accent (Eady, Cooper, Klouda, Müller and Lotts, 1986; Fowler and Housum 1987; Koopmans-van Beinum, 1990; Hirschberg, 1993; Bartels and Kingston, 1994; Ayers 1995). The conclusion to draw for the issue at hand is that there are no universal cues to focal accent and no reason to expect a simple relation between phonetic properties of the signal, the phonological construct ‘focal accent’ (which has prosodic prominence as a psycho-perceptual effect) and the triggering of that effect.

Focal accent is just one way of expressing focus, itself an abstract grammatical construct organised within *Information Structure*. According to Chafe (1995), when a referent is introduced into a discourse for the first time, it is new information and may be anchored, in that it is linked to some more identifiable referent, otherwise it is unanchored (Prince, 1981). Once in the discourse, a referent becomes identifiable (Chafe, 1995). In Chafe’s model, if a referent is identifiable, it is said to be active if it is the current focus of attention and awareness. If not active, it may be accessible if it is inferable from the situational or linguistic context or inactive if it is represented in long term memory but not in short term memory. Information structure can be integrated in this way into a set of assumptions about on-line processing of sentences in discourse, attention, and memory functions. Information structure is, consequently, a grammatical system with potentially significant processing effects and directly relevant to a discussion of salience and the Noticing Hypothesis. *Focus structure* is the name given to the conventional organisation of the distribution of information in a conceptual structure such that some bit of information is to be asserted against a set of presuppositions which the listener is assumed to know or believe (Lambrecht 1994: 213).⁴ Focal structure can be realised syntactically, lexically or phonologically through focal accent. Focal accent may map directly to the listener’s conceptual representation of an utterance (Jackendoff, 1972, 1990).

⁴ This is the standard view. Herberger (2000), in contrast, rejects the view that focus is part of information structure and argues instead that focus re-organises in Logical Form (LF) the quantificational structure of unary quantifiers. Focus is thus part of the standard semantics and has no immediate implications for language processing or attention. See Portner and Yabushita (1998) who also reject the hypothesis that we compute an independent information structure in computing meanings.

A final point to make in this section revolves on the constant confounding of causes and effects in speech processing versus input to language acquisition, in this case segmentation of sound forms and what causes one to suddenly 'hear' them. Cutler has demonstrated quite clearly that native speakers process words faster when new information is focally accented and old information is de-accented (Cutler 1976, 1988). However, accenting given information and de-accenting new information can actually slow down the perception of words (Cutler 1988). This shows that the listeners have expectations of what is given or new information from previous discourse which is preparing them to process ongoing speech. In other words, the computation of information structure and the conceptual representation of the discourse prepares the listener to seek out de-accented and focally accented constituents. As Cutler puts it: "Salience is necessarily a relative concept." (Cutler 1988: 267). Note that none of this will be relevant for the problem of learning to segment words from the speech stream as an L2 learner since, in the absence of an ability to segment, the learner will not be computing focal accent, information structure, or a discourse representation. Rather, we would be better off looking for some possibly universal sensitivity to particular acoustic properties which would help the learner to construct some initial phonetic representations. Phonetic representations, being discrete entities, will have left and right edges. In other words, they will be segments.

4. Phonetic cues to segmentation?

Hatch (1978, 1983) has suggested both stress and pause as universal cues in speculative but work which is much cited in the L2 literature. Stress is supposed to be intrinsically salient, i.e., prosodically prominent, an idea which we have now seen is problematic, to say the least. Stress, moreover, is not a phonetic construct but a phonological one and presupposes the prior segmentation of at least syllables. Pause is also treated as if it were an acoustic construct but it is, once again, a perceptual effect. Like prosodic prominence, it can be related to a variety of distinct phonetic cues and a variety of distinct linguistic functions, in particular, signalling prosodic phrase or intonational phrase boundaries, cueing syntactic phrases, or cueing points for shifts in speaker turn (Goldman-Eisler 1958, 1961a,b, 1972; Grosjean 1980; French and Local 1983, 1986; Gee and Grosjean 1993; de Pijper and Sanderman 1994; Holmes 1995; Nagel et al. 1996; Shattuck-Hufnagel and Turk 1996). More importantly, experimental studies testing if learners in the initial stage of exposure to an L2 are sensitive to pause as a cue to syntactic boundaries reveal that they are not (Henderson and Nelms 1980; Pilon 1981). These same studies suggest an initial sensitivity to what is called 'intonation' but might be construed to be kinetic tone. This is a useful beginning in that it suggests a language-independent sensitivity to one property of the signal, however, in the absence of some set of principles or constraints on how a continuous phenomenon like shifts in fundamental frequency (i.e., kinetic tone) map onto a discrete unit, it will not explain how segmentation occurs.

From the first language acquisition literature (FLA), which includes a number of studies of the learning of artificial grammars more relevant to SLA than to FLA, come other suggestions, all equally problematic: distributional

regularity (Brent and Cartwright 1996), i.e. the language-making faculty ‘counts’ or computes sequences of sounds that occur together, which presupposes that segmentation has already occurred (if there is no individuated THING, there can be no counting); phonotactics (Brent and Cartwright 1996; Cairns et al., 1997), which raises similar problems; typical word shape (Cutler and Carter 1978), which presupposes that words are segmentable and also that the language-making faculty can distinguish between what is typical and what is atypical (which also presupposes some counting of words); rhythm and melody (Christophe et al. 1993; Christophe and Dupoux 1996) bring us back to the segmentation of intonational phrases but do not explain how words or syllables are segmented. In short, while there is much speculation on what cues learners might use to segment speech, many of them are circular in that they presuppose an individuated entity. What we need instead is a learnability logic which explains how particular continuous cues might be mapped onto discrete entities, and then an empirical demonstration that learners are sensitive to the cues and, indeed, make use of them in the manner the logic postulates.

7. Conclusions

Once one bothers to examine the literature exploring the relationships between the psycho-perceptual effect of prosodic prominence and its proximate linguistic causes, it becomes evident that the relationships between what is available in the signal and what is perceived are complex and highly abstract. I have argued that prosodic prominence is a perceptual effect due, in those languages where it occurs, to knowledge of focal accent, itself a particular manifestation of focal structure. Focal structure, in turn, is part and parcel of an information structure. While it is critical to understand this in order to see why it might well take 8 months before an adult learner can start segmenting out discrete units of a language with remarkable phonological similarities to the L1, understanding this much of the complexity of the learning-to-segment problem still leaves entirely unexplained how learners map a continuous and variable input onto a discrete and abstract representation. I suspect that this ‘alignment problem’ will end up raising a nice Poverty-of-the-Stimulus problem, which will not be resolvable without some built-in constraints on linguistic perception and a bias to map certain acoustic cues onto specific phonetic units. At this point, however, it should be apparent that there is a great deal of empirical work to be done to wade through a morass of unmotivated assertions. Phenomenological anecdote suggests that at least some adult L2 learners go through a rather long period of initial phonetic learning where they have no awareness of linguistic properties of the input because they cannot segment it. The same anecdotes suggest that awareness emerges as a *consequence* of segmentation, something which might lend support to Jackendoff’s (1987) speculation that we project awareness from phonological representations. There are no reasons, as yet, to believe that awareness of salient bits emerges before the necessary phonetic acquisition has occurred (awareness of what we have successfully segmented, not awareness of the cues to segmentable bits). Learning how to segment cannot be reduced to (i.e., be waved away as) non-linguistic encoding of distributional frequencies

(the 'counting' problem presupposes something to count). Consequently, the Noticing Hypothesis is very suspect. When an already complex story about the microstructure of attention, prosodic prominence, information structure, focal accent, and phonetic cues to focal accent is worked out, it will probably reveal a strong argument for implicit learning of highly constrained mappings from phonetic cues to various linguistic units and functions.

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