TRANSITION AND VARIATION IN CHILD PHONOLOGY: MODELING A DEVELOPING SYSTEM

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Child phonology is different from general phonology in several important areas. When we try to characterize those differences we find in many cases that a set of phenomena which play a central role in the one field play a marginal role in the other. It is quite reasonable a priori that this should be the case when we consider the topic of variation in child phonology versus the topic of variation in adult phonology: the very notion of acquisition implies long-term change in performance, whereas we assume that in the adult, the phonology is sufficiently stable for any change to be relegated to the limbo of marginal phenomena.

In this paper, I will briefly review certain types of variation which are prominent in child phonology, and consider how one might incorporate these types of variation in a theoretical model. We will not take up those types of variation that are prominent in both child phonology and adult phonology, such as registral, sociolinguistic, allomorphic, and allophonic variation, although a complete model must deal with those as well; we will keep to the more restricted topic of those types of variation that seem to be intimately associated with the process of the acquisition of phonology.

These will include, as mentioned, long-term changes in rules and pronunciations. These are orderly, one-way transitions in language behavior: the child learns to hit a particular phonetic target, or learns to render a particular sequence of sounds in accord with the adult model word instead of producing it in some scrambled order.

Acquisition studies show that there are also several types of short-term variation among renditions of a given word. Two of these can be considered as being the microstructure of long-term variation: transitional variation and local scatter in the production of a particular phone in a phonologically defined context.

Transitional variation refers to the vacillation between

well-defined pronunciations of a word that frequently occurs during the period when an old rule is being superseded by a new rule. Such bimodal variation in renditions of a word is usually taken as evidence that two rules are in conflict. Sometimes the changeover from old to new rules has an intermediate period showing transition variation, and sometimes no such period is observed.

Local scatter is a unimodal variability in the production of a particular phone. This simply looks like the result of poor articulatory control compared to the adult norm: the child's shots at a target more often fall wide of the mark. (There must also be a second-order long-term variation associated with local scatter, since we expect to see a reduction in local scatter as the child matures.)

Presently I can enumerate five other kinds of short-term variation. One of these is called backgrounding (Ferguson & Farwell 1975). As they say, one portion of a word may be "deleted or drastically reduced while the child is 'working on' another part of the word." They cite from their data one child's production of 'milk' as [b̃ʌʔ] and [ʌk̃] in the same session. I think we now have enough evidence from selective avoidance (Ferguson & Farwell 1975) to assert that children can and sometimes do monitor the quality of their own output; therefore, the most reasonable explanation of backgrounding as Ferguson & Farwell describe it is to assume that it takes place under conditions of high self-monitoring of the phonetics of the output or the input.

A second type of variation which also seems to involve self-monitoring is the well-documented imitation effect: a word may be pronounced very differently when it is an imitation than when it is produced without the adult model ringing in the child's ears. Frequent anecdotes report one sub-type of model-induced variation: a child will be reported to have said a word 'perfectly' or nearly so on the very first attempt, and then to have reduced it drastically in later renditions. One would expect to find parallels to backgrounding and imitation-effect variability in adult speech when one is attending to the sound of the word as well as its meaning, while speaking.

(It is also well-known that children can spectacularly fail to be aware of the sound of their output, and imitation may fail to induce any variation at all; he or she may insist vehemently that what she/he said is the same as what the modeling adult has said. It is of course difficult to know whether the child is referring to pronunciation or to content in such assertions; metalinguistic conversations with two-year-olds tend to be unsatisfactory (Brown & Bellugi, 1964; in Brown, 1970, p. 79).)

The third type of unexpected variation is again a bimodal variation brought about by rule conflict, but this time it is not a passing unstable phase marking the cusp-point of change. Instead, it seems to reflect the co-existence of competing rules which may arise and decay at about the same time (Menn, 1973). We will refer to this as rule-coexistence variation when it is necessary to distinguish this type of rule-conflict variation from transition variation.

A fourth interesting kind of variation, which we will call floundering, can be described as wide fluctuation in the production of a particular model phone or string of phones under phonologically stable conditions. An example is Daniel Menn's 'peach' attempts, [i̯tš] [dits] [pipš] [gik] [nitš] etc. (Menn 1973). This kind of variation I have interpreted as being what happens when a child has no well-formed rule for dealing with a particular string of phones, that is, where the model word does not meet the structural description of any of the child's rules, and where the outputs look like what would happen if one or several features of the model word were changed so that it could be an input to the child's rules. Conceptually, floundering is quite distinct from backgrounding; floundering is the result of trying to use rules that don't quite apply, while backgrounding occurs when the child's output is produced with less reliance on practiced rules and more attention to pronunciation as a task. The parallel distinction can be made in adult second-language learning. Suppose we have an American trying to pronounce a hypothetical word /ndaŋa/, containing the unEnglish cluster /#nd/ and the morphologically controlled medial /ŋ/. Suppose our speaker is able to get each of these difficult items correct when thinking about it, but that s/he otherwise reverts to initial /#end/ or /#d/ and to medial /ŋg/. The variation between /ŋ/ and /ŋg/ (and also between /#nd/ and either of the two wrong pronunciations) is controlled by the amount of attention that it gets: this is

backgrounding. On the other hand, the variation between /#end/ and /#d/ for /#nd/ is floundering: it is a random choice among sounds which have a close resemblance to the difficult target.

Finally, some young children show lexically controlled variation. Here, certain words show great variation in the production of some or all their sounds while other words that have similar adult models show much less variation. Jacob (Menn 1976) had a much greater variability for the /æwn/ sequence in 'down' than for the same target in 'around'. This also has parallel at the margins of adult phonology: consider for example the great variety of sounds permissible (as expressive variants) for the 'phoneme' /o/ in the word 'no'. This variety is not found in renditions of the same phoneme in the word 'know'.

We have named seven types of variation of special interest to child phonology. Now, by a 'model' of a phonological system, I mean a flow chart which specifies roughly what information is stored, what is used in real time, and how the different pieces are brought together to specify the articulatory instructions needed to produce a word. How can these seven types of variation be represented in such a model?

The most important capability to be added to extant models actually is, I think, one that has not been explicitly mentioned so far, since it manifests itself indirectly. Child phonology models almost all represent the steady state: the rule or word is established. These models need new apparatus to simulate what happens when a new word is being tried or a new rule is being formed, for practiced behavior is very different from novel behavior. This familiar-novel distinction seems to be related to the distinction that we have already invoked between monitored and automatic behavior, but they are not the same. To deal with both novelty and attention, models will have to allow more than one route from adult word to child word. We could say that one route, the one used most frequently, would represent automatic, over-learned behavior, and other routes would correspond to the special cases when at least part of a word is not being produced under automatic control. We can make this more explicit by considering an available child-phonology model.

Suppose we use a two-lexicon model similar to the one in Kiparsky and Menn (1977), concerning ourselves with the part of

it that would run: adult form → (perceptual strategies) → phonetic representations perceived by child = input lexicon → (reduction rules) → encoded articulatory representations = output lexicon → (motor routines) → child's output form. The input lexical entry represents the child's encoding of his/her percept of the adult word, the output lexical entry represents an encoding of articulatory instruction, and the reduction rules relate the two lexicons.[1] We can modify such a model to allow for non-automatic speech production by adding routes from the input lexicon (percept of model word) to the output side (pronunciation) that bypass the output lexicon and some of the rules that lead into and out of it. This would represent an attempt to give a spontaneous rendition of a known word without most of the automatic apparatus, and might represent what goes on during word-practice. To represent imitation, we would also add routes from some point(s) among the perceptual processing routines that would bypass both lexicons and feed into some points among the articulatory routines.

The variation in the points of beginning and ending of these bypasses would reflect the degree to which established perceptual and articulatory routines were employed in the utterance. (Presumably, the more that one monitors, the more habits of perception and production can be overcome.)

It seems, then, that some aspects of transition (rule change), backgrounding, and imitation-effect variation can be modeled by the addition of these new processing 'routes' to a K & M-type model. It turns out only a few more entities are required to adapt this model or its descendants to represent the other four types of variation that we have discussed.

Coexistence variation can be simulated by letting both of the competing reduction rules operate on each applicable input lexical item, thus generating two forms in the output lexicon corresponding to each of those input forms. Either of those forms could be translated into output any time the child said the word. If the probabilities that the two forms both occur are not equal, some notion of the 'strength' of a lexical entry must also be added, so that one could say that the stronger entry is the

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(1) The recent revision of the K & M model presented in Menn 1977 would allow a clearer formulation of some of the following discussion, but occasions no major differences.

one produced more frequently.

Transition variation would also be represented by having two output lexical entries, one generated by the older rule and one by the new rule. As we have implied, we can model the loss of a rule by removing it from the set of production rules. This will 'disconnect' some output lexical entries from their input lexical entries. (Transition variation would thus not be rule competition, as we stated above, so much as competition between two output lexical entries.) Since new rules normally spread to older words, we might hypothesize that the 'disconnected' output lexical entries lose strength and fade away. However, we know that some lexical entries which clearly do not have live support, such as phonological idioms and fossils (words which inexplicably resist rule changes), do not fade in the usual way but remain vigorous for long periods. If the 'fading' notion is used, we require special apparatus to handle phonological idioms and fossils. Several have been proposed (see Macken 1978) but we cannot pursue that topic here.

Local scatter does not involve lexical entries at all, but has to do with the lowest output processing levels: we shall assume that it occurs when articulatory instructions for a phone are executed with more tolerance than they would be by an adult.

Lexically controlled variation, on the other hand, requires, obviously, a special entry in the output lexicon just as phonological idioms do, and in addition this entry must specify special articulatory instructions rather than the general output routines or in addition to them.

The remaining form of variation that we have discussed is floundering. The basic situation in floundering seems to be a rule-input that is ill-formed. The proper analysis of a given case, however, may depend on the whole rule-structure, because there are several ways that this could happen in the present type of model. There are two relevant loci: the input lexical entry could fail to meet the structural description of necessary reduction rules, or the output lexical entry could fail to be of the proper form for the articulatory instructions to handle. In addition either case of ill-formedness might be better modeled by overspecification, underspecification, or some other type of malformation. Further elaboration of the psychological interpretation of this or similar models of child phonology will be required in order to make a principled choice among these alternatives.

To conclude: certain types of variation are intimately and essentially involved with learning to pronounce. As we build richer models of child phonology, we can incorporate them without undue difficulty. Regardless of how easily we can draw new lines and little boxes, however, one problem about transition and variation remains very difficult. How does a new linguistic behavior cease to be effortful and become automatic?

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