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ACQUISITION OF PHONOLGY

Paula Fikkert

1. Introduction

Given the limited length of this article the generative scope of this journal I will be primarily concerned with issues regarding the acquisition of phonology, relative to the field of phonology. The latter term is often used to describe phonological phenomena found in child language, without consideration of theoretical linguistic issues of acquisition. Although good descriptions of phonological phenomena and developmental patterns occur in child language are an absolute necessity for developing a theory of acquisition, phonology are by no means sufficient. We also need to explain the attested phenomena and patterns of development, both to gain a better understanding of what happens during acquisition, why certain patterns occur and not others, and to be able to test current theories of grammar with respect to their learnability properties. These issues are investigated in the field of acquisition of phonology. However, work in this field is relatively sparse. Moreover, research into these issues is not restricted to the logical problem of acquisition and often ignores child language data as such. Of course, the two are closely related. They should be merged in the field of child language acquisition (cf. Ingram 1989). Perhaps optimistically, I detect a trend in current research in this direction: i.e. the consideration of theoretical issues on the basis of extensive child language data collections.

The study of child phonology has been investigated early in this century, but it can hardly be said that there is a consensus about what the main issues are. The field is very interdisciplinary, and approaches differ drastically. The approach taken in Phonological Development, Models, Research, Implications edited by Ferguson, Menn and Stoel-Gammon (1992) differs fundamentally from that in that in ARCHFIELD (ed.) (1986) Phonological Acquisition and Phonological Theory. The latter addresses acquisition from a theoretical phonological perspective and focuses mainly on production, while the former approaches acquisition from a wide range of perspectives — although not including a formal theoretical one — and addresses, as well as production, perception, vocalisation, child development in general, and other topics. As noted above, I give here an overview of the theoretical aspects of acquisition of phonology, focusing on production. I will not address the relationship between perception and production, although this is a very interesting and important topic (Macken 1980; Smith 1973, Spencer 1988, among others). Nor will I discuss acquisition of phonology above the word, tone, babbling, the difference between babbling and early child language data collections. In this sense, the methodology also changed. Large sample studies were replaced by longitudinal language sampling, where a number of children are visited at regular intervals over a period of time, to gain representativeness of the language development of more than one child. Longitudinal language sampling studies focusing on phonological development are abundant and very time-consuming and partly because existing data bases are not (easily) accessible. This will hopefully soon change: currently, discussions on how to make phonological databases accessible through CHILDES are taking place on the CHILDES (e-mail) network.

In addition to longitudinal studies, experiments can be conducted to find answers to specific questions. Although this is potentially a very fruitful method to get into questions such as whether there is a universal order in which segments are acquired or whether there are laws of irreversible solidarity, i.e. claims about the distribution of phonological features among the world's languages, that not only define inventories but also dictate what kind of rules are to be expected in acquisition. For example, front consonants presuppose back consonants, and are therefore acquired earlier. Front consonants are also more likely to substitute for back consonants. Similarly, stops are acquired before voiceless stops before voiced stops, and fricatives before affricates.

An important feature of Jakobson's theory is the clear relationship between children's phonological systems and those of adults. A child's system may be simpler (having fewer contrasts), but not fundamentally different. In other words, the child's initial phonological structure is relatively impoverished. If positive evidence for a particular contrast has been encountered by the child, he or she is forced to add structure. This assumption is shared by most researchers, although not by all. However, the study of acquisition is however not meant to replace the child's initial phonological development, whereas the study of acquisition data that of adults with maturation being the key factor. On this assumption, however, the study of acquisition is however a problem, although not by all. Smith (1973), for example, views acquisition as the suppression of rules, Stamps (1972) as the suppressing of natural rules. In their views the child's system becomes simpler as the acquisition process goes along. On this view we might also assume that a child's system is fundamentally different from that of adults with maturation being the key factor. On this assumption, however, the study of acquisition is however not particularly interesting or enlightening for linguists.

Jakobson's work has been widely criticised, mainly because it predicts a universal order of development, whereas the study of acquisition data has revealed a great deal of both inter-and intralinguistic variability. Jakobson was not based on extensive longitudinal databases, he was probably not aware of different kinds of variation in child language data. His work was based on phonological, which is a clear view of the relationship between linguistic universals and languages acquisition. Even though there might be some variation, this variation is by no means random. Certain segmental inventories are

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3.2. Segmental processes in child language

Many articles on child phonology provide lists of processes or rules that occur in child language (cf. Ingram 1976, 1988, Stampe 1973, Smith 1973, Menn 1971, 1977, Iverson & Wheeler 1987). Processes or rules are often formulated in such a way that they are applicable to more or less complex input forms to the adult target form, and perform changes to this form so that they deliver an output, the child's production form. In other words, these processes describe the relationship between the adult and the child phonology of some examples of such processes are given in (2), from Ingram (1976), who divides processes into three types: assimilation, substitution, and syllable structure simplification processes. The latter are discussed in section 4.

(2) List of segmental processes in child phonology (Ingram 1976).

A. Assimilation processes (reduplication).

1. Total reduplication: a CV syllable is repeated in the child's word:
   - Patrick → [patat]

2. Partial reduplication/or a consonant harmony or a vowel (vowel harmony) of a target syllable appears twice in the child's word:
   - Peter → [petet]
   - Andrea → [anderta]

B. Substitution processes

1. Stopping: the change of fricatives and affricates into stops:
   - [voo] → [bubu]

2. Prevoicing: the voicing of obstruents before the following vowel:
   - pocket → [bat]

3. Final devoicing: the devoicing of final voiced obstruents:
   - [gAk] → [gAb]

4. Fronting: the change of a liquid into a glide:
   - [ka] → [ka]

Smith (1973) formulates these rules which he called realization rules in an SPE framework, and assumes that they are simplified and ultimately underlie a process of development; Stampe (1973) calls them natural rules, which have to be suppressed in the course of acquisition. Speaker (1986) reanalyses Smith's data in a nonlinear phonological framework. Iverson & Wheeler (1987) analyse many of the segmental processes using non-linear phonological tools. A non-linear framework allows us to formulate the rules much more elegantly. However, even in a non-linear framework, the assumptions made by Jakobson's theory are not completely invalid, and the child's productions may be seen as a result of an underlying representation. These two points are elaborated on, accounting for inter-child and cross-linguistic variability. With respect to intrachild variability it turns out that in the absence of contrast specific contrast can be found, while in the presence of contrast the amount of variation decreases.

All the works mentioned above have in common that they deal with individual features and/or phonemes. Although they may take different positions in the world into consideration, they fail to explain why differences between different positions exist. Some recent work shows that it is useful to look at whole words (Macken 1979, Stoel-Gammon 1983, Levelt 1994, Velleman 1985), and to consider a child's whole vocabulary as some point in time (Levelt 1984). I will return to this in 3.3.

3.2.1. Consonant harmony

Consonant harmony (CH) is the process by which consonants in the word become more similar. This usually only affects primary place of articulation features. The process is relatively often attested in child language, but is hardly found in adult languages, where it always involves secondary place of articulation features, never primary. CH is usually defined as an assimilation-at-a-distance process (Vihman 1978). Features from one consonant spread to a non-adjacent consonant. A well-known example is presented in Menn (1978): [gok] for duck.

In non-linear phonology CH is accounted for by reanalysing features of one consonant to a consonant not specified for place of articulation (Steinberger & Stoel-Gammon 1991). Coronals are usually assumed to be unspecified for place and are therefore prone to adopt features spreading from other consonants. This feature-filling process can be represented as in (3a). A problem arises, however, when the vowel is also specified for place, since now the spreading results in crossing association lines, as shown in (3b). Of course, this problem does not arise if we assume that consonants and vowels have different sets of place features (cf. Steinberger & Stoel-Gammon 1991). However, evidence from consonant-vowel interactions points towards a shared set of features for consonant and vowels (cf. Lahiri & Evers, 1991). McDougal & Myers (1993) propose a different solution to the problem in (3b) by assuming that vowels and consonants are on different planes (planar segregation), a view shared by, for instance, Macken (1988), Lisko (1991), Stoel-Gammon (1995). In this view there is no crossover and there is no intervening vowel that causes association lines to cross. This account is schematized in (3c):

(a) CH as feature spreading from a specified Place to an unspecified Place.

(b) CH as feature spreading from a specified Place to a Place.

(c) CH as feature spreading assuming planar segregation.

Although this seems an elegant account of the process, examination of the full vowel inventory of the child reveals certain problems, as argued by Levelt (1994). First, planar segregation presupposes that the order of consonants and vowels is entirely predictable. As long as the child only has CV syllables, this is the case. When the child has VC, CV and CVC words this statement is no longer valid. At this point the order of consonants and vowels in a word has to be learned and planar segregation can no longer be assumed. Second, if spreading is...
3.3. Considering the whole lexicon

Waterston (1971) observed that all early production forms of her son fitted into one of five basic word structures, also called prosodies or canonical forms. Furthermore, she noted that these early production forms often did not have a straightforward relationship with the adult forms: the relationship could not be expressed by any of the rules or processes described in 3.2. Nevertheless, on closer inspection, adult and child forms had certain features in common, although the distribution of these features in the word might be complex and difficult to describe. She noted that some processes were always present in the child's productions, while others appeared in the adult forms at different stages, and that the schemata of these early production forms or prosodies facilitate both the production of other forms and the acquisition of new forms, through pattern recognition. Development takes place when the child perceives more phonetic detail, which differentiates new processes, until the final state is reached in which each word has its own prosody. Although Waterston's account may account for the initial stages, it has been convincingly shown that incomplete perception at best accounts for a small subset of the production data, and this in most cases the child's account may account for differences that he or she cannot produce.

4. Acquisition of suprasegmental phonology

Although research on the acquisition of suprasegmental phonology is not abundant, its development has been similar to research on the acquisition of segmental phonology. In the seventies, a major goal was to describe the main differences between adult forms and child forms, by formulating a set of rules or processes such as those given in (5):

- Final consonant deletion
- Cluster reduction
- Syllable deletion
- Syllable insertion

Again, these processes or rules are at best a description of the relationship between adult target forms and children's production forms, and provide no insights into why children's production forms differ from adult forms. With the emergence of non-linear phonology these rules were subsequently reanalyzed in a non-linear framework. The relationships between input (adult) and output (child) forms was often described as the result of mapping the adult target onto the child's template (cf. Iverson & Wheleir 1987, 1995; Fikke 1994). If the child's template cannot contain the whole segmental pattern of the adult target, the result is simplifications, as illustrated in (6):

- Mapping of adult target onto universal word template

4.1. Mapping of adult target onto universal word template

With respect to onsets the following develop­ments can be found for Dutch children (Fikke 1994a): after a stage of onsets without segmental inter­nalization the child's production forms result in default CV syllabes, even when the target syllable is onsetsless — onsetsless output forms appear, and finally, complex onsets are produced. Characterization of children's first complex onsets is that the two members of the onset differ maximally in sonority: preferably a stop plus a glide (Jakobson's principle of maximal contrast). Furthermore, these three stages can be distinguished in a three stage acquisition of onset-sonorant clusters: (i) at the late stage the onsets are simplified to single onsets (again creating a maximal contrast between the vowel and the onset sound); (ii) at the middle stage they are simplified to single onsets (metathesis); (iii) finally, they are produced as obstruent-sonorant clusters. A striking feature is that, while most children start with onsets-sonorant clusters, some children start with vowel-onset clusters. Apparently, these involve two different, unrelated parameters.

4.2. Word stress

Until recently, the literature on the acquisi­tion of stress mainly focused on the following two questions: (i) whether children learn stress lexically or stress rules, and (ii) whether stress is based towards a particular foot type. Hoffberg (1988a, b) argues that children do indeed learn stress rules, while Klein (1984) concludes that there are extra-linguistic factors influencing the early stages of learning word stress. Allen & Hawkins (1978, 1980) found that English children are biased towards a trochaic pattern, with initial unstressed syllables often being deleted to fit this pattern.
Hoehnberg (1988a, b), however, concludes that children approach the task of stress learning with a bias towards any particular stress type.

The issue of stress acquisition has recently been addressed in the literature from a learnability perspective, without looking at actual acquisition data (Dresher & Kaye 1990, Gills et al. 1991); others base their work on psycholinguistic experiments (Banks 1987, 1988, Echols & Newport, 1992, Gerken 1992a, b, 1994); and yet others analyze longitudinal data from children’s development (Fikkert 1994a, b, Fee 1992, Demuth 1995a, b).

Echols (1987, 1988) and Echols & Newport (1992) demonstrate that children are most likely to retain the stressed and final syllables of adult target words. They claim that these syllables are most salient and therefore best perceived by the child, following Waterson’s (1971, 1989) principle of what is best perceived is best produced. They make no claims about the child’s own stress system. Gerken (1992a, b, 1994) shows that an account based solely on perception does not explain the facts and that children seem to have a preference for trochaic words. This is confirmed by the longitudinal study carried out by Fikkert (1994a, b), in which it is shown that iambic and trochaic target words are perceived similarly by children so that the former are more prone to truncation and show more stress errors, thus confirming Allen & Hawkins’ observations. Fikkert shows further that by studying the child’s production forms more carefully a clear developmental pattern appears, as illustrated in (7):

(7) Development of disyllabic target words

<table>
<thead>
<tr>
<th>Adult target</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>baby ‘baby’</td>
<td>(bebi)</td>
<td>(bebi)</td>
<td>(bebi)</td>
<td>(bebi)</td>
</tr>
<tr>
<td>‘guitar’</td>
<td>(baail)</td>
<td>(baail)</td>
<td>(baail)</td>
<td>(baail)</td>
</tr>
</tbody>
</table>

The target in (7) contains one foot; that in (7b) more than one foot, as shown in (8) (next column).

The child’s forms at stage 2 still contain exactly one foot, but the monosyllabic forms of stage 1 are now disyllabic. The transition from stage 1 to stage 2 may be triggered by the fact that the child’s output in (7b) and the adult input forms display a mismatch in the number of syllables.

None of the stress parameters is changed: since there are no stress mismatches the child has not (yet) encountered evidence that triggers the setting of a stress parameter from the default to the marked value. As a result the child forms are disyllabic, with initial stress for both initial and final stress-stressed target words at stage 2.

Comparing these new output forms with the input forms, the mismatch in the number of syllables is solved; however, now a stress mismatch exists. The existence of words with the same number of syllables but different stress patterns may trigger the setting of the quantity-sensitivity parameter to the marked value quantity-sensitive, since in a quantity-insensitive system words with the same number of syllables can have the same stress pattern. At stage 3 very closed syllable is considered heavy and forms a foot on its own. Moreover, the data show that the string of segment is fully parsed into feet, and, that the main stress parameter is still relevant: the child produces both feet with the same degree of stress.

When comparing his or her output forms with the input forms the child may detect that not all feet in the language have the same number of syllables, which is accounted for by the child’s own stress system at stage 4. Now, the child’s representation of the target words in (7) is adult-like. This account demonstrates that a close study of child data reveals the principles and systematic nature of development. The child builds up his or her grammar step by step. The transitions from one stage to the next can be understood as (1) the setting of one or more parameters from the default (unmarked) value to the marked; and/or (2) the extension of the child’s template.

Although metrical theory might not predict exactly what the intermediate stages are, the attestable stages can easily be accounted for within the theory. It might be the case that the study of the acquisition of other stress systems will reveal different patterns, but the theory severely reduces the number of possible intermediate grammars. Also, it predicts that the initial stages are more or less equivalent, and independent of the language being acquired. Again, it is an empirical question whether this is true and more research based on detailed longitudinal databases is required.

### 5. Concluding remarks

The question of how learning is accomplished in the presence of incomplete and contradictory input cannot be reliably derived from a formal theoretical point of view, without looking at actual data. This is often referred to as the logical problem of acquisition. An important characteristic of any theory of grammar should be that it is learnable and, therefore, any theory should also provide an account of the acquisition process. I have shown in this article that research into the acquisition of phonology is not only not based on formal theories of phonology, but also on analyses of longitudinal data from child language, in which the complete set of data at different stages of development is taken into account.

Different phonological theories of course make different predictions concerning the specific details of acquisition. Acquisition studies should help decide on which theory is better suited to account for the attested variation and uniformity in children’s grammars.

To conclude, although the first studies of acquisition of phonology date from some time ago, progress has been very slow, both because the field is interdisciplinary and because the study of the actual acquisition process very time consuming. Nevertheless, by combining the efforts of theoretical phonologists, psycholinguists and researchers studying child language, we may hope to find an answer to the question of how phonology is acquired, which part of phonology is innate and which part has to be learned.

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**An Acquisition of Phonology Bibliography**


