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ACQUISITION OF PHONOLOGY

Paula Fikkert

1. Introduction

Given the limited length of this article and the generative scope of this journal I will be primarily concerned with issues regarding the acquisition of phonology, rather than the acquisition of language. The latter term is often used to describe phonological phenomena in child language, without consideration of theoretical linguistic issues of acquisition. Although good descriptions of phonological phenomena and development patterns occur in child language are an absolute necessity for developing a theory of acquisition of phonology, they are 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 in this area is primarily 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 treated in the same framework of 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. Historically, the focus of research on child phonology has been studied from at least early 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 Stoezl-Gammon (1992) differs fundamentally from that in that in Archibald (ed.) (1996): 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 in the field of phonological acquisition, 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 speaking, or language disorders. Needless to say, this survey is far from complete, and inevitably reflects my own interests in the field.

2. A Brief History

The first studies of child language took the form of parental diaries. Some of the best known are Prayner (1889), Stern & Stern (1907), Grégoire (1937), Velten (1943) and Leopold's four-volume work (1895-1947). The goal of these works was mostly descriptive and often had a larger focus than just language, because little was known about children's behaviour in general. Diaries focus on the development of one or two children; they are not very systematic, and do not provide norms for acquisition. Under the influence of Jakobson's 1939/1962 article — 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 in the field of phonological acquisition, 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 speaking, or language disorders. Needless to say, this survey is far from complete, and inevitably reflects my own interests in the field.

The first two steps make clear why Papa and mama — the title of Jakobson's 1939/1962 article — are among the first words in every language. Jakobson further clarified that there is a relationship between the order of acquisition and the distribution of sounds in the languages of the world. Those features or contrasts that figure in all languages are acquired first. Furthermore, he claimed that there are laws of contrast and the so-called solidarity, i.e. claims about the distribution of phonological features among the world languages, that not only determine inventories but also dictate what kind of rules are to be expected in acquisition. For example, front contrasts presuppose back consonants, and are therefore acquired earlier. Front consonants are also more likely to substitute for back consonants. Similarly, stops are acquired after vowels, particularly before voiced stops before voiceless 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. Smith (1973), for example, views acquisition as the undermining of rules, rather than the suppressing of natural rules. In their views the child's system becomes simpler as the acquisition process goes on. 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 intralectal variability. Jakobson's work 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 theory, and there are clear indications of the relationship between linguistic universals and child language acquisition. Even though there might be some variation, this variation is by no means random. Certain segmental inventories are

3. Acquisition of Segmental Phonology

In the area of segmental phonology two basic approaches have been developed. The first attempts to search into the acquisition of segmental inventories (3.1); the second investigates the acquisition of segmental rules or processes (3.2). Surprisingly, hardly any work has been done on the acquisition of the segmental rules that play a role in the acquisition of phonology. The focus has largely been on rules typical of child language, e.g. consonant harmony - a process in which two consonants (partly) assimilate to each other. Recent proposals show that development and segmental inventories and segmental processes have to be studied simultaneously (3.3).
more likely than others, while others simply never occur. Several researchers have attempted to improve Jakobson's theory by taking variation and variability into account. To gain insight into the amount of inter- and intra-child variation in the development of segmental inventories (Ferguson & Farwell 1975, Shihamoto & Ohseta 1978). Since phonological processes are not an inherent part of the child's phonological system, the adult child's productions are the result of the composition of processes that change individual segments of the child's production into the adult's, in what is called the output form (Iverson & Wheeler 1987). Orthographic use of phone classes and constructed phone trees: for each target phoneme a child's corresponding productions, forming a phone class, are noted; by connecting these phone classes of a longitudinal series of language samples a phone tree is constructed. This method emphasizes the range of variation rather than the uniformity. The child was seen as a little linguist, an active hypothesis tester, each child can therefore in principle come up with different hypotheses. Acquization in this view is thus more probabilistic rather than deterministic (as in Jakobson's theory). This theory does not make any predictions about acquisition, moreover, it does not account for the large amount of uniformity that is found in children's developmental patterns. Ingram (1981, 1988) criticizes Jakobson's theory of acquisition, because it is not falsifiable, in that no criteria for acquisition are given. This criticism can hardly be taken seriously, especially since he proposes to amend this by merely stipulating the length of the process. He also criticizes Ferguson & Farwell's work because of its sensitivity to all kinds of variability, not only due to competence factors, but also to performance factors. Criticism of Jakobson's work was also implicit in Jakobson's work. What Ingram proposes is in fact only a method for analysing children's data, not a theory of acquisition, let alone an improvement of theory.

Another model that takes both uniformity and variability into account is that of Rice & Avery (1995). They hypothesise that inventories expand gradually, but systematically. Structure is built up over time, by increasing the number of contrasts in the inventory. Furthermore, elaboration must follow a predetermined path within any particular organisation node, in the Jakobsonian sense. This means that new discoveries imply the existence of others (i.e. the presence of fricatives presumes the presence of stops), thus accounting for the universality of certain features. However, there is a certain freedom as to which organisation nodes are elaborated on, accounting for inter-child and cross-linguistic variability. With respect to intra-child variability they argue that in the absence of contrast specific organisation can be found, while in the presence of contrast the amount of variation decreases.

All the works mentioned above have in common that they work with individual features and/or phonemes. Although they may take different positions in the word 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, Macken 1992, Levelt 1994, Velleman 1995, Stoel-Gammon 1995). In this view, words are built up iteratively, by the addition of syllables up only as required, by increasing the number of elaboratory rules. This method emphasises the range of variation which resembles the adult target form. Development means getting rid of rules, which 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 vowels and consonants have different sets of place features (cf. Stemberger & Stoel-Gammon 1991). Coronal vowels are usually assumed to be underspecified for place and are therefore prone to adopt features spreading from other consonants. This feature-filling process can be represented as in (3a).

1. Stopping: the change of fricatives and affricates into stops
   
   **Examples:**
   
   *Patrick* → *[ba:d]*
   *Prevoice: the voicing of obstruents before liquids*
   
   **Examples:**
   *[bɪ:l]*
   *Final devoicing: the devoicing of final voiced obstruents*
   
   **Examples:**
   *[ka:*]*
   *Fronting: the fronting of the front of mouth*
   
   **Examples:**
   *[dɑ:k]*
   *Gliding: the changing of a liquid into a glide*
   
   **Examples:**
   *[nɑ:k]*

2. Assimilation processes (reduplication) — which he called *realisation rules* — in an SPE framework, and assumes that they are simplified and ultimately underlie the course of development; Stamep (1973) calls them *natural rules*, which have to be suppressed in the course of acquisition. Spencer (1986) reanalyses Smith's data in a non-linear phonological framework. Iverson & Wheeler (1987) analyze many of the assimilation 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, all the representations are enriched and the number of rules severely limited: only spreading (assimilation) and deleting (deletion) rules are allowed — the problem mentioned above remains. Although, for instance, stopping can now be elegantly described as the deletion of the feature [continuant], and consonant harmony as the spreading of one or more features from one consonant to another (as we will see in 3.2.1), in the formulation of the rule reference still has to be made to an underlying representation that resembles the adult target form. Therefore the rules do not seem psychologically real: it is hard to believe that a child, having an underlying representation which resembles the adult form — based on the fact that the child's perception is far more advanced than his or her production — subsequently changes it to create a new impoverished form. Nevertheless, this is often implicitly assumed. If the input form is the underlying form and resembles the adult target form we have to conclude that the rules are performance rules and do not reflect competence. Another problem with formulating rules to express the relationship between adult and child forms is that rules can only operate on input or adult forms, while many phenomena seem to be better accounted for by assuming constraints on the output, the child's forms. For example, if in a particular position not only fricatives are changed into stops, but also other types of consonants, such as liquids and nasals, we could still try to formulate a rule that would result in a prediction of all the constraints (cf. Menn 1978). By constraining possible output forms the relationship between adult and child forms can be expressed more accurately. Finally, there is recent literature (cf. Macken 1992, Levelt 1994, Fikkert 1994b-a, Demuth 1995b-a, Demuth & Peets 1995); it is now often assumed that children have certain canonical forms or templates on which the adult forms are based. For example, canonical forms or templates are constrained in certain ways, the child's production form often differs from the adult target form. Development means getting rid of constraints on elaborating templates so that the child forms resemble the adult target more and more. This may proceed will be shown in 3.3 for segmental processes and in 4 for suprasegmental processes.

To summarise, all approaches assume an input form that is more or less identical to the adult target form, and an output form — the child's production. They differ, however, in the way they formulate the relationship between input and output forms. In recent work attention has been shifted to explaining this relationship on the basis of a child's developing phonological system, rather than merely describing it by formulating a rule or process. One segmental rule which has received much debate lately is consonant harmony (cf. Levelt 1994).

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): *g* → *d* for *duck*.

In non-linear phonology CH is accounted for by spreading features of one consonant to a consonant not specified for place of articulation (Stemberger & Stoel-Gammon 1991). Coronal vowels are usually assumed to be underspecified 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. Stemberger & Stoel-Gammon 1991). However, evidence from consonant-vowel interactions points towards a shared set of features for consonants and vowels (cf. Lahri & Evers, 1991; McDonough & Myers 1992). This suggests 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 (1992b, 1993a, 1993b), Lecic (1995), Stoel-Gammon (1995). In this view, coronal vowels and coronal consonants are adjacent and there is no intervening vowel that causes association lines to cross. This account is schematised in (3c):
Vallence (1985). Thus, as the child's phonological system develops, features are first aligned to word edges, rather then to the whole word. Later, these alignment constraints are gradually relaxed, so that features can be attached to any segment in the word. As a result the child is able to expand the set of word forms, until each word has its own form. 

Work like this shows that it is not sufficient to look at features or segments in isolation, but that one needs to take whole words into account. Furthermore, it is also important to consider a child's whole vocabulary at particular stages, to gain a deeper understanding of how segment inventories and vocabularies develop, and how processes such as those mentioned in 3.2 take place. This shows once more the importance of longitudinal databases.

Work from a holistic point of view has only just begun, and much more research is needed.

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 find the main differences between adult forms and child forms, by formulating a set of rules or processes such as those given in (5):

\[
\begin{align*}
(5) & \text{List of syllable structure processes (Ingram 1976)} \\
& \text{1. Final consonant deletion} \\
& \text{2. Cluster reduction} \\
& \text{3. Unassimilated syllable deletion} \\
& \text{4. Mapping of adult target onto universal word template} \\
& \text{5. Initial consonant deletion} \\
& \text{6. Deletion of palatal} \\
& \text{7. Deletion of velar} \\
& \text{8. Deletion of nasal} \\
\end{align*}
\]

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 insight into why children's forms differ from adult forms. With the emergence of non-linear phonology these rules were subsequently reanalyzed in a non-linear framework. The relationship between input (adult) and output (child) forms was often described as the result of mapping the adult target onto the child's template (cf. Iversen & Wheeler 1987, Fee 1995, Fikkert 1994). If the child's template cannot contain the whole segmental configuration of the adult target, this results in simplifications, as illustrated in (6):

\[
\text{(6) Mapping of adult target onto universal word template} \\
\]

4.2. Word stress

Until recently, the literature on the acquisition of stress mainly focused on the following two questions: (1) whether children learn stress lexically or phonologically; and (2) whether stress is acquired passively or is built up actively by the child. Several studies have shown that, once a child has acquired a word in its own language, stress is acquired passively. According to Fikkert (1994a) after a stage in which stress is acquired passively, children are able to build up stress actively. However, children's stress systems are simple and do not follow the adult stress system. Fikkert (1994a) distinguishes five stages in the development of stress in Dutch children's speech. First, only open syllables are allowed, where vowel length is non-distinctive, again reusing the stress system of the adult language. In the second stage stress is acquired at the syllable level, and finally, stress is acquired at the word level.

Fikkert (1994a, b) distinguishes five stages in the development of rhyme. In Dutch children's speech. First, only open syllables are allowed, where vowel length is non-distinctive, again reusing the stress system of the adult language. In the second stage stress is acquired at the syllable level, and finally, stress is acquired at the word level.
The child's forms at stage 2 still contain exactly one foot, but the monosyllabic forms of stage 1 are now diphthongal. The transition from stage 1 to stage 2 may be triggered by the fact that 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 in the child's output (7b) and the adult forms both produce 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 shown by the setting of the main stress parameter from the default to the marked value. As a result the child forms are diphthongal, with initial stress for both initial and final-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 by child the same stress pattern. At stage 3 very close syllable is considered heavy and forms it forms on its own. Moreover, the data show that the string of segments 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.

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, psychologists and researchers studying children 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.

An Acquisition of Phonology Bibliography


