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ABSTRACT

This study explores children's development of dual-level phonological processing posited by generative theory for adult language users. Evidence suggesting 6-year-olds' utilization of morphophonemic segments was obtained by asking children to imitate complex words, omit specified portions, and discuss the meaning of the resulting word-parts. The words represented instances in which phonetic forms differ significantly from underlying representations. Language-advanced first graders produced more evidence suggesting morphophonemic segments than language-delayed age-mates; young adults supplied more evidence than either first grade group, a result consistent with the assumption that children's segments begin in early childhood at phonetic levels and gradually become more abstract. Nevertheless, the strength of evidence from language-delayed youngsters leads to the interpretation that these 6-year-olds are forming and using morphophonemic segments, and that differences in performance between groups must derive from differences in metalinguistic abilities and experience with particular lexical items (as well as cognitive and maturational factors) rather than from differences in the units of phonological processing. The data suggest further that first graders are not responding to acoustic-phonetic cues in order to recover the appropriate base form of a word, supporting the inference that young children refer to an underlying representation containing a morphophonemic segment in order to perform this task. (Author/AMH)

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March, 1983

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Development of Morphophonemic Segments in Children's Mental Representations of Words

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According to generative phonological theory, adults form and use underlying segmental representations of utterances in the processes of producing and perceiving speech. The segments of these representations are abstract in the sense that a limited inventory of segments (defined by relativistic articulatory features) converts to a variety of phonetic forms in the utterances speakers produce. These phonetic or surface forms are themselves abstractions--patterns or classes of sounds observed across unique renditions of words and phrases by individual speakers in particular performances.

Examples of phonetic variants of a more abstract segment include: (1) The positional allomorphs of /t/ in ton, stew, net, letter, and train; (2) The three phonetic forms of the plural morpheme /Z/ in words like hats, guns, gases (realized as [s], [z], and [ɨz] respectively); (3) The varying phonemic representations of the final /d/ in divide observed in the derivative forms division and divisive; and (4) The effects of rules specific to certain dialects, such as the elision of final consonants or the reduction of final consonant clusters in black vernacular English (e.g., [win] for wind and [pos] for post).

Because of its explanatory power, generative phonological theory in its general outlines is widely but not universally accepted, even though

within this framework many issues remain unresolved. Debate continues over the limits of abstractness of segments in adults' representations of words; example three above, for example--the claim that a morphophonemic /d/ underlies the third consonant of divide, division, and divisive--is still disputed (Kiparsky, 1968). A second unresolved issue is: At what point and through what processes do children begin to utilize segments as abstract as those posited for adult speech competence?

At present very little is certain about children's development of the adult system of phonological representation. Generative theory implies that when children's speech resembles adult speech, children must be forming and using underlying segmental representation (Chomsky and Halle, 1968; Schane, 1973), but how abstract children's segments are at any stage is unclear. C. Chomsky (1970) has shown that children are still learning vowel shifts and morphophonemic changes for such cases as evade, evasive, and evasion into their adolescent years. Segment changes appear, however, even in inflected forms used by pre-school children. For example in Berko's study (1958), children used [s] for the plural morpheme affixed to word forms ending in a voiceless consonants (e.g. biks) and [z] for word-forms ending in voiced consonants.

Berko's data supplies little evidence concerning children's abilities to make segment changes in base morphemes, however. On nonsense items where such changes might have occurred (*bing and *gling), only 4 of 80 children changed the vowel to form a past tense (e.g., [raeŋ] or [glaeŋd]). Using real words, seventeen first graders, but no nursery schoolers changed ring to rang. Whether children represent forms such as ring and rang and get and getting as separate lexical items, or whether they are aware of the semantic and/or phonological relationships has not yet been determined.

Some writers have suggested that children's segments may be closer to the phonetic level than the morphophonemic level hypothesized for adults--for example, they may at some point represent the various positional allomorphs of /t/ (see example 2 above) as categorically distinct segments (Savin, 1972; Chomsky, 1970). Certainly it is difficult to believe that when children first acquire a word their mental representation of that word contains abstract morphophonemic segments.

If one assumes that the segments of representations used for producing and perceiving speech begin in early childhood at a phonetic level and gradually become more abstract, then one would expect not only (a) that children would supply much less evidence suggesting such segments than would adults, but also (b) that children whose language development is accelerated would supply more evidence for abstract segments than children developing slowly.

This paper represents an initial attempt to test these expectations. The specific objectives of the study are to determine whether 6-year-old children form mental representations of words that contain morphophonemic segments, and whether there are differences in the extent to which morphophonemic segments are used between children who are notably successful in performing linguistic tasks (such as learning to read) and those who have difficulty with such tasks.

Methodology

Investigation of the development of morphophonemic segments raises a number of methodological issues. First is the question of what constitutes clear and sufficient evidence that such abstract segments underlie children's speech processing. For adults, the presence in spontaneous speech of related forms containing categorical segment changes (e.g., divide and

division), awareness of the meaning relationships between these forms, and categorical changes produced in converting one form into another are the evidence upon which generative phonological theory is predicated. This study seeks to avoid the issue of the psychological reality of morphophonemic segments by obtaining and analyzing what would be comparable evidence from children.

For very young children, the presence of two related forms (such as press and pressure, or get and getting with a flapped medial consonant) in spontaneous or elicited performance cannot be considered sufficient evidence for base, generative segments, since the child may be representing and storing each word as a distinct lexical item. Some indication that the child is aware of and uses the meaning commonality of the two forms is also necessary. For this reason, the experiment used in this study presented children with the task of taking apart complex words and commenting about the meaning of the base portion. In this way, both the base and derived forms could be elicited from the child, the extent of change in the phonetic form of the base words could be observed, and the child could be interviewed about the meaning of the word fragment produced in response to the examiner's directions.

The second methodological issue concerns the interpretation of differences in performance. Comparisons between the responses of adults and children on the same linguistic task would be interesting, but since many factors associated with disparities in cognitive and linguistic maturity may affect performance, we have no metric with which to judge differences. It is important, however, to find out what adults do with this specific task, and to make some qualitative comparisons, since the basic issue here is whether children's linguistic competence is equivalent to adults'. In other words, adult-child comparisons can

at least be helpful in deciding whether the evidence obtained from children might be viewed as evidence for abstract segments.

Comparisons between the performance of children who are advanced vs. delayed in general language development allows a direct test of the assumption that children's segments become progressively more abstract. But here too there are problems in interpreting performance differences. Measurable differences in language development may reflect metalinguistic abilities, differences in learning and experience, and/or cognitive abilities rather than (or in addition to) differences in linguistic competence. In short, this experiment has potential for demonstrating that abstract segments are used by 6-year-olds to understand, store, and produce words; but it has limited potential for providing evidence that such segments are not present.

Given the problem of determining what is sufficient evidence that morphophonemic segments are present, this study must be considered primarily exploratory. The data obtained may be more useful in determining what might be convincing evidence for such abstract segments, and in generating additional hypotheses on this issue, than it will be for determining the nature of children's segments.

Procedures. The experimental task is similar to the ones used by Bruce (1964) and by Rosner and Simon (1971). Subjects were asked to omit a morpheme, syllable, or segment from a word in this way: first, the examiner read a sentence containing the test word; second, the child was asked to pronounce the test word; then he was requested to "Say it again, but leave off the _____" (the specified part). If the subject produced an incomplete or wrong segmentation, he was asked to say the test word once more, then "Say it again and leave off just the _____."

As soon as the child produced a word fragment, he was asked, "What does that mean?" If no answer was received, prompts were used such as, "What does it make you think of?" or "Can you show me what it means?" Prompts were usually necessary only for the first two or three items.

Subjects were tested individually in an isolated setting within the school during the school day. Items were presented orally, and responses were both hand-transcribed during the task and tape-recorded for later analysis.

Subjects were selected from schools in a New York community representing rural, urban, and suburban populations and a wide range of socioeconomic levels. Adult subjects were 20 high school sophomores (11 females and 9 males) constituting the total enrollment of one English class of average ability. Thirty-six first graders were randomly chosen from classrooms of five schools. Data had been collected from these 6-year-olds on three additional linguistic tasks in the context of a related experiment. These tasks were:

1. Reading a set of 30 consonant-vowel-consonant (CVC) words (10) and non-words (20); for example, ten and fim.

2. Omitting a segment from an orally repeated word using the procedures of Rosner and Simon (1971); for example: "Say steep" . . . (response). "Now say it again, but don't say the [t^h]." . . . ("seep"). The result of a correct omission was always a real word.

3. Marking a set of 8 pictures on the basis of the presence or absence of a specified segment in the names of the objects pictured and named by the examiner. For example, children were asked to make an 'X' if there was, and an '0' if there was not a [p^h] in the words pencil, zipper, cup, spoon, prince,

beads, strawberry, and crib. Eighty-eight trials were presented testing the presence or absence of 11 segments in initial, final, and medial positions and in two clusters.

Children were divided into "language advanced" and "language delayed" groups (those with high likelihood vs. low likelihood of possessing and using morphophonemic segments) on the basis of combined Z scores from these tasks. Using natural breaks observed in the distribution of scores, the 16 highest-scoring children were selected as the "advanced" group and the 20 lowest-scoring children were then selected for the "delayed" group.[1] Extreme scores were used to establish a stronger possibility of difference in linguistic competence between the two groups.

Although there is a high degree of similarity between the experimental task and the tasks used to identify children as language advanced or delayed, reports of school achievement in language learning and performance allow an independent validation of these ratings. Children in the advanced group were making excellent progress in learning to read; whereas delayed group subjects were from classes deliberately composed of children identified as poorly prepared to begin learning to read or were reported by teachers to be having great difficulty. (Reading instruction was proceeding for most of these children, however, using an intensive decoding approach--Englemann and Bruner, 1968.)

Description of items: Words were chosen so that omission of a specified part would remove the phonetic environment which, according to generative phonologists, causes the base segment to assume a particular surface form; for example, omitting /θ/ from eighth should produce "eight" with a final [t] (although the /t/ may be unreleased). Six types of items were used:

1. Compound words in which the final segment of the first element and the first segment of the second element are the same phoneme:

homemade	(The part to be omitted is
earring	underlined in all examples.)

Here there are phonetic and phonological clues to the duplicated segment: both the doubled consonant and the preceding vowel may be slightly lengthened; and the stress pattern is that of compound words and contrasts with what would otherwise be rhyming items, such as pomade and hearing.

2. Compound words from which a segment is almost entirely omitted by many native speakers of English.

grandfather	[graenfaðər]
windshield	[wIn:ʃIld]
windmill	[wIn:mIl]

3. Derived forms in which a segment is omitted or changed with the addition of a bound morpheme:

natural	(/ey/ in nature changes to /ae/)
pressure	(/s/ in press changes to /ʃ/)
eighth	(the /t/ in eight disappears or becomes a tap.)

4. Plural forms in which the final segment of the singular is changed phonemically or allophonically:

leaves and wolves	(/f/ changes to /v/ with pluralization.)
plants and pants	(the /t/ disappears or becomes a glottal stop, although phonologically it must be there, or else the plural morpheme would be pronounced [ʒ] .)

5. Inflected and uninflected forms in which medial /t/ and /d/ are phonetically represented as flaps in many American dialects:

rider and writer

wedding and getting

cattle and middle

For rider and wedding, the lengthened vowel gives a clue that the medial stop is voiced. In cattle and middle, this clue is not present.

6. Single morpheme items in which the underlying nasal /n/ becomes /ŋ/ in the environment of a velar stop:[2]

pink and finger

The complete list of 21 items appears in Table 3 (below) which presents the proportion of positive responses produced by each subject group for each item.

Scoring and Interpreting Responses

Determining what should count as an acceptable response presents some problems, since there are six different ways a person might respond to the task even if he successfully omits the specified portion of a trial word. The subject might supply:

a) a phonetic fragment (e.g., [ho] for homemade), and no meaning.

b) a phonetic fragment of the test word, and an unexpected definition that fits that fragment (e.g., [liv] for leaves, meaning "to go, or to exit").

c) a phonetic fragment of the test word, but a definition for the expected morpheme (e.g., [wIn] for windmill, meaning "the 'win' is blowing").

d) the expected morpheme (with correct representation of the critical segment), and no meaning (e.g., [wEd] for wedding, but "it's not a word").

e) the expected morpheme, but the definition of a homophone (e.g., [eyt] for eighth, with the definition, "I ate some pie").

f) the expected morpheme, with the definition of that morpheme (e.g., [paent] for pants without the [s], with the definition "panty-ho(se)").

Obviously responses of type f provide the strongest argument for morphophonemic segments. But there are several reasons that a subject might fail to produce type f responses, even if his underlying representation of the word contains such an abstract segment.

1. Subjects might interpret the task at a literal level, deliberately producing phonetic fragments. Inquiries about meaning might not alter this interpretation of the task, because for several trial items a phonetic fragment produces a meaningful word (particularly homemade, windshield, windmill, eighth, leaves, plants, pants, and pink).

2. Subjects might separate words by omitting more or less than was requested. For example, one first grader produced [winč] for windshield and said it was a thing on the front of a jeep to pull cars with.

3. A subject might be prompted by phonetic similarity to think of a near homophone and therefore be led to produce a phonetic fragment rather than the expected morpheme. This could explain why some subjects produced [liv] ("to exit") rather than [lif] when asked to omit [z] from leaves. (Ten adults and six 6-year-olds produced this response.)

4. Even though a subject produced the expected morpheme, he might be misled by a homophone to produce an unexpected meaning for the remnant. For example, eighth without [θ] yields "ate" (the past tense of eat) as well as "eight".

5. Subjects might not have conscious access to morphophonemic segments, even though they have such segments in deep-level representations.

6. Finally, younger subjects especially may not be able to express a meaning for the remaining portion of the word.

One can also argue that successful production of the anticipated morpheme and its meaning might not constitute sufficient evidence for morphophonemic segments. There are two reasons:

7. Subjects might know and refer to the spelling of the word to accomplish the task. Several adults commented that they performed the task this way; but even some first graders' performance might be influenced by spelling knowledge.

8. Production of the anticipated response may be prompted solely by meaning relationships, even though the test item and the component morpheme may be stored as distinct lexical items.

For all these reasons, it is clear that isolated responses or responses by an individual subject cannot be interpreted as evidence for base, generative segments. However, tendencies of groups of subjects to produce responses of one type over another are meaningful when the groups can be compared on the basis of some independent measure of language performance (and by implication, competence).

To make such comparisons, responses were classified first according to the categories a through f described above. In a liberal approach to scoring, responses of types a, b, and c were judged to be negative responses (they supply no positive indication for morphophonemic segments) and responses of types d, e, and f were grouped together as potentially positive responses (these response types are at least not inconsistent with the claim that children are

generating variable surface forms from a common abstract, generative form).

In a more conservative approach to scoring, responses of types a and b (only) were judged as negative, and responses of type f (only) were judged as positive. Both scoring approaches were used.

Predictions based upon the assumption that segments become progressively more abstract at least through early childhood years are: (1) that language advanced first graders should supply a greater proportion of positive responses and a smaller proportion of negative responses than language delayed children of the same age; and (2) that language delayed first graders should supply very few positive responses overall. If, on the other hand, one assumes that abstract segments are present from very early in the course of language development, language advanced first graders might still be expected to outperform language delayed peers for some of the reasons discussed above; however, there would be a clear expectation that lower achieving children would produce a sizeable number of positive responses on the experimental task. Adults would, of course, be expected to outperform first graders according to either of these hypotheses because of advantages accruing from literacy and maturity.

Results

Table 1 presents the proportions of responses of each of the six types for each subject group. Summary statistics are presented in Table 2. Clear differences appear between groups in the number of responses that might be considered positive evidence for abstract segments (types c, d, and e). The adult group is very clearly superior to both first grade groups, and language advanced first graders are superior to the language delayed group ($p < .001$ for all comparisons). Comparing responses of type f only, the same pattern of difference is observed, and the level of significance of difference is still .001.

Insert Table 1 About Here

Comparisons of negative responses (types a and b) fit the same pattern: language delayed first graders produce significantly more negative responses than language advanced 6-year-olds, who in turn produce more negative responses than adults.

Insert Table 2 About Here

Despite the differences between groups in task performance, however, the fact remains that the language delayed group was able to perform the task successfully on a substantial number of items. One-third of their responses are of types d, e, and f, with 27% falling into category f. Examples of such categorical changes as pressure to "press," middle to "mid," pants to "pant," leaves to "leaf," wolves to "wolf," wedding to "wed," and rider to "ride" come from these non-reading first graders as well as from their more literate age-mates. Table 3 presents the proportions of positive responses (types d, e, and f) on individual items for each subject group.

Insert Table 3 About Here

Clearly, children in this sample supply positive evidence that relationships exist, both at a semantic and at a phonological level, between derived word-forms and their component morphemes. Whether the component morpheme and the derived form are related phonologically through an underlying representation containing one or more abstract morphophonemic segments can only be inferred. However, qualitative aspects of children's performance on this task suggest that this

interpretation may be justified.

One interesting feature of the data consistent with this interpretation is that children appear to be quite tentative about the nature of segments that hold positions subject to morphemic change. Children frequently demonstrated uncertainty or hesitancy about a segment, occasionally producing two different forms or vacillating between forms. Rider and writer produced several examples. The tape captured the whispered indecision of one child on writer. He whispered [ray] and then [rayt], then said [ray] out loud. When asked the meaning, he said, "Getting a [rayd]." On rider he paused and thought before producing [rayd]. A girl pronounced a clear [rayd] for writer, but demonstrated the act of writing for the meaning.

Another subject said [wEd] distinctly for wedding, but paused and tried it out again before giving the meaning, "A wet towel." Vowel length and final consonant voicing were clearly different. Middle, cattle, and pressure produced similar examples. On pressure, children might not previously have been consciously aware of the change. There were 4 or 5 speech-correction examples. A girl from the low group: "[prE^{y}š] (means) preshing, pressing on something; you can just say presh." A boy from the high group: "[prE^{y}š], I'm presh-, pressing on something."

Children also showed a tendency to produce these final segments weakly or faintly. Final /d/ or /t/ was often reduced to the faintest alveolar tap if it was present at all. Many children said [wIn] or [wIn'] ; some of them went on to talk about the wind and said it the second time with a clear /d/, but some pronounced the word just as ambiguously throughout, supplying examples such as "The [wInz] blowing," or "Whoo-oo-oo!" Some children produced segments that seem halfway between the two choices. This was noticeable on pressure (something between [s] and [š].) on wolf ([wUlvf]) and on middle ([mIdt]).

Responses to items containing medial flaps (intervocalic /t/ and /d/) offer another indication that 6-year-olds treat phonetic information according to the same rules that govern adult performance. If the medial flap occurs in an inflected form (e.g., getting) and if both the inflected form and the base word (get) are very frequently used, then children convert the flap to /t/ or to /d/ as adults do. However, if one of these forms (either base or derived) is an infrequently used word for children, or if the medial flap occurs in a free morpheme (like cattle), first graders tend to convert it to /d/ or /t/ about equally. Table 4 presents the data for all forms containing medial flaps (getting, wedding, rider, writer, middle, and cattle.)

Insert Table 4 About Here

Get, getting, rider, rider, and write are words very familiar to children (Wepman and Hass, 1969), but writer may be an unfamiliar word (write is on the 7-year-old list in Wepman and Hass, but writer does not appear). Alternative explanations of responses to writer might be (a) that this item followed rider in presentation, and (b) that the illustrative sentence for this word was not sufficient to compel all children to make a connection--perhaps because it contained two independent clauses ("Mr. Green writes books for children; he is a writer.")

Responses to cattle were equally divided between /t/ and /d/, despite the possibility of converting the first syllable to the familiar but unrelated word cat. Equivalent performance was expected on middle, but 7 first graders produced [mId] in conjunction with an appropriate meaning (e.g., "midnight" or "Mid-West") and this degree of acquaintance with a related form seems to be reflected in the results.

Differences Between Groups

Although children respond to many of these items in much the same way adults do, it is also apparent that children's performance differs from adults' in some ways. Six-year-olds tend to have stored versions of some lexical items that differ noticeably from standard adult forms. For a few of these first graders, the singular version of wolf was [wUf] or [wUl] and the corresponding plural [wUfs] or [wUlz]. [Liv] may actually have been the singular form of leaves for some children. For two youngsters, the initial morphemes of grandfather and graham crackers were homophones, although one settled on [graen] and the other on [graem] for both crackers and ancestors. Responses to items or discussions of meaning produced the following additional immature forms: [ho:d] for hold; [mI^{y}Al] or [mI?l] for middle; [eyr·riŋ] for earring; [wIn] for wind and "nash potatoes" for mashed potatoes.

A second difference observed in the performance of children compared to adults in this sample is that vowel shifts do not appear in the data from young subjects but do appear in responses from adults. One first grader did produce "nature" for natural, but this was the only example. High schoolers, on the other hand, not only applied that strategy to the word natural but also applied it where inappropriate ([lEv] for leaves, [rId] and [rod] for rider, and [priy] for pressure.) Young adults seem to expect vowel changes to accompany morphemic change; whereas, first graders do not yet show this expectation.[3]

Neither of these explanations (immature forms or vowel shifts), however, explains much of the difference between child and adult performance. A larger share of that difference can be explained by adult subjects' knowledge of orthographic representations of words. Specifically, knowledge of spellings could have helped adult subjects divide words between component morphemes, thus producing more responses of type f and fewer of types a, b, and c.

Nevertheless, the data suggest that children just do not share the same knowledge that adults have about the phonological forms and meanings of many common words and their inflected or compound derivatives, even though they might know these related forms when they stand alone or appear in other contexts. Grandfather, eighth, and pressure are particularly good examples. Several children did not seem to make any connections between eighth and eight, for example, at least within the parameters of the experimental task.

Knowledge of spellings does not appear to be a reasonable explanation of the difference between language advanced and language delayed first graders. Subjects in the advanced group had begun to read, but it is doubtful if any of these children could spell more than 1 or 2 of the trial words. Two other explanations of performance differences need to be considered: (a) the advanced group were better at separating words, and (b) they were better at supplying meanings.

Examination of the data indicates that ability to separate words does not account for much of the difference between the two groups: on less than 3% of all trials did the language delayed group fail to produce a reasonable separation of words (omitting what the directions called for). Neither do the data suggest that the advanced group were particularly superior in supplying meanings. They did supply more positive responses with appropriate meanings (type f), than did the delayed group, but they also supplied more positive responses without meanings (type d): advanced group, 27 instances (8.5%); delayed group, 21 instances (5%).

A more reasonable explanation of the difference is that the advanced group had simply acquired more knowledge of base words and their derivative forms and the phonological and semantic relationships between them, than the delayed group. Advantages in experience or in tuition or greater ability to learn might

account for their superior knowledge.

This account of the difference amounts to a claim that the advanced group had, in fact, made greater progress toward adult linguistic performance, and by implication adult linguistic competence, than their, lower-performing age-mates. The inference that these youngsters utilize a higher proportion of morphophonemic segments in their stored representations of words is consistent with generative phonological theory.

A Second Experiment

An alternative explanation for the difference in performance between language advanced and language delayed first graders might be that advanced subjects were using acoustic-phonetic clues to make appropriate changes in base forms when the compounded portions were removed. Instead of using stored knowledge of related word-forms, these subjects might be using, for example, such clues as vowel lengthening (as in rider vs. writer) or the occurrence of [z] as the plural morpheme (as in pans vs. pants) to infer a voiced rather than an unvoiced stop. The following mini-experiment conducted with some of the adults and 6-year-olds in this study indicates that first graders are not relying, at least primarily, upon acoustic-phonetic clues to underlying representations as their chief means of performing the task.

Three additional items were given to a few randomly selected first graders and young adults. Subjects were asked to omit the plural morpheme from words ending in -ants, -ance, and -ands, presented in the same manner as the other experimental task. All subjects were given the words plants, glance, and glands, but language delayed first graders were given, in addi-

tion, the words dance and hands so that the effect of word unfamiliarity could be assessed (it made no difference).

Except for one response of "plan" for plants, high school subjects' responses were perfectly consistent with the spellings of these words. All first graders performed very differently from adults on glands (all said "glan"), but language delayed subjects performed differently from everyone else on plants (all said "plan"). Table 5 summarizes the results.

Insert Table 5 About Here

If subjects were performing the task on the basis of acoustic-phonetic clues, they should produce responses of "glant" for glance nearly as often as they produce "plant" for plants. (In both instances, an unvoiced /s/ follows a nasal continuant /n/.) Instead, glance was interpreted as "glan" by all subjects. For plants, however, high schoolers and language advanced children produced "plant". This suggests that these first graders refer to knowledge of an underlying representation of plant and plants containing a /t/--knowledge gained from the manipulation of these 2 forms over many uses. High school subjects may have done the task in the same way, but they may as easily have used spelling knowledge.

On glands and hands, children should occasionally respond "gland" or "hand" if they are responding to surface phonetic clues to underlying representations (there is at best a very slight phonetic difference between, for example, bans and bands), but no first grader gave a response ending in a clear [d]. The fact that tenth graders always gave responses ending in [d] probably verifies their reference to spellings, as well as underlying representations, to perform the task.

The word pans was included among the 21 items in experiment one as a comparison to plants, glance, and glands. According to the rules of English, a noun ending in [aenz] could be the plural or possesive of a word ending in /d/ (or any voice consonant); but it cannot be the plural of a word ending in /t/. Words ending in /t/ must form their plural with the voiceless sibilant /s/. All first graders in this sample observed the constraints of this rule: none of them produced a phonetic fragment ending in a clear /t/. On the other hand, a few of them (3 out of 36) produced a response ending in /d/ ([paend]). This result supports Berko's claim (Berko, 1958) that children observe the regularities of the language even when they cannot use those rules productively--to recover a component morpheme, as in this task; or to add an inflected ending to a nonsense word, as in Berko's task. However, the meanings children supplied for pans did not always observe the constraint against morphemes ending in /t/: three children gave meanings such as "pantleg", "pants", or "pant like a dog". This suggests that phonological representations and meaning associations are not so neatly tied together as generative phonologists would predict, at least in the minds of some first grade children.

Acquisition of Morphophonemic Segments

The suggestion has been made above that children learn the specific surface assignments of underlying abstract segments through manipulation of the base and derived forms in oral language use and that such learning is still very much in progress for first grade children. The data show that children produce a higher proportion of positive responses (types d, e, and f) when the trial word and its component morpheme(s) (e.g., windshield and wind) both occur in common childhood usage.

Responses produced on getting, wedding, rider, writer, plants and pants illustrate this point. For 3 of these items--getting, rider, and plants--both the base form and the inflected form are very familiar to young children. In contrast, either the base form or the inflected form of wedding, writer, and pants were presumed to be much less familiar to young children (wed, writer, and pant should be the less-well-known forms).

Table 6 presents the proportions of positive responses (type f only) and negative responses (types a and b only) produced on the familiar items vs. the 3 less-familiar items. Both the advanced and delayed groups produced more positive responses on getting, rider and plants than on wedding, writer, and pants, but the difference on the 2 types of words was more dramatic for the delayed group. Clearly, the language advanced group's representations of these words is closer to the adult representation, and this is particularly true of words less common in childhood use.

Insert Table 6 About Here

It is interesting to speculate about the specifics of the process through which children might acquire morphophonemic representations, although this study supplies only hints toward the construction of such an account. Evidence presented here suggests that children may become aware of a meaning relationship between a word and its derivative form before they have learned the adult phonological form for one of the items. The child may say eight correctly, but pronounce the cardinal number as [eyθ]. Given opportunity to convert eight to eighth and the reverse in meaningful

situations, the child develops an abstract morphophonemic representation capable of alternative surface representation, as appropriate. At that time, the child's pronunciation of eighth might reflect a slight change.

Another possibility is that a child might learn an inflected form and its base form as separate items. For example, wolf might be learned as [wUf] at time 1, and wolves learned as [wUlz] at time 2, in different contexts. Either of these words might move toward the adult form independently prior to the time that a common underlying representation is formed. Conversion of one form to the other with a meaning association is presumably the learning experience that would generate the abstract representation.

An important prior question for our understanding of children's acquisition of morphophonemic segments is the degree of specificity of segments when a word is first added to a child's repertoire. Some investigators have reported a considerable amount of phonetic variability in the utterances of very young children (Ferguson and Farwell, 1975; Olmsted, 1971). Data from this study and from a related study (Jones, 1979) suggest a considerable degree of tentativeness or variability in school-age children's segments in some task conditions. Of course, if children's segments were wildly unspecified, it would be hard to account for successful speech communication. Yet if they are fully specified (in terms of features) when the word is established in the child's lexicon, then some explanation must be given to account for changes in segments at a later time. The account offered above may be helpful toward understanding how such changes come about.

Summary

Evidence from a sample of first grade children shows that all subjects understand (at a sub-conscious level) relationships between the meanings and phonological forms of inflected or compound words and their base morphemes. Although such knowledge has been demonstrated at least on some items by every child in the sample, there are clear differences between children as well as between adults and children in the extent of such knowledge. Many children seem not to have learned either the phonological relationship or the meaning relationship, or both, between such forms as grand and grandfather, write and writer, and press and pressure. Children whose language achievement and meta-linguistic abilities are high possess such knowledge to a greater extent than children whose achievement and metalinguistic ability are poor.

Language usage, particularly the manipulation or conversion of a derivative to a base morpheme or vice versa, would seem to be the mechanism through which children acquire the abstract underlying representations of such related word-forms. Children's mispronunciations of words--some of which might even have been learned from adults (e.g., [mIʔʌl] for middle, and [wUfs] for wolves), and some of which presumably would not have been heard (e.g., [rIŋmIl] for windmill) --also reflect imcomplete learning due to limited exposure and language manipulation opportunities.

The language of first grade children may also be incomplete in another sense, too. Evidence presented here supports Berko's claim (op. cit.) that children differ from adults in their awareness and utilization of the phonological regularities of the language. Youngsters in this sample seem to ignore the possibility that words ending in [aenz] could be represented

as /aendz/ or /aenz/; they show no tendency to convert vowel segments, as in nature-natural; and their responses to words like rider, writer, getting, and wedding reflect usage probabilities rather than acoustic-phonetic cues or phonological rules.

If children do not productively employ phonological rules to the extent that adults are presumed to do, can it be that segments in children's representations of words are abstract morphophonemes as generative phonologists claim adult segments to be? It seems that they are. Even though some children are limited in their perception of relationships between derivative word-forms, all children demonstrate knowledge of some of these relationships and make some phonetic changes in segments when producing those forms. Children differ from adults and from one another in awareness of lingusitic regularities, not in observance of these regularities. Differences among children in ability to learn as well as opportunities to learn would account for differences in the extent of such awareness (Liberman and Shankweiler, 1976).

Data from this experiment suggest that children's segments (in certain word positions) are abstract in the sense of being incompletely specified. According to generative phonologists, segments are abstract when they vary systematically, at the surface level. For example, the prefix /in/ takes on the forms [In] (insect), [Im] (impart), [Iŋ] (income), [Il] (illegal), and [Ir] (irregular), obeying a rule of homorganic assimilation. Segments would be unspecified if they vary within prescribed limits, but unsystematically. Children seem to treat flaps, for example, as alveolar stops; but in the absence of knowledge from derivative forms, they convert these flaps to /t/ or /d/ about equally and in random pattern. Such as interpretation allows for the fact that children's segments vary regularly according to rules of

the language, and it also allows for learning processes to work on these segments--toward greater specification at the lexical level while retaining their abstract, generative potential.

NOTES

1. Divisions between groups were also based on analysis of the tasks and arguments about performance levels with small probability of chance occurrence.(Jones 1979).

2. According to generative phonological theory, pink and finger are represented at the deep level without the velar nasal /ŋ/ (/pInk/ and /fIngər/). There is no clear data from either adults or children to verify that this deep level representation is psychologically real. Fromkin supplies a speech error example suggesting the psychological reality of /ng/ as the underlying representation of [ŋ]. She cites an instance in which the name Chuck Young was pronounced [čʌŋk yʌg], the [g] left in the last name presumably coming from the underlying cluster /ng/ (Fronkin, 1971, cited in Hyman, 1975).

3. Underlying representations of pink and finger predicated by Chomsky and Halle (1968) are not apparent from the data either from adults or from children. Some scattered examples suggest, however, that /pInk/ and /fingər/ may be the underlying forms for a few children. Four children produced a clear [pIn] for pink and the 3 produced [fIn] for finger; also a few other children pronounced the initial CV portion of the word with a nasalized vowel but no clear /n/. Possibly these children were omitting the velar stop and retaining the /n/, although they simply may have failed to de-nasalize the vowel when they omitted /ŋ/. High school subjects supplied 11 cases of [pIn], but these responses obviously cannot be accepted as evidence for /pInk/ because of the ease with which adults can refer to spellings for this task.

4. Procedures and equipment used in this study do not allow clear identification in all cases of the segments children used or resolution of the issue of the degree and kinds of variability. Children's hesitancy, tentativeness, and variable pronunciations are clear tendencies, however, within these data.

5. Pant was assumed to be a rare form, but it turns out that children are very familiar with 'panties,' 'panty-hose' ("panty-ho"), and 'pant-leg' as well as the verb 'to pant'.

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Table 1

Proportions of responses within each of six response types produced by adults, and by language advanced and language delayed first graders.

Response Type - Explanation[a]	Adults	Advanced	Delayed
A - Phonetic fragment, no meaning e.g., [ray] - "doesn't mean anything"	.05	.26	.38
B - Phonetic fragment, homoph. meaning e.g., [ray] - like rye bread	.09	.13	.19
C - Phonetic fragment, morph. meaning e.g., [ray] - "with a pencil"	.00	.07	.09
D - Correct morpheme, no meaning e.g., [rayt] - "I don't know"	.03	.08	.05
E - Correct morpheme, homoph. meaning e.g., [rayt] - "it's not wrong"	.04	.03	.01
F - Correct morpheme, morph. meaning[b] e.g., [rayt] - "write a letter"	.80	.43	.27
Responses of types D, E, and F combined[b]	.86	.54	.34

[a]Examples are from the item writer. Paraphrases of actual responses are used except for type B; no responses of this type appeared on writer.

[b]Differences between groups (all comparisons) significant at .001 level.

Table 2

Summary statistics for adults and for language advanced and language delayed first graders, based on responses of types d, e, and f combined.

		First Graders	
	Adults	Advanced	Delayed
Number of subjects	20	16	20
Range of scores	14 - 21	6 - 18	3 - 15
Group mean	17.6	13.9	9.4
Median	18	14	9.5
Standard deviation	1.76	3.00	2.64

Table 3

Proportions of positive responses[a] to individual items produced by adults and by language advanced and language delayed first graders.

Items	Adults	First Graders	
		Advanced	Delayed
1. grandfather	1.00	.56	.15
2 eighth	.80	.75	.45
3 pink	.70	.19	.05
4 rider	.85	.88	.68
5. windshield	.95	.81	.74
6. cattle	1.00	.38	.15
7. leaves	.35	.56	.32
8. writer	.90	.63	.25
9. pressure	.80	.19	.33
10. earring	1.00	.81	.63
11. wolves	.75	.88	.70
12. middle	1.00	.63	.30
13. plants	.95	.81	.74
14 getting	1.00	.88	.65
15. homemade	1.00	.75	.40
16 pants	.85	.38	.25
17 finger	.45	.13	.05
18 windmill	.95	.81	.70
19. wedding	1.00	.63	.53
20. natural	.60	.06	.00
21 pans	1.00	.88	.90

[a]Responses of types d, e, and f are included as positive indicators of underlying morphophonemes.

Table 4

Comparison of language advanced and language delayed groups' responses to items containing medial flaps.

	Advanced Group		Delayed Group	
Item	Rspns No.	Rspns No.	Rspns No.	Rspns No.
getting	get - 14	ged - 0	get - 13	ged - 2
wedding	wed - 10	wet - 4	wed - 10	wet - 7
rider	ride - 14	rite - 0	ride - 13	rite - 2
writer	write- 10	ride - 3	write- 5	ride -12
cattle	cat - 6	cad - 6	cat - 3	cad - 4
middle	mid - 10	mit - 4	mid - 6	mit - 4

Table 5

Results of experiment two. Responses to plural morpheme omission items by first grade groups and high school subjects.

		plants		glance			glands	
Groups	N	/n/	/t/	/n/	/t/	/d/	/n/	/d/[a]
Adult subjects	5	1	4	5	0	0	0	5
All First Graders	10	6	4	10	0	0	10	0
Language Advanced	4	0	4	4	0	0	4	0
Language Delayed	6	6	0	6	0	0	6	0

[a]Letters represent the segment at the end of the response, e.g., /n/ under glance represents the response "glan".

Table 6

Proportions of positive and negative responses[a] produced by all first graders and by language advanced and language delayed first graders on items of higher and lower familiarity to children.

Items	All First Graders positive	All First Graders negative	Advanced positive	Advanced negative	Delayed positive	Delayed negative
2 Familiar forms						
getting	.75	.06	.88	.00	.65	.10
rider	.75	.06	.88	.00	.65	.10
plants	.67	.33	.69	.31	.65	.35
Total - 3 items	.72	.16	.81	.10	.65	.18
1 Unfamiliar form						
wedding	.56	.31	.63	.25	.50	.35
writer	.42	.42	.63	.19	.25	.60
pants	.58	.31	.75	.25	.45	.35
Total - 3 items	.52	.34	.67	.23	.40	.43