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Phonological rule usage in mother-child speech

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Abstract: The present study examined the incidence of phonological rule usage in maternal speech to children with expressive MLUs of 1.0 to 2.5. In contrast to earlier work which found the application of optional rules such as palatalization, dental deletion, /ð/ deletion, and conversion of ts/s to be more prevalent when mothers spoke to children than when they spoke to an adult, the present study found that the latter three rules were used much less frequently in maternal speech than in adult-adult speech. Palatalization was more common in mother-child speech than in adult-adult speech, but occurred in environments in speech to children which are more condusive to rule application. Results suggest that (1) there is a need to control the variable of child addressee linguistic maturity in studies of mother-child speech, (2) maternal speech to children at very early stages of language learning is in many ways phonologically clarified, and (3) phonological modification may differ across different languages' babytalk registers. Additionally, the patterns of rule application noted in the present study suggest that mothers alternate canonical and rule-distorted forms systematically in speech to such young children. Implications of such strategies are addressed.

Introduction

There is a growing but equivocal body of literature which has examined the nature of phonological input to language-learning children. In large part spurred by psycholinguists' interpretations of studies carried out by Pollack & Pickett (1963, 1964), who described the lack of precision and intelligibility which characterizes typical adult-adult (A-A) conversational speech, researchers have endeavoured to find qualitative differences between speech input addressed to children and that normally shared between adults.

The search for such qualitative differences addresses the realization that current models of speech perception include a deeply rooted knowledge of the lexicon and syntax of the language that a listener attempts to decode. Cole & Jakimik (1980), after reviewing studies which describe the unintelligibility of adult conversational speech, posited specific strategies for the deciphering of the degraded phonetic strings which typify adult-adult speech style:

> "(our) assumptions are (that):
> 1. Words are recognized through the interaction of sound and knowledge.
> 2. Speech is processed sequentially, word by word. Each word's recognition:
> a. locates the onset of the immediately following word; and

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b. provides syntactic and semantic constraints that are used to recognize the immediately following word.
3. Words are accessed from the sounds which begin them.
4. A word is recognized when the sequential analysis of its acoustic structure eliminates all candidates but one." (p. 134)

While such a model may indeed account for adult perception of connected discourse, its features should pose numerous problems for a linguistically-naive listener, such as an infant. Because young children have limited lexical and grammatical knowledge which can be brought to bear on the segmentation and identification of phonetic strings, it would appear that they should not be able to process much of the incoming linguistic data necessary to their future acquisition of language skills. An assumption of relative clarity of phonetic strings addressed to children could do much to resolve any hypothetical dilemma faced by the young language-learner.

A number of researchers have in fact characterized segmental phonology addressed to children (M-C, or A-C speech) as acoustically better-specified than that addressed to adults (A-A speech). Moslin & Keating (1977), Moslin (1979) and Malsheen (Moslin) (1980) describe voice-onset-time for stop consonant production in the M-C speech of six women as more discreetly defined than VOT in speech by the same mothers to an adult listener, where VOT values were more likely to overlap between intended voiced and voiceless targets. All three reports emphasize that the clearest distinction between VOT patterning in A-A and M-C speech appeared in speech to children just learning first words.

A separate set of investigations has examined the nature of vowel articulation to young language-learning children. Bernstein (1982) and Bernstein Ratner (1984, in press) examined the speech patterns of nine women, and suggested that mothers of children just learning first words, and of children beginning to combine words into short utterances produce vowels with much less formant overlap and greater distinction in formant characteristics than do the same women addressing an adult listener. As in the Moslin/Malsheen project, phonemic "clarification" occurred across parts of speech. Both studies found that function words (such as particles, pronouns, auxiliaries, modals and deictics) were characterized by atypically precise articulation patterns when embedded in speech to children.

Conversely, two sets of investigations have found A-C speech to be characterized by equal or greater phonological imprecision or distortion than speech shared between adults. Baran, Laufer & Daniloff (1977) also examined VOT in the speech of mothers addressing children and adults. Their three subjects spoke to children who were at a stage "which preceded emergence of the infant's first meaningful words." (p. 341) The authors concluded that mothers do not change the VOT characteristics of their conversational speech when speaking to infants, although the performance of one of their subjects did suggest that individual mothers might make greater efforts than others to be "clear and precise" when speaking to young language learners. Baran *et al.* (1977) speculated that "It may be that the stage of language acquisition is a critical factor in determining the phonological characteristics of child-directed language" and suggested that "parents will selectively maximize the differences between sound categories once their children begin to produce meaningful words" (p. 349). While the authors did not pursue this notion, their prediction is rather directly supported by the findings of the Moslin/Malsheen project carried out a few years later. Thus, though partially non-supportive of a view of A-C speech as phonetically clarified, Baran *et al*'s results can in some sense be accomodated within the model of maternal speech provided by the Moslin/Malsheen and Bernstein Ratner reports.

A final study of adult-child phonological modifications was carried out by Shockey & Bond (1980). Noting that certain optional phonological rules which operate in fluent conversational speech may distort the canonical form of words, the authors sought to ascertain whether processes such as palatalization (did you → dɪdʒu), dental deletion (want ɪt → wan ɪt), /ð/ deletion (throw them → θrou ɛm), and the conversion of ts/s (that's nice → ðæs nais) were less prevalent in adult-child speech. Shockey & Bond found that all four phonological rules were *more* likely to be observed when their eight mothers spoke to children than when they spoke to adults. They interpreted these findings as evidence that phonological modifications are not as "conscious" or "habitual" as other levels of modification seen in A-C speech, and further hypothesized that, since such rules distort the canonical form of words, that use of them serves to "set a tone of intimacy in a dialogue" (p. 272) which outweighs any possible negative effects such modifications might have on the child's ability to process the spoken signal. Thus, palatalization and other optional phonological rules operate heavily in A-C speech because they serve the socio-linguistic function of establishing closeness and intimacy, despite the fact that this functional expression might complicate the child's efforts to unravel the sound system of English (or of any other language that he might be exposed to.)

Shockey and Bond did not specify their child addressee sample in terms of age and linguistic maturity. In their discussion section, they allude to a sample of "2- to 4-year old" listeners, but do not delineate the age or language distribution of their eight child addressees further. Even so, this sample would appear to be more mature than that used in the three studies discussed previously. This may not be a trivial issue. Just as Baran *et al.* speculated that certain children might be too young to elicit phonetic modifications, one may speculate that children past a certain point in the language acquisition process also do not engender such speech style modifications.

The study of adult-child speech in general seeks to elucidate the relationship between input to the child and the child's subsequent (or ongoing) acquisition of the rules of language. Before the child can learn to appreciate the relationships between referents and their corresponding phonetic representations, or before he can note the component constituents of utterances, he must first be able to isolate words out of the sound stream. Thus, it may well be that, if speech is to be clarified to children at all, it must be clarified at a relatively early stage in the child's acquisition of linguistic skills. Once the child is able to isolate and discriminate sound patterns in the input language, he can begin to perform analysis of the input at higher levels. That is, when the child can reliably identify words and "word candidates", then he can begin to hypothesize about the nature of their usage in utterances. Additionally, since it will become necessary for the child to be able to sort out "dirty" phonological data (that which has suffered articulatory undershoot or phonological rule application, for example), it may be reasonable to hypothesize that an early stage of phonological clarification in A-C speech will allow the child to later "template match" to more degraded productions of words he has already learned to distinguish.

Because the variable of child addressee linguistic maturity may be a possible explanation for the different results obtained by previous studies of adult-child speech, a replication of the Shockey & Bond study was undertaken, utilizing a younger, less linguistically-sophisticated sample of child listeners. A possible interpretation of previous results might pinpoint children's one-to-two word stages as those most likely to elicit phonetic modification of the input register. It would therefore be predicted that use of optional phonological rules would decline in maternal speech to children at this stage.

Method

Subjects

Subjects for this study were seven mother-child dyads. An eighth dyad participated, but did not provide sufficient usable data for the analysis to be described. All children were female, and had expressive linguistic abilities which ranged from MLU values of approximately 1.0 to 2.5, as determined by home visits and calculation of the child's productions during the taping sessions to be detailed below. All dyads could be classified as standard American English dialect-speaking/learning, and were middle-class.

Dyads were recorded three times over a 6 month period in a sound-proofed playroom located in a university-setting speech research laboratory. Interactions were recorded onto Ampex 406 audiotape by a Revox A-77 recorder. Mothers were outfitted with Sony ECM-50 lavalier microphones, ostensibly to allow better recording of both mother and child while engaged in play. Mothers were instructed to stay close to their children during the play sessions, and were provided with an opportunity to hear their children's speech as recorded in this manner during a warm-up session. Mothers were informed that safety regulations prohibited lavalier microphone use on their young children because of the possibility of entanglement. Thus, mothers were not told that their speech was the focus of the study, and later debriefing sessions indicated that mothers felt that their children's productions, rather than their own, had been the area of interest to the investigator.

Dyads were provided with a range of toys, and mothers were instructed simply to interact in any manner they wished with their children. Recording sessions of the mother-child interactions lasted approximately one $\frac{1}{2}$ h at each visit.

Following the play sessions, mothers were interviewed by the investigator about their children's current play preferences. The purpose of the interview was to gather a sample of adult-adult speech from each mother to utilize for comparison purposes. Mothers were recorded with the same equipment and in the same setting as in the play session.

Analysis

Following tape transcription, the transcripts were analysed to locate instances which fulfilled contextual requirements for application of the phonological rules examined by Shockey & Bond (1980). The specifications for each of the four phonological rules of interest are provided in Table I. Environments and rules were maintained as specificed in the earlier study, with two modifications. First, for the dental deletion rule, obvious and typical concatenatives such as "gonna", "wanna", etc. were not tabulated as possible environments for dental deletion, as there is some evidence that, even for adults, they function as a single over-learned lexical unit (Limber, 1973). Second, when listening for rule application, the

Table I Specifications of the phonological rules and their conditioning environments

Dental deletion:	$\begin{Bmatrix} t \\ d \end{Bmatrix} \rightarrow \begin{Bmatrix} \phi \\ ʔ \end{Bmatrix} / \_\_\_\_\_ \#$
/ð/ deletion:	$ð \rightarrow \phi / \begin{bmatrix} + \text{continuant} \\ + \text{coronal} \end{bmatrix} \# \_\_\_\_\_$
Palatalization:	$\begin{Bmatrix} t \\ d \end{Bmatrix} \#y \rightarrow \begin{Bmatrix} tʃ \\ dʒ \end{Bmatrix}$
ts/s rule:	$ts \rightarrow s / \_\_\_\_\_ \#$

dental deletion rule output was altered to allow either glottal stopping *or* deletion; evidence suggests that they are alternate realizations of the same process (Locke, 1983).

It was at this point in the analysis process that the eighth dyad was discarded, as the mother provided fewer than five instances of any of the phonological rule environments to either listener, and in some cases provided none.

Audiotapes of the interactions were then mounted on a Voiceprint machine, and the slow-scan loop repeater was used to examine whether or not a phonological rule had been applied to those contexts which had been selected as appropriate for possible application.

Simple dichotomous judgements were tallied. Following a first pass of the data, a second listener was provided with coded transcripts isolating the rule environments and asked to make the same judgements. The second listener re-analysed one recording session each from three women. Inter-judge agreement for rule application judgements was 90.23% overall (90.9, 94.3, 85.5 respectively). 57% of disagreements involved judgements on dental deletion application.

Results

Results were expressed as the percentage of positive rule application out of total possible environments for rule application. These results were tabled for each mother across the two listener conditions (adult vs child). The derived percentages are shown in Tables II–V.

As Table II indicates, palatalization was much more likely to occur in mother-child speech than in mother-adult speech. Sixty-nine per cent of maternal utterances capable of being palatalized were palatalized when they spoke to their children. Conversely, only 18.6% of phonetic strings eligible for palatalization were palatalized in adult-adult conversation. These patterns of rule application are significantly different from each other ($t = 3.5053$; $P < 0.02$; df = 6).[1] This finding is congruent with that obtained by Shockey & Bond (1980), who found palatalization in 34.3% of possible environments in mother-child speech, but in only 12.5% of possible environments in adult-adult speech.

However, examination of the other three rules shows a pattern of rule application very different from that reported by Shockey & Bond. For *no* dyadic comparison was the dental deletion rule applied more to the child than to the adult listener. Overall, dental deletion applied in 39.4% of permissible environments in M-C speech and in 69.4% of environments in adult-adult speech ($t = 7.3285$; $P < 0.001$; df = 6). While the present incidence of dental deletion or glottalization obtained here in the adult-adult condition is congruent with results reported by Locke (1983) for adult conversational style, it is much higher than that reported for Shockey & Bond's sample, where mothers distorted or deleted final dentals 43.6% of the time to children, and only in 32.1% of environments when speaking with an adult. Because the present study did not examine concatenatives, an especially likely environment for dental deletion, it is not clear why Shockey & Bond only noted approximately half as many instances of dental deletion as did the present study or Locke's (1983) investigation of adult-adult speech.

/ð/ deletion applied 19.8% of the time in speech to children, and 31.2% of the time in speech to the adult in this study ($t = 1.0084$, NS; df = 5); this contrasts with incidences of

[1] Degrees of freedom (df) differ across comparisons because of cases in both studies where mothers did not evidence appropriate environments for a particular rule's application. In such cases, any corresponding data gathered from the other addressee condition could not be compared, and the dyad's data had to be discarded for that comparison. It should be noted that in some cases, the resulting degrees of freedom were so reduced that a presumption of statistical significance for the difference between the samples became unreasonable.

Table II Application of *palatalization* across the two addressee samples

	No. in M-C*	Percentage changed†	No. in A-A	Percentage changed
Anne G.	28	75.0	1	0.0
Alexis	28	75.0	5	20.0
Monica	27	67.0	3	33.3
Kate	41	48.7	5	20.0
Cindy	58	72.4	7	57.1
Anne B.	14	78.6	1	0.0
Anne D.	40	67.5	3	66.6

*Number of environments fitting description for rule application.
†Percentage of times rule operated upon permissable environments.

Table III Application of *dental deletion rule* across the two addressee samples

	No. in M-C	Percentage changed	No. in A-A	Percentage changed
Anne G.	19	0.0	15	33.3
Alexis	13	15.4	27	52.0
Monica	26	54.0	23	74.0
Kate	21	61.9	51	82.4
Cindy	32	53.1	28	78.6
Anne B.	36	58.3	23	73.9
Anne D.	51	33.3	80	76.3

In *no* dyadic comparison does the rule apply more frequently in speech to the children.

Table IV Application of /ð/ *deletion* rule across the two addressee samples

	No. in M-C	Percentage changed	No. in A-A	Percentage changed
Anne G.	24	0.0	8	0.0
Alexis	12	25.0	–*	–*
Monica	30	10.0	11	45.0
Kate	51	25.5	19	26.3
Cindy	77	15.6	22	40.9
Anne B.	22	40.9	17	5.9†
Anne D.	37	21.6	39	69.2

*No opportunity for rule application.
†Only dyadic comparison in which rule applied *more* to a child listener.

Table V Application of *ts/s rule* across the two addressee samples

	No. in M-C	Percentage changed	No. in A-A	Percentage changed
Anne G.	1	0.0	–*	–*
Alexis	2	0.0	–	–
Monica	23	0.0	8	63.0
Kate	68	12.7	9	11.0
Cindy	82	1.2†	12	8.3†
Anne B.	51	1.9	18	5.6
Anne D.	39	15.4	20	30.0

*No opportunity to observe.
†Both represent one instance in sample.

56% and 35.8% for the two groups of addressees in the Shockey & Bond study. Additionally, while seven out of the eight women in that study deleted /ð/ more frequently in speech to children than to an adult, five out of six mothers in the present study showed exactly the reverse tendency (one mother provided no data for an A-A comparison of this rule).

/ts/ was converted to /s/ in only 4.46% of possible environments in M-C speech in this study, but was reduced in 23.58% of possible environments in A-A conversation ($t = 1.4799$, NS; df = 4). Again, this finding contrasts with one of 39.63% and 25.5% application of the rule for these two listener groups in the Shockey & Bond study.

One can make the argument that the present study is not comparable to Shockey & Bond because it utilizes speakers of two different dialects of English (the prior study was carried out in Great Britain.) A series of *t*-tests for differences between the two sets of means was carried out, to determine whether British and American mothers' conversational speech to adults differs significantly in its usage of the four phonological rules. Of the four comparisons, three were non-significant: palatalization – $t = 1.1898$, NS; df = 11; /ð/ deletion – $t = 0.3647$, NS; df = 12; ts/s – $t = 0.1413$, NS; df = 11. Only the dental deletion rule appeared to operate differently across the two dialects ($t = 3.465, P < 0.01$; df = 13), with British mothers significantly less likely to delete final dental consonants in speech to adults than American mothers. Locke (1983) also used American subjects. Therefore, it is either possible that usage of this rule distinguishes the two dialects, or that maternal behavior measured in the British study was in some sense atypical. However, nothing in the incidence of the other phonological rules suggests that one cannot compare the phonological behavior of mothers across the two cultures.

On the other hand, *t*-testing for differences between the two sets of mean behaviors when adults spoke to children in the two studies clearly suggests differential behavior on the part of the British and American mothers when addressing young children. With the exception of the troublesome dental deletion rule ($t = 0.4078$, NS; df = 13), all other comparisons reached significance. For /ð/ deletion and ts/s, American mothers were significantly less likely to apply the rule in speech to children than were British mothers ($t = 3.5628; P < 0.01$; df = 13; $t = 3.5758$; $P < 0.01$; df = 13, respectively). For palatalization, the trend was reversed ($t = 2.8587$; $P < 0.02$; df = 13) such that American mothers were significantly more likely to palatalize to child listeners than were British mothers.

Discussion

Except for patalization, the present study found little evidence that "mothers use . . . more reduction (when speaking to a child) than when speaking to adults" (Shockey & Bond, 1980, p. 272). Rather, the pattern we observed suggests that rules such as dental deletion, /ð/ deletion and ts/s are much *less* likely to appear in speech to children than in speech to adults.

We would suggest, given certain theoretical concerns and the pattern of past study findings in this area, that the reason for such contradictory findings is primarily one of child addressee age. The present study examined speech to children who were most definitely in the beginning stages of language acquisition. As such, their mothers seem to have had input strategies which "clean up" phonological strings to make them much more canonical or citation-like in nature. As the children age and become more linguistically proficient, we might expect these parents to more freely apply optional phonological rules in their conversational speech. Why Shockey & Bond found that, with older children, adults applied such rules *more* frequently is still not easily answerable. Possible explanation would appeal perhaps to their own interpretation of such rules as sociolinguistic markers, which are more

readily employed when mothers sense that their children are linguistically sophisticated enough to tolerate distortion of by-then familiar phonetic strings. It is also possible that their data elicitation strategy (unspecified) made parents aware that "babytalk" was the focus of the investigation, and that this awareness somehow produced behaviors not necessarily generalizable outside the research recording session. A final possible explanation appeals to cultural differences in input register specification across dialects of English. Perhaps phonetic clarification is not an integral part of British babytalk registral style; on a more general level, Snow, De Blauw & van Roosmalen (1979) did note some differences between maternal attitudes and behaviors of British and Dutch mothers, for instance.

A recently published study (Bard & Anderson, 1983) provides support for this notion, as well as the possible effect child addressee age has on phonetic modification of speech. Six British English-speaking father-mother-child triads were analysed. In general, intelligibility of parental speech to the children was lower, even for matched words, than was intelligibility of speech to an adult listener. While intelligibility ratings are not easily related to the kinds of phonological parameters investigated by the other studies addressed in this article, such findings do at least suggest that phonetic modification may not be a universal feature of input registers. Alternatively, it is also the case that Bard & Anderson do not specify the linguistic abilities of their child addressees, either, and their results may be interpretable by the same reasoning we have supplied for Shockey & Bond. Bard & Anderson were also the only investigators of all those surveyed to examine *fathers'* speech to children, and sub-analysis of their data suggests that they are much less likely than mothers to be differentially clear when speaking to a child.

How is the rampant application of palatalization to be explained to both studies' child listeners? First, it should be noted that both the prior and present studies had difficulty finding loci for potential palatalization in A-A speech. Those which were obtained in this study tended to be instances in which a subordinate clause-introducer such as *what/that* was followed immediately by *you*. These settings contrast with the many, redundant examples of direct questions such as "did you?", and commentaries such as "let you", "get you" which were sprinkled liberally throughout all of the mother-child interactions. There is some evidence (Cooper & Paccia-Cooper, 1980) that phonological rules may frequently *not* apply across the syntactic boundaries at which we were able to find potential environments for palatalization in A-A speech. It is probable that Shockey & Bond encountered similar problems in matching instances of potential palatalization in their two samples as well.

Additionally, it is of interest that Stampe (1973) has argued that palatalization is a natural process which is probably more difficult to suppress than produce in American English. As such, when mothers palatalize to their children, they may be providing them with data that is, in a sense, more canonical than if they did not.

While the present data do not support Shockey & Bond's contention that maternal speech is more reduced or distorted than adult-adult speech, they should not be taken as a strong statement that maternal speech is "cleaned up" on an absolute level at any given stage in the child's linguistic development. All studies claiming to demonstrate evidence of maternal clarification in speech style to children, including this one, only provide evidence of *relative* clarification. That is, some VOT values are in fact still imprecisely delineated, some vowels are still undershot, and some phonological rules are in fact applied, whether or not such behaviors result in what might be construed as distorted speech. However, we noted a behavior which might be an additional, important function of maternal speech: *alternation* of clarified forms with less clarified forms.

When mothers spoke to children in the present study, they were often quite redundant,

repeating or paraphrasing the same utterance rapidly in succession if the child did not answer, often calling attention to items in multiple, chained utterances or requests to obtain the child's attention. As such, within the data, it is possible to observe instances in which mothers first produce utterances with phonological rule application, then produce the lexical items in more canonical fashion. Examples such as the following were quite common (numbers refer to transcript lines):

To Kate	1-80:	"w'n put your /putʃyɚ/ hand in?" (speaking about a puppet)	Kate does not respond
	1-81:	"Put your hand in *there*." (absence of palatalization)	
To Cindy	1-5:	What's your name, Cindy?" (absence of palatalization)	Cindy does not respond
	1-12:	What's *your* name?" (no palatalization)	No response
	1-13:	"What's your /wʌtʃyɚ/ name?"	/tzi mi/
	1-97:	Look at the dragon! oops! /gatʃya/! He's /gatʃya/. He's got you. He's got you." (absence of palatization)	

The same sorts of alternating forms could be found for the other three phonological rules studied. Thus, mothers might produce an utterance with palatalization, or dental deletion, then quickly follow it up with a paraphrase in which the rule was not applied. Conversely, a phrase such as "get them" might eventually end up as "get 'em" after the mother had strung a number of them in a row in a set of commands to the child.

Such alternations are perhaps a very fine example of how mothers may teach their children about optional phonological rules. That is, by alternating them within a very confined length of time on identical word sets, they may alert the child to the acceptable variation in production of words in conversational speech. Such a notion may be more appealing than simple notions of maternal clarification, since it suggests that, from the outset, maternal or input speech is not *so* clarified that it does not provide a natural sample for deriving linguistic hypotheses. It may need to be only slightly modified at the phonological level to provide greater ease of processing to the child, and to present enough alternating productions of similar items to allow the child to abstract natural and acceptable phonological variability in conversational speech.

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