INNOVATIONS IN LINGUISTICS EDUCATION 5.1 (1987), 85-90.

A PROBLEM OF ALLOPHONIC VARIATION IN A SPEECH DISORDERED CHILD*

A. Lynn Williams Daniel A. Dinnsen

Indiana University
Bloomington, Indiana

Introduction

In recent years, various aspects of linguistic methodology have been incorporated by speech-language pathologists in the analysis of young children's misarticulated speech. One aspect of a phonological analysis is the determination of the child's stored form or underlying representation of a morpheme.

Presently there are two main approaches to the phonological analysis which differ on the nature and determination of a child's underlying representations. These approaches are the natural process analysis (Shriberg and Kwiatkowski 1980, Hodson 1980, Weiner 1979, Ingram 1976) and generative analysis (Kenstowicz and Kisseberth 1979, Dinnsen 1984).

According to the natural process approach, claims are made that the child's underlying representations are identical to the adult ambient speech community. This approach is based largely on the theory of natural phonology proposed by Stampe 1972 and Donegan and Stampe 1979. Within this framework, it is assumed that innate processes interfere with the child's stored adult form of a moprheme resulting in a simplified output.

Proponents of generative phonological analysis (Elbert, Dinnsen and Weismer 1984; Dinnsen 1984; Maxwell 1984; Gierut 1985). propose that the child's underlying representations are not always identical to the adult standard and consequently should be analyzed independently with empirical evidence to support the claims made about the child's underlying representations. This approach is based largely on generative phonology as developed by Chomsky and Halle 1968. Within this framework of analysis, children are differentiated on the basis of their knowledge of underlying representations and a priori assumptions are not made about the nature of their underlying representations.

The characterization of one particular error pattern, namely allophonic variation, has been identified as especially problematic for the natural process approach (Camarata and Gandour 1984). The purpose of this paper is to present some data illustrating another case of allophonic variation

*The data reported here are drawn from a larger corpus and are presented primarily for pedagogical purposes.

in one child's phonological system. A similar consonantal alternation is observed here as presented in Camarata and Gandour 1984. This particular error pattern with be analyzed under the generative approach and under the natural process approach. The data to be presented illustrate a number of fundamental linguistic concepts, some of which reflect on the controversy in the speech pathology literature regarding underlying representations.

Problem

Child: N. E. Age: 4 years, 6 months

1. From the data listed below, identify the stops that occur in this child's phonetic inventory.
2. What word-initial consonant constrasts are evident in this sample?
3. Specify the distributional constraints for initial stops.
4. What rule would account for these data?

Data

1. [pɪ] 'pinch'
2. [pʊʰ] 'push'
3. [piˀ] 'peach'
4. [pe] 'page'
5. [bɪ] 'big'
6. [bɛ] 'bed'
7. [bo] 'blow'
8. [buˀ] 'boot'
9. [bʊˀ] 'book'
10. [ko] 'comb'
11. [goˀ] 'goat'
12. [bɑʰ] 'bath'
13. [dɛ] 'leg'
14. [tɪkʊ] 'chicken'
15. [dɪ] 'swim'
16. [diʊ] 'deer'
17. [tɛi] 'catching'
18. [te] 'cage'
19. [dɛ] 'dress'
20. [deˀ] 'gate'
21. [guʰ] 'tooth'
22. [kuˀ] 'soup'
23. [kʊ] 'hill'
24. [gʊ] 'girl'
25. [kɑʰ] 'cough'
26. [kɑ] 'Tom'
27. [gɑh] 'wash'
28. [gɑ] 'dog'

Solution

1. Phonetic inventory of stop consonants:

   p b t d k g

   N.E.'s phonetic inventory of stops is fully represented.

2. Alveolar and velar stops contrast with bilabial stops as shown in Table 1. However, there is an absence of a contrast between alveolar and velar stops. Instead, alveolar and velar stops occur in mutually exclusive environments.

3. Alveolar stops are produced before front vowels and velars are produced before back vowels. Table 1 shows that obstruents are produced as [d] or [t] when the following vowel is a front vowel, but as [g] or [k] when the following vowel is a back vowel. This pattern of distribution is pervasive and cuts across several target sound categories.

4. A generative phonological analysis of N.E.'s phonological system indicates that the alveolar and velar stops are allophones of a single non-labial stop phoneme. According to this analysis, the production of alveolar and velar stops is predictably conditioned by the following vowel environment. This evidence supports the claim that N.E. produces velar stops in complementary distribution with alveolar stops. This fact is described by the following allophonic rule:

$$\begin{bmatrix}-\text{son}\\-\text{lab}\end{bmatrix} \rightarrow \begin{bmatrix}+\text{ant}\\+\text{cor}\end{bmatrix} \;/\; \# \_\_ \begin{bmatrix}+\text{syll}\\-\text{back}\end{bmatrix}$$

(Non-labial obstruents are produced as alveolars when followed by a front vowel word-initially.)[1]

Process Analysis

In comparison, a phonological process analysis fails to identify the pattern of complementary distribution thereby requiring inconsistent application of processes which result in contradictory surface phonetic forms. For example, results from a phonological process analysis indicate that the following processes are involved in the production of alveolar and velar stops: 1) FRONTING, whereby a target velar is replaced by an alveolar, e.g., [deʔ] 'gate' and [te] 'cage'; 2) BACKING, in which target alveolars are replaced by velars, e.g., [kɑ] 'Tom', and [guʰ] 'tooth'; and 3) VELAR ASSIMILATION, whereby a non-velar consonant is replaced by a velar in the environment of a velar consonant, e.g., [gɑ] 'dog'. All three processes apply inconsistently as illustrated in the following forms: velar stops in [ko] 'comb' and [go] 'goat' fail to undergo velar fronting; alveolar stops in [di] 'teeth' and [dɛ] 'dress' fail to undergo backing; and the alveolar in [dɛ] 'leg' contradicts velar assimilation.

The generative analysis, on the other hand, is able to account for the apparent inconsistency in the production of velar and alveolar stops by identifying the following vowel environment as a predictable condition for the production of alveolar and velar stops.

Discussion

In addition to identifying the pattern of complementary distribution, a generative analysis also provides a phonetic explanation for the allophonic variation. Velar consonants are [+back] according to the distinctive feature system in *The Sound Pattern of English* (Chomsky and Halle 1968), and alveolar stops are [-back]. N.E.'s distribution of stops may be described as an assimilatory process with the feature [back]. That is, non-labial stops assimilate to the backness of the following vowel such that alveolars [t] and [d] occur before [-back] vowels [i, ɪ, e, ɛ] and velar stops [k] and [g] occur before [+back] vowels [u, ʊ, o, ɑ].

In summary, this problem from a speech disordered child illustrates how a number of fundamental linguistic concepts can be applied to a related field, speech pathology. The data show that children are very systematic in their sound errors and that their disordered phonological systems are similar to primary languages.

Note

[1]This particular analysis assumes that the non-labial phoneme is specified underlyingly as a velar. This assumption may be relatively arbitrary since it would be equally possible to make the contrary assumption that the underlying representation is an alveolar stop with the allophonic rule producing velars before back vowels.

Acknowledgements

The authors are indebted to Steven B. Chin for his helpful comments on an earlier version of this manuscript.

This work was supported in part by a grant from the National Institutes of Health (R01 NS20976).

Table 1. Distribution of word-initial stops

Bilabials	Alveolars	Velars
pɪ 'pinch'	tɪku 'chicken'	
bɪ 'big'	dɪ 'swim'	
piʔ 'peach'	diu 'deer'	
bɛ 'bed'	tɛi 'catching'	
	dɛ 'dress'	
	dɛ 'leg'	
pe 'page'	te 'cage'	
	deʔ 'gate'	
bo 'blow'		ko 'comb'
		goʔ 'goat'
buʔ 'boot'		guʰ 'tooth'
		kuʔ 'soup'
puʰ 'push'		ku 'hill'
buʔ 'book'		gu 'girl'
baʰ 'bath'		kaʰ 'cough'
		ka 'Tom'
		gaʰ 'wash'
		ga 'dog'

References

Camarata, S. and J. Gandour. 1984. On describing idiosyncratic phonological systems. *Journal of Speech and Hearing Disorders* 49.262-5.

Chomsky, N. and M. Halle. 1968. *The Sound Pattern of English*. New York: Harper & Row.

Dinnsen, D. A. 1984. Methods and empirical issues in analyzing functional misarticulation. In M. Elbert, D. A. Dinnsen and G. Weismer (eds.), 1984, pp. 5-17.

Donegan, P. and D. Stampe. 1979. The study of Natural Phonology. In D. A. Dinnsen (ed.), *Current Approaches to Phonological Theory*. Bloomington, IN: Indiana University Press, pp. 126-73.

Elbert, M., D. A. Dinnsen, and G. Weismer (eds.). 1984. *Phonological Theory and the Misarticulating Child* (ASHA Monographs No. 22). Rockville, MD: American Speech-Language Hearing Association.

Gierut, J. A. 1985. *On the Relationship Between Phonological Knowledge and Generalization Learning in Misarticulating Children*. Ph.D. dissertation, Indiana University. [Also published Bloomington, IN: Indiana University Linguistics Club, 1986.]

Hodson. B. W. 1980. *The Assessment of Phonological Processes*. Danville, IL: Interstate Printers and Publishers.

Ingram, D. 1976. *Phonological Disability in Children*. New York: Elsevier.

Kenstowicz, M. and C. Kisseberth. 1978. *Generative Phonology: Description and Theory*. New York: Academic Press, Inc.

Maxwell, E. M. 1984. On determining underlying phonological representations of children: A critique of the current theories. In M. Elbert, D. A. Dinnsen, and G. Weismer (eds.), 1984, pp. 18-29.

Shriberg, L. and J. Kwiatkowski. 1980. *Procedures for Natural Process Analysis (NPA) of Continuous Speech Samples: NPA Application Manual*. New York: John Wiley & Sons.

Stampe, D. 1972. How I spent my summer vacation. Mimeograph, The Ohio State University. [Revised as *A Dissertation on Natural Phonology*. Ph.D. dissertation, University of Chicago, 1973. Dissertation published Bloomington, IN: Indiana University Linguistics Club, 1979.]

Weiner, F. 1979. *Phonological Process Analysis*. Baltimore: University Park Press.