

PHONOLOGICAL UNDERSPECIFICATION IN DEVELOPMENTAL APRAXIA OF SPEECH

I. Boers, B. Maassen and G. Thoonen
Child Neurology Center / Medical Psychology,
University Hospital Nijmegen, The Netherlands

ABSTRACT

Consonant substitutions and assimilations of two clinical groups of children (diagnosed with DAS or SLD) and a control group were analysed by means of computerized analysis (LIPP). Particular aspects of our data could be explained as the effect of phonological underspecification. Patterns of assimilation preference indicated that 'alveolar' and 'plosive' were underspecified relative to 'labial' and 'fricative' for all three groups.

1. INTRODUCTION

Developmental apraxia of speech (DAS) as a specific clinical entity has gradually gained support, but the disorder remains poorly understood. In a study by Thoonen et al. [2], imitations of words and pseudowords, spoken by 11 carefully selected 'clear cases' of DAS and 11 age-matched control children, were phonetically transcribed. A quantitative analysis of the consonant productions showed that children in the DAS group produced significantly more substitutions and omissions than the control group, and showed a particularly low percentage of retention of place-of-articulation. Both findings were strongly related to the severity of the apraxia.

Also, the substitutions in DAS were more often assimilatory errors (anticipations, perseverations) than non-assimilatory errors, both for place and manner of articulation. This supports the finding in the literature that substitutions in DAS are related to context.

However, when assimilatory substitutions were assessed as a proportion of the total number of substitutions, no difference was found between the DAS group and the controls. Thus, quantita-

tive but no qualitative differences were found between the groups.

In this paper we discuss the results of a qualitative analysis of the error profile in DAS, to examine if the patterns in feature assimilation of the DAS group can be explained based on the concept of phonological underspecification [1]. This concept holds that for some feature values the underlying phonological representations are not yet fully specified, but can be filled during the course of language production. It is hypothesized that assimilations of underspecified feature values to specified ones occur more frequently than the reverse. For place-of-articulation, the feature value 'alveolar' is considered to be underspecified, whereas 'labial' and 'velar' are specified.

2. METHOD

2.1 Subjects and material

More subjects were added to the DAS and control group of Thoonen et al. [2]. Also included was a small group of children diagnosed as 'speech/language-delayed' (SLD).

Our subject group consisted of 16 'clear cases' of DAS, between 5 and 10 years of age, 5 children diagnosed as speech/language delayed (SLD), ages between 4 and 10 years, and a control group of 24 age-matched children with no reported speech, language or hearing disorders. All subjects were native speakers of Dutch (for a detailed description of the subject selection see [2]).

Each child imitated 30 multisyllabic words and 36 two- and three-syllabic nonwords, spoken by the experimenter. All sessions were recorded.

2.2 Error analysis

All responses were phonetically transcribed according to standard IPA. Broad transcription was used. Based on the transcriptions, errors were classified as either a substitution, an omission, a distortion or a disfluency. A substitution was defined as a phonetically accurate production other than the intended target phoneme. To assess reliability of the transcriptions part of the material was transcribed by two other transcribers. Correlations of 0.9 and higher were obtained between transcribers.

By means of a computerized analysis [3], the transcribed substitutions were transferred into confusion matrices, indicating the relationship between consonant target and realization. The substitutions were then coded as 'correct' or 'incorrect' with respect to the features 'place' and 'manner' of articulation.

Separate confusion matrices for the features place and manner were constructed (see Table 1). The values for the feature place are 'labial', 'alveolar/dental', 'palatal' and 'dorsal'. The feature manner had the values 'plosive', 'fricative/affricate', 'nasal' and 'semivowel'. On the diagonals in Table 1a and 1b the 'correct substitutions' with respect to this particular feature appear, the off-diagonal numbers represent the errors.

For example, if a /t/ was replaced by an /s/, this was counted as a correct realization with respect to place of articulation (alveolar -> alveolar) so it appears on the diagonal of the place matrix. It is however incorrect for manner of articulation, and is counted as an error ('plosive to fricative') in the manner matrix. The totals of the columns of Tables 1a and b indicate the number of substitutions (including only the errors) towards this particular feature value.

In a subsequent analysis on the transcribed substitutions, the proportion of assimilatory substitutions was determined. Only regressive assimilations (anticipa-

tions) were taken into account. This analysis was done for each feature value separately, and proportions assimilatory substitutions were taken relative to the total number of substitutions towards this particular feature value. Thus, biases for particular feature values were accounted for.

3. RESULTS

In Table 1a to 1d the numbers of substitutions for place and manner are summarized.

Table 1a to 1d Confusion matrices of place and manner for the substitutions produced by the DAS and the SLD groups.

1a) PLACE (DAS, n=16)

tar-gets	realizations			
	L	A	P	D ²⁾
L	125	128	1	46
A	100	216	11	105
P	1	9	0	2
D	29	137	1	33
tot ¹⁾	130	274	13	153
#place subst:	570			
mean:	35.6 (sd 15.3)			

1b) MANNER (DAS n=16)

tar-gets	realizations			
	PL	FR	NA	SV
PL	400	105	38	41
FR	50	77	7	3
NA	26	9	64	19
SV	13	40	31	21
tot ¹⁾	89	154	76	63
#manner subst:	382			
mean:	23.9 (sd 12.8)			

¹⁾ The column totals exclude the numbers in italics (= substitutions that are correct with respect to place resp. manner).

²⁾ Dorsal combines velar and glottal

- table 1 continued -

1c) PLACE (SLD, n=5)

tar-gets	realizations			
	L	A	P	D
L	36	18	0	5
A	30	38	1	11
P	0	0	0	0
D	6	9	0	9
tot ¹⁾	36	27	1	16

#place subst: 80
mean: 16.0 (sd 5.4)

1d) MANNER (SLD n=5)

tar-gets	realizations			
	PL	FR	NA	SV
PL	72	13	7	20
FR	5	8	1	0
NA	6	1	13	9
SV	1	2	4	1
tot ¹⁾	12	16	12	29

#manner subst: 69
mean: 13.8 (sd 7.0)

All groups made more substitutions for place than for manner (means: DAS 38 vs 24, SLD 16 vs 14, controls 5 vs 4. Results for the control group are not displayed since they made so few substitutions). The numbers on the diagonal indicate the substitutions that were correct with respect to place (Table 1a and 1c) or manner (Table 1b and 1d) of articulation. Column totals are the numbers of substitutions towards each particular feature value.

In Table 2a and 2b proportions of substitutions towards a particular feature value are given.

Place. Almost half of the place substitutions in the DAS group were made towards 'alveolar' (.49) Proportions for 'labial' and 'dorsal' were approximately equal (.24 resp. .25). 'Palatal' was excluded from the table since hardly any substitutions towards this value were made. For the control group the same pattern emerged: towards alveolar the highest proportion (.43), then 'dorsal' (.31) and 'labial' (.26).

The SLD group differed in their preference: the proportion of substitutions toward labial was highest (.44), then

alveolar (.34) and dorsal (.20) followed.

Table 2 Proportions substitutions towards feature values for place (2a) and manner (2b), relative to the total number of substitutions for that particular feature.

2a) feature PLACE

group	prop. substitutions to feature values:		
	L	A	D
DAS	.24	.49	.25
SLD	.44	.34	.20
CTRL	.26	.43	.31

2b) feature MANNER

group	prop. substitutions to feature values:			
	PL	FR	NA	SV
DAS	.27	.35	.20	.18
SLD	.22	.22	.21	.36
CTRL	.22	.26	.29	.23

Manner. For manner of articulation, the proportions of substitutions towards feature values were approximately equally spread, although the proportion substitutions towards 'fricative' were slightly higher than towards 'plosive', for both DAS and control group.

Assimilatory substitutions

In table 3a and 3b proportions of assimilatory substitutions are given.

Place. For both the DAS and the SLD group the majority of the substitutions to labial were assimilations (.70 resp. .76). Although both groups assimilated more often towards labial than towards alveolar (as predicted by phonological underspecification), we did not find higher proportions assimilations towards 'dorsal' than toward 'alveolar' (although predicted).

Since the control group made very few place and manner substitutions (mean 5.3 for place and 3.4 for manner) the data concerning the assimilatory substitutions (1 or 2 per feature value) should be interpreted with caution

Manner. For the DAS as well as the SLD group more assimilations were ma-

de in the direction of 'fricative' than towards 'plosive' (DAS: .72 vs .54, SLD: .78 vs .53). The proportion assimilations towards 'nasal' for the DAS group was lower than towards 'plosive', and approximately equal for the SLD group.

Table 3 Proportions assimilatory substitutions for the feature values of place (3a) and manner (3b), relative to the total number of substitutions for that particular feature value.

3a) feature PLACE

group	prop. assimilation to feature value		
	L	A	D
DAS	.70	.48	.35
SLD	.76	.42	.37
CTRL	.30	.40	.25

3b) feature MANNER

group	prop. assimilation to feature value			
	PL	FR	NA	SV
DAS	.54	.72	.45	.30
SLD	.53	.78	.55	.43
CTRL	.32	.71	.37	.64

4. DISCUSSION

Stoel-Gammon and Stemberger [1] have used the concept of 'phonological underspecification' to explain patterns of consonant assimilation in child speech.

Two predictions can be derived from the concept of phonological underspecification. First, if the place and manner features remain underspecified until ultimate production of the segment, an alveolar plosive is produced (/t/ or /d/). Second, during the production process, underspecified feature values are vulnerable to intrusion from the context, resulting in more frequent assimilations from underspecified to specified values than the reverse.

Particular aspects of our data from children with DAS can be interpreted as the effect of underspecification. Firstly, with regard to place of articulation, DAS children produced a high proportion of substitutions towards 'alveolar' --as if in

many instances the place feature remained underspecified. This pattern is in contrast with the preference for 'labial' in the children with SLD (but similar to the control subjects). No distinctive patterns for manner were found.

Secondly, as with regard to both place and manner of articulation, the children with DAS produced --as predicted-- a higher proportion assimilations towards the specified values 'labial' and 'fricative' than towards the underspecified values 'alveolar' and 'plosive'. These patterns were quite similar for all three subject groups investigated.

These results pertain to a clinically salient characteristic of many children with DAS or SLD; they have a tendency to substitute towards /t/ (known in Dutch as "hottentottism"). Clearly, not all aspects of the presented data are explained; further study of speech production processes in DAS is needed.

5. REFERENCES

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