ON VARIATION IN EARLY SPEECH PRODUCTION

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ABSTRACT

The Kiel Project on Early Phonological Development focuses on data from German children during their initial stages of phonological development. Based on this new evidence it will be shown that not all types of phonological variation and the children's deviations from target words can be accounted for in terms of production difficulties. Certain kinds of variation require either perceptual explanations or have to be discussed with regard to the maturation of mental processing abilities [1].

DATA COLLECTION

Eight children, growing up in L1 monolingual German-speaking environments, were visited at home at weekly intervals. The investigation began when the children produced their first words. The children’s utterances were recorded with a wireless beyer dynamic microphone on Uhre 4000 IC tape recorders connected with a led NE 42 receiver.

The goal was to document the children’s early phonological and lexical development by eliciting as many tokens per lexical item as possible in each session.

The children’s utterances were transcribed using the IPA symbols (1993). In this paper the data from four subjects (Isabell, Julian, Simon and Till, see Table 1) provide the basis for a typology of phonological variation and phonetic deviations from source words.

For each child there exist lists of all replications (tokens) per word narrowly transcribed plus remarks regarding session number, age, situation and the child’s mood.

RESULTS

Except for one group of replica which displayed target-like phonological forms from the beginning, the children’s productions can be divided into three types:

(a) words whose phonetic structure is often stable but not target-like;
(b) words whose phonetic structure is similar to the target, the lack of accurate articulation, however, leading to particular types of minor deviations from the target.
(c) words whose productions varied greatly, especially in early periods of development and words that deviate from an established routine (see (a) leveling of gestures) in later developmental stages.

The data analysis and interpretation is based on the assumption that the child’s mental word representations reflect the input, i.e. the representations are assumed to be "fuzzy". The storing of particular sound chains over time is based on an extremely variable input and must be linked to information about situations and moods. This means that the child’s representations cannot be as accurate as his/her ability to distinguish between phonemes in a test paradigm (e.g. Categorical Perception investigation,[2]), might suggest.

The time span up to when word representations become accessible for reproduction differs greatly from child to child as pointed out by many researchers [3]. Our data suggest that the frequency of access to mental representations has an effect not only on the automization of nerve impulses to certain muscles in the vocal tract but also on the ability to distinguish between entities of mental representation.

Articulatory difficulties and articulatory simplifications are explained in terms of Gestural Phonology [4]. Phoneme-sized entities of aquisition are not postulated, although our data indicate that they may exist in some early word production. But the ability to consistently reproduce sound features in the same position in a word develops differently from child to child and from word to word. Therefore the size of phonological entities may differ at a given stage of acquisition and cannot at all be assumed consistent.

(a) Leveling and Elision of Consonant Constriction Gestures per Word

Similarity between gestures or a low number of gestures per word specify types of variation that display phonologically simplified tokens. The resulting output is either stable in at least three tokens produced in a row, all tokens in one session or over a longer period of time or they reflect a unique phonetic form in an unstable stage of word development as described in the last part of this paper.

Words, for instance, that require dorsal gestures and labial gestures were reproduced either by dorsal gestures or by labial gestures:

SIM Frauke (first name) [krajke]
ISA Schiff (ship) [mil]
JUL Köffer (case) [pope]
kommm (come) [pom]

Words that require labial gestures and tip of the tongue gestures were reproduced either by tip of the tongue gestures or by labial gestures:

JUL baden (to take a bath) [dakm]
TIL bitte (here you are) [dzizi]
JUL baden (to take a bath) [zipm]
Words that require dorsal gestures, labial gestures and tip of the tongue gestures were reproduced by dorsal gestures and tip of the tongue gestures:

ISA Löffel (spoon) [dokel]
[gakel]

If the representation of a particular source word is activated frequently and generates phonologically stable reproductions over several weeks, a kind of allocation automatism has apparently developed. This is particularly true in cases where children rely extensively on a small set of articulatory patterns [5] to render different words.

The data show individual preferences for either certain consonantalstructions or consonant-vowelcombinations that shaped the idiosyncratic phonological development of each child.

Isabell for instance reproduced words with labial/ventral and dorsal fricatives primarily with dorsal constrictions.

Table 2. ISA’s preference for dorsal gestures instead of labial gestures.

<table>
<thead>
<tr>
<th>Word</th>
<th>tokens</th>
<th>age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schlaf/</td>
<td>07</td>
<td>11:00-07:11:17</td>
</tr>
<tr>
<td>Schleife</td>
<td>10</td>
<td>11:00-07:11:17</td>
</tr>
<tr>
<td>Fische</td>
<td>09</td>
<td>11:00-17:11:10</td>
</tr>
<tr>
<td>Käfer</td>
<td>26</td>
<td>11:37:22-00:15</td>
</tr>
</tbody>
</table>

Examples:
Schlaf/ (st., bag) [slpssak]
Schleife (how) [slpssax]
Fische (fishes) [lspax]
Käfer (bug) [lpssax]

Another sort of output simplification is the elimination of certain gestures or the reduction of complex sequences of motion to single components. The position of the eliminated gesture in the target word as well as the number and complexity of different gestures determine the child’s reproduction.

For instance, final gestures of construction as well as initial fricatives were often eliminated. Plosives, however, tended to be preserved in initial position.

Elision of final gestures:
JUL. heiss (hot) [haz]
Baum (tree) [bas]
Deckel (lid) [dakel]
ISA Schiff (ship) [fif]
Gockel (cock) [ggaz]

Elision of medial gestures:
JUL. Teddy (teddy bear) [taz]
ISA Pullover (pullover) [polaz]
Elision of initial gestures:
JUL. Reiter (horseman) [naetaz]
ISA Vogel (bird) [naz]

Instead of a fricative in initial position children reproduced glottal gestures relatively often, e.g. ISA’s [lalaz]: weich (smooth); SIM’s [lspg]: Wagen (car).

JUL’s [haen]: rein (to put sth. in sth.), ISA’s [lith]: Zwetsch (toy duck).
More rarely reproductions started with the following vowel of the source word, e.g. ISA's [IPA]: Füße (feet).

We assigned this kind of variation to Elisions of gestures, because the glottal gestures were interpreted as varying reflexes of the necessity to avoid different oral constrictions per word. The variation between glottal stops, glottal fricatives and a smooth beginning of vocal fold vibrations could be explained in terms of unstable voicing.

Final cluster reductions

JUL: Kind (child) [t̩n]
ISA: Milch (milk) [m̩ts]

Medial cluster reductions

JUL: Katze (cat) [kæζe]
ISA: Flugzeug (plane) ['fju:jok']
SIM: Knöpfe (buttons) [ɡn̩p]e

Initial cluster reductions

JUL: trinken (to drink) [t̩t̩n]
ISA: Schwanz (tail) [f̩ts]
SIM: Frauke (first name) [f̩uk]

(b) Variation due to Lack of Articulatory Precision

In this group variation types were included whose phonetic forms deviate from their targets because either the coordination of gestures is unstable, certain constrictions lack one or more gestures, or the gestures match the direction of the target constriction but vary in their amplitude. The child's abilities at this point to make precise articulatory adjustments do not allow for more stable productions. In general the resulting output varies at a particular constriction of the source word, whereas the other sound components are reproduced fairly targetlike. Moreover, tokens that show these phonetic deviations appear next to target-like tokens, i.e. they cannot be assigned to a particular stage of word development except for the fact that motor control is still developing. The following examples illustrate variation that is caused by unstable timing between vocal fold vibration relative to the movements of the articulators and varying amplitude of gestures.

Voicing

JUL: Baby [bʌbi], [bʌpl], [bʌpl], [bʌpl]
Teddy [t̩d̩], [t̩d̩], [t̩d̩], [t̩d̩]
ISA: weich (smooth) [vaε], [vaε]

Stopping

ISA: Wasser (water) [ʁa̝sr]
SIM: auf (open) [ɔ̝p]
JUL: Haus (house) [h̩a̝s]

Continuation instead of friction noise

ISA: Mörve (seagull) [mywʌ]
SIM: weg (out of sight) [wεg]

(c) Variation That Cannot Be Attributed to Articulatory Constraints

The most interesting part of our data corpus is represented by those replica whose deviations from their targets cannot be explained sufficiently by articulatory constraints.

Particularly during their first attempts to reproduce a word children try to match the perceived sound features. As long as no articulatory routine can be established these tokens are phonetically variable, because the child may be limited to match different sound features each time as:

TILL: Tasse (cup) (1:00,10)
1. [a̝ːze], 2. [a̝ːze], 3. [a̝ːze], 4. [a̝ːze], 5. [d̩d̩q̩d̩q̩]

The fact that each token differs from its predecessor to a certain extent suggests that TILL fails to generate the appropriate motor commands, i.e. he is not able to imitate the perceived sound chain yet. It remains unclear, however, whether the word representation is indistinct or whether the transmission of afferent and/or efferent nerve impulses is still immature or both.

The example in Table 4. illustrates the role that the "fuzzy" word representations and immature mental processing might play in relation to output variation: ISA's weg (st., or sh. is to disappear).

<table>
<thead>
<tr>
<th>Initial gest.</th>
<th>Final gest.</th>
<th>Example</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>palatal constr.</td>
<td>velar clos.</td>
<td>[kεk]</td>
<td>50</td>
</tr>
<tr>
<td>or constr.</td>
<td>velar clos.</td>
<td>[t̩k]</td>
<td>33.3</td>
</tr>
<tr>
<td>labiodental constr.</td>
<td>velar clos.</td>
<td>[vεk]</td>
<td>16.6</td>
</tr>
</tbody>
</table>

ISA's tokens of weg varied greatly in their initial sounds up to token no. 15 at 2:00:08. The following tokens displayed the form [kεk] relatively stable.

ISA's tokens of weg in their initial sounds up to token no. 15 at 2:00:08. The following tokens displayed the form [kεk] relatively stable.

Her input of weg had been standard German [vεk] and colloquial North German [vεg]. One explanation of ISA's favorite output form could be that her representation of the end of the word includes not only a velar closure but also a palatal constriction. On the other hand, one can argue that [kεk] reflects a leveling of dorsal gestures for the purpose of simplification. Since palatal constructions belong to ISA's preferred articulations and serve as substitutes in positions where labiodental constructions are required in other words, too (see Table 2.), this argument seems powerful.

But ISA had no difficulties in pronouncing an initial labiodental constriction as the tokens no.3 [vεg], no.8 [vεg], no.9 [vεg] and no.23 [vεg] illustrate. Due to the fact that palatal constrictons occur much more frequently in ISA's repertoire a more spontaneous and faster access to the appropriate mental processes may be assumed. Still the first question of how the palatal constriction is stored in ISA's representation of weg remains unanswered, not to mention those renderings of the sound word that display apical gestures in initial position (e.g. [t̩k]).

Although conclusive explanations cannot be given, the data indicate that the initial sound of weg either has no distinct mental representation at all, or it may simply indicate, that access to a given representation is still insufficient. This results in the inability to imitate this sound structure in a consistent way, i.e. the child varies between dorsal, apical and labiodental articulations.

In contrast, the stable reproductions of the final sound suggest a distinct representation of a velar closure. However, if one takes into account that ISA's caretakers provided a considerable amount of those variants that display a final palatal fricative in weg, one cannot be so sure about that.

OUTLOOK

Although only a few instances could be discussed and related to different types of phonological variation they suggest that early phonological variation cannot be related to articulatory restrictions as a general and exclusive explanatory framework. Constraints in terms of perceptual and mental processing abilities at a given acquisition stage must be taken into consideration for an adequate account of the "inconsistency" in early speech production.

REFERENCES