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 Uher 4000 IC tape recorders connected with a bd 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 reproductions (tokens) per word narrowly transcribed plus remarks regarding session number, age, situation and the child`s mood.

Table 1.

Child	Sessions	words	Age
Isabell	40	351	1;00,30-2;00,15
Julian	32	128	1;00,11-1;09,22
Simon	54	211	0;10,07-1;10,10
Till	22	79	0;11,24-1;05,25

RESULTS

Except for one group of replica which displayed target-like phonological forms from the beginning, the children`s reproductions 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 reproductions 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

aquisition 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)* ['kɑ̣ŋkə]
ISA *Schiff (ship)* [ʃɩɕ]
JUL *Koffer (case)* ['pɔpɐ]
komm (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)* ['da̠dn̩]
TIL *bitte (here you are)* ['dzɩzɩ]
JUL *baden (to take a bath)* ['b̥a̠pm̩]

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) ['dɔkəl]
['çœkəl]

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 consonantal constrictions or consonant-vowel-combinations that shaped the idiosyncratic phonological development of each child.

Isabell for instance reproduced words with labiodental and dorsal fricatives primarily with dorsal constrictions.

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

Word	tokens	age	%
Schlafsack	07	1;10,07-1;11,17	71
Schleife	10	1;10,07-1;11,17	70
Fische	09	1;10,27-1;11,10	56
Käfer	26	1;07,22-2;00,15	39

Examples:

Schlafsack (sl.bag) ['ɕlɑ̣çs̠ʌk]
Schleife (bow) ['ɕlaĕçə]
Fische (fishes) ['ɕɩɕə]
Käfer (bug) ['kʰɩçːɛ]

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 constriction as well as initial fricatives were often eliminated. Plosives, however, tended to be preserved in initial position.

Elision of final gestures

JUL heiß *(hot)* [ha̠ːe]
Baum *(tree)* [ɓaə]
Deckel *(lid)* ['d̥ɛkə]
ISA Schiff *(ship)* [ʃɩ̆]
Gockel *(cock)* [gy'ga̠ː]

Elision of medial gestures

JUL Teddy *(teddy bear)* ['tʰeɩ]
ISA Pullover *(pullover)* [pɷ'lɷə]

Elision of initial gestures

JUL Reiter *(horseman)* [haĕtɑ̣]
ISA Vogel *(bird)* ['hoːçe]

Instead of a fricative in initial position children reproduced glottal gestures relatively often, e.g. **ISA`s**[ʔ̆aĕç]: *weich (smooth)*; **SIM`s**['ʔɑ̣gŋ]: *Wagen (car)*, **JUL`s** [haen]: *rein (to put sth. in sth.)*, **ISA`s** ['ɦɩtʰi]: *Zwietschi (toy duck)*.

More rarely reproductions started with the following vowel of the source word, e.g. ISA`s ['ys̱ə]: *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)*	[tɩn]
ISA	Milch *(milk)*	[mɩç]

Medial cluster reductions

JUL	Katze *(cat)*	['kɑs̱ej]
ISA	Flugzeug *(plane)*	['ʃuʃɷk˺]
SIM	Knöpfe *(buttons)*	[gnœ'pɛ]

Initial cluster reductions

JUL	trinken *(to drink)*	['d̥̱ɩtn̩]
ISA	Schwanz *(tail)*	[fɑ̣ts]
SIM	Frauke (first name)	['ʁɑ̣ɷə]

(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 ['b̥eb̥ɩ],['b̥epiː],['pʰypʰɩ]

Teddy [dɩh'd̥ɩh],['tɛt̪æ],[t̪ʰɩrɩː]

ISA

weich *(smooth)* [vaĕç],[faĕç]

Stopping

ISA	Wasser *(water)*	['ba̱s̱ə]
SIM	auf *(open!)*	[ɑ̣ɷ̆p]
JUL	Haus (house)	[had̪˺]

Continuation instead of friction noise

ISA	Möve *(seagull)*	['mywə]
SIM	weg *(out of sight)*	[weʔ]

(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.

Particulary 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 liable to match different sound features each time as:

TILL: *Tasse (cup)* (1;00,10)

1.[aːb̥ë], 2.[b̥ẕ'ẕɑ̣], 3.[d̥a̱hə̃],

4.[d̥aɵː], 5.[dɑ̣'dɑ̣z̥ə̃]

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, wether the word representation is indistinct or wether the transmission of afferent and/or efferent nerve impulses is still immature or both?

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

Table 4. Variation of initial and final strictures of weg. Nr. of tokens=24, age: 1;08,30-2;00,15

Initial gest.	Final gest.	Example	%
palatal constr.	velar clos.	[çɛk] [jɛg̊]	50
alveolar clos. or constr.	velar clos.	[dɛkʰ] [s̱ɛkʰ] [ʔneːk]	33,3
labiodental constr.	velar clos. pal. constr.	[vɛkʰ] [vɛç]	16,6

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 [çɛk] relatively stable.

Her input of *weg* had been standard German [vɛk] and colloquial North German [vɛç]. 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 [çɛk] reflects a leveling of dorsal gestures for the purpose of simplification. Since palatal constrictions belong to ISA`s preferred articulations and serve as substitutes in positions where labiodental constrictions 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 [vəg], no.8 [ɣ̆vɛğ], no.9 [vɛç] and no.23 [vɛkʰ] illustrate. Due to the fact that palatal constritions 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 renditions of the source word that display apical gestures in initial position (e.g. [s̱ɛkʰ]).

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 aquisitional stage must be taken into consideration for an adequate account of the "inconsistency" in early speech production.

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