WHERE HAVE ALL THE CONSONANTS GONE? 'MISSING' CONSONANTS IN THE SPEECH OF HEBREW-SPEAKING ATYPICAL POPULATIONS

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ABSTRACT

This paper examines the phenomenon of 'missing' or 'unintentional silently articulated' consonants in Israeli Hebrew (IH)-speaking atypical adult and child populations. 'Missing' consonants first appeared in the phonological process of 'Non–Vocalization' (N-V) in eight profoundly ('speech readers') and severely ('hearers') hearing-impaired adults (4 male/4 female-17-45 years old). In N-V the hearing-impaired articulate the consonant phoneme but without phonation: i.e. looking as if it is produced but sounding as if it is omitted. Atypical children display a similar phenomenon in Consonant-Free-Words (CFWs): (a) six monolingual hearing-impaired children using a cochlear implant device (3 male/3 female-1;5-2;8 years) and (b) the a-synchronization of the development of syllable structure, the extreme manifestation of which is CFWs**,** found in 16 children with Childhood Apraxia of Speech (CAS) (11 male/5 female-average age 3;11). Spectrographic analysis of these CFWs indicates clues to the articulation of the 'missing' consonants in a way similar to the N-V originally found in hearing-impaired adults.

Keywords: non-vocalization, consonant free words, hearing impairment, childhood apraxia of speech

1. INTRODUCTION

This paper examines the phenomenon of 'missing' or 'unintentional silently articulated' consonants in the speech of Israeli Hebrew (IH)-speaking atypical adult and child populations. The data will be analyzed and explained according to the theory of Phonology as Human Behavior (PHB) of the Columbia School (CS) of linguistics (e.g. [5, 14]). The phonological processes of both typical and atypical speech exemplify the basic axiom underlying PHB/CS: i.e. language represents the compromise resulting from the constant struggle between the communication factor (our striving for maximal communication) and the human factor (our propensity to exert minimal effort) (e.g., [13, 15, 16, 17])

2. NON-VOCALIZATION

'Unintentional silently articulated' or 'missing' consonants were first found in the phonological error process we called 'Non-Vocalization'. In the process of N-V the hearing impaired actually articulate the consonant phoneme but without phonation. This means the consonant ends up looking as if it is produced but sounding as if it is omitted. We used video-recordings meaning transcriptions done by both ear and eye (audio-visual), the only way to observe this process. We video/audio recorded the speech of eight profoundly ('speech readers') and severely ('hearers') hearing-impaired adults (4 male/4 female-17-45 years old). All participants in the study were either congenitally or prelingually deaf; Israeli born; and speak IH as their first language (L1). They all use Israeli Sign Language (ISL) as a second language (L2) in addition to spoken language. Group 1, 'speech readers', had over 90 dB hearing loss, corner audiogram, and Group 2, 'hearers' had 70-90 dB hearing loss, mostly – medium and high tones.

All participants in the study were video/audio-recorded (Sony Handycam Vision CCD TR24E) in four speech tasks (presented here from the easiest to perform, to the most difficult):
1. Articulation test (= word level) – which contained 80 pictures of words representing all the IH phonemes in initial, mid, final, opening and closing positions. 2. Conversation (= spontaneous speech) – the participants responded to questions such as: 'what is your name?'; 'what is your address?'; 'what did you do last Saturday?' etc. 3. Reading aloud from a book – a passage containing 58 words. 4. Describing absurd cards (= challenged

spontaneous speech) – all the participants were given cards that displayed absurd or illogical objects and situations (e.g., 'a pig with wings') and were asked to describe: 'what is wrong with this picture?' in 6 cards (e.g., [6, 7, 8]).

The speech tasks were presented randomly. All participants were video-recorded and tested by the same researcher (a speech pathologist), in a quiet room placed in familiar surroundings such as in the work place, school or at home. All recordings were phonetically transcribed by the researcher. A sample transcription was done by another observer (a speech pathologist) for reliability. The Kappa value of agreement was 94%.

All phonological error processes were analyzed disregarding familiar or descriptively non-prescriptive accepted 'errors' commonly found in colloquial IH speech. There were 24 criteria for data analysis, such as: error type, phoneme type, position in word, position in syllable, voicing, change of voicing, airflow constriction, change of airflow constriction, active articulator, change of active articulator, etc.

In subsequent research related to N-V ([9]), a video of words containing the N-V of front articulators in final position (pronounced by a deaf speaker) was presented to naïve judges. The results indicated that only the combination of visual and auditory channels made it possible to detect the phenomenon of N-V. It should be mentioned again that N–V is a part of oral speech and it is distinguished from the phenomenon of mouthing which is a part of sign language ([3]) or a communication-oriented method for post larynx operation. N–V is an unintentional atypical error process of 'unintentional silent articulation' and thus it is also distinguished from what is usually referred to as silent articulation which is an intentional process.

N–V is a process requiring moderate effort, it requires less effort than substitution (no voice is produced) and more effort than omission (articulation is actually performed). The distribution of N-V was 13% for all subjects but there was a difference in the distribution of N-V between the two groups: group 1 (profound hearing loss, 'speech readers') demonstrated 19.3% of N-V (similar to the frequency of omissions), while group 2 (severe hearing loss, 'hearers') rarely used this error process (2.7%).

We assume that group 1 relies mainly on speech reading and less on auditory perception, therefore N-V is a very communicative process for those with profound hearing loss, because it looks like (but does not sound like), regular articulation, resulting in efficient speech decoding. Group 2, on the other hand, relies more on auditory perception and N-V, therefore, is not as communicative for them as it is for group 1. The result is a low distribution of N-V in group 2 (the 'hearers' with severe hearing loss).

It also should be mentioned that in some cases it was rather difficult, even almost impossible, to discriminate between N-V and omission. Therefore, we recommend that in the cases of final or closing positions of back (anterodorsum, posterodorsum and/or glottal) active articulators, spectrographic analysis should be performed to distinguish between omissions and N-V since those two processes look very much alike in/with those positions/articulators. Preliminary analyses using hearing speakers trained to use N-V versus omissions have shown that vowel transitions preceding the non-vocalized consonants do appear on spectrograms [9]. In our research we predicted that N-V might be found in the speech of hearing-impaired children as well.

3. CONSONANT-FREE-WORDS

Further research uncovered a similar phenomenon of Consonant-Free-Words (CFWs) in: (a) the speech of six monolingual hearing-impaired children using a cochlear implant device (3 male/3 female-1.5-2.8 years) (e.g. [1, 2]) and (b) the a-synchronization of the development at the prosodic word level (number of syllables) and the syllable structure (onset-nucleus-coda), the extreme manifestation of which is CFWs, found in 16 children with Childhood Apraxia of Speech (CAS) (11 male/5 female-average age 3;11) [18].

Study (a) describes an early stage of language acquisition in which words that are exclusively composed of vowels appear in the speech of hearing-impaired IH-speaking children with cochlear implants. Therefore, during the initial stage of acquisition the children of this study did not produce the consonant onset of the target words, thus producing CFWs given that the coda is not yet produced at this stage. This phenomenon occurred in both monosyllabic and polysyllabic target words and gradually decreased throughout subsequent stages of L1 acquisition.

The quantitative data are drawn from the speech of 6 monolingual hearing-impaired IH-speaking children, 3 boys and 3 girls, using a cochlear

implant device. Their age ranged from 1.5 to 2.8 years at their first recording session. The elicitation procedure was based on spontaneous speech as well as picture and object naming.

The findings revealed that during the initial stage of the prosodic word development, out of 252 tokens, 99 of the productions were CFWs (almost 40%), while during the next stages, the numbers decreased significantly to 6% (157/2580) during the minimal word stage, and to 1% (103/9773) during the final stage. Towards the end of the development of the prosodic word there were no CFWs in the speech of the implanted children.

Our findings raise the following questions: Are these CFWs to be considered a deviant stage in the speech of the hearing-impaired children of this particular study? In other words: are these words a result of auditory deprivation? Or do these forms also appear in the speech of other disordered children (e.g., children with apraxia, SLI, ADHD)? In addition what is the role of this period in the developmental process of these children?

We hypothesized that CFWs may also appear in the speech of typically developing children as well as in other developmental speech disorders. Thus, these forms present the interface between prelinguistic babbling and words and serve as an intermediate stage in the initial period of acquisition. However, this stage is longer in the speech of children with cochlear implants than in typically developing children; however, it is not as long as in other speech disorders.

Study (b) deals with the prosodic structure of early words: the case of CFWs in dyspraxic IH-speaking children. Childhood apraxia of speech (CAS) is defined as: "a group of phonological disorders resulting from disruption of central sensorimotor processes that interfere with motor learning for speech" [4]. The aim of this study was to compare and contrast the word acquisition of typical and CAS children with regard to one major feature: a-synchronization. Sixteen children with CAS with an average age of 3 years and 11 months participated in study (b). All had difficulty in oral praxis, and showed inconsistent phonological substitutions and increasing difficulty in articulation in longer and more complex words. In addition, each child had at least three phonological processes related to the simplification of the syllable or the alteration of its segments. The data collected from each child in eight weekly meetings, were elicited from spontaneous conversation, naming and the imitation of single words. The results indicated that many of the phonological phenomena shown in the language of the CAS children were identical to those in the language of children with typical language development, but one major irregular phenomenon was found: a-synchronization. This process of a-synchronization of the development at the prosodic word level (number of syllables) and the syllable structure (onset, nucleus and coda) was manifested in the most extreme way in the CAS children by producing syllables without consonants and thus creating CFWs – i.e. the apparent weakening or deletion of all the word's consonants. As opposed to productions by typically developing children in which all words had at least one consonant, the CAS children's productions often had no consonants although they produced polysyllabic words.

4. PRELIMINARY RESULTS AND CONCLUSIONS

Spectrographic analysis of the children's data revealed that although the speech of these atypical children appears to contain CFWs, there were indications of clues for the articulation of the 'missing' or 'unintentional silently articulated' consonants in a way similar to the N-V originally found in hearing-impaired adults. These clues were discovered specifically in the transitions that would have appeared between CV and VC segments such as the *loci* associated with active articulators: e.g. the lowering of formants associated with labials, the approaching of the second and third formants associated with posterodorsal-velar consonants, etc. We also found clues for turbulence in the airflow where fricative and sibilant consonants were 'missing' in the appropriate frequencies associated with manner and place of articulation as well as some parallel spectrographic clues for stop and affricate phonemes. In addition, relative changes of voicing values appeared for these 'missing' or 'unintentional silently articulated' obstruent consonant phonemes as well. Not surprisingly, the spectrographic data were the strongest and the most consistent for the adult N-V data, which were followed by the CAS data. The spectrographic data for the CAS children, however, were more frequent and consistent than the spectrographic data collected for the younger hearing-impaired children using a cochlear implant device. We

further hypothesize that CFWs may also appear in the speech of typically developing children as well as in other developmental speech disorders.

The data for the N-V of the hearing-impaired adults that were analyzed and explained according to the theory of PHB/CS indicated that: (a) each group invested more effort in processes that enhanced communication, (b) the more a process enhanced communication the more frequent its use, (c) the easier the elicitation task, the more frequent the use of the more difficult processes that enhanced communication (d) the more difficult the elicitation task, the more frequent the use of easier to produce processes that did not enhance communication, (e) the more a phonological feature enhanced communication the more it was favored even if it required greater effort. The CFWs studies for children are still in a preliminary stage and we intend to analyze them in the future when we have collected more data. We also intend to add additional adult dysarthric data that we have collected from other languages as well such as Polish [10, 11, 12].

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