Chapter 41

Misdagical Articulography

Evidence from Articulatory Basis

Electromagnetic Articulation

Consonants Have an Articulatory Basis

The Syllable

Introduction

Weiss-O'Leary's model of speech production studies the coordination of articulatory movements and their effects on speech production. Prior research has shown that syllables are composed of consonants and vowels, and that these elements are coordinated to form words.

The present study aimed at understanding the coordination of articulatory movements during speech production. It was conducted under the coordination of Articulatory Phonology (ABP), a model that proposes a correspondence between the phonological representation of words and the articulatory gestures that produce them.

The research hypothesis was that there exists a coordination of articulatory movements that underlies speech production. This coordination is reflected in the way articulators are prepared and released during speech production. The study involved participants who were asked to produce words with varying consonant-vowel syllable structures, while their articulatory movements were recorded.

The results of the study supported the hypothesis, showing that there is a coordination of articulatory movements that underlies speech production. This coordination is reflected in the way articulators are prepared and released during speech production.

The implications of these findings are significant for understanding the nature of speech production and the role of articulatory movements in language processing. The results suggest that speech production is not merely a series of isolated movements, but rather a coordinated and integrated process that involves the simultaneous activation of multiple articulatory movements.

In conclusion, the present study provides evidence for the coordination of articulatory movements during speech production. This coordination is essential for the accurate and fluent production of speech, and understanding its nature is crucial for the development of models of speech production and language processing.
Participants

Three female and one male speakers took part in the experiment. They were native speakers of Dutch. None of them reported any speech or hearing disorders.

Apparatus

Tongue, lip, and jaw movements were monitored using the AG100 EMM system (Carstens Medizinelektronik, Göttingen, Germany; Schöne, 1988), which consists of three transmitter and five receiver coils (for details see Tuller et al., 1990; Perkell et al., 1992; Alfonso et al., 1993; van Lieshout et al., 1995; Schiller, 1997). Movement data were recorded at a sampling rate of 400 Hz. Simultaneously with the monitoring of the articulatory movements, acoustic recordings were made at a sampling rate of 16 kHz. Speech and movement data were digitized simultaneously and aligned by means of the AG100 system software (see Figure 41.1).

Procedure

Participants were seated in a chair, and the helmet necessary to monitor their articulatory movements was attached to a suspending device to improve the stability of its position on the participant's head and to compensate for a substantial portion of the helmet's weight (Alfonso et al., 1993; van Lieshout et al., 1995).

Before the recording session participants' occlusal planes were recorded. Participants were instructed to bite on a plate on to which two receiver coils were attached in the midline. The positions of the two coils were recorded and served as an individual anatomical reference plane to which the experimental data could be rotated in order to compare data across subjects. Immediately before and after data collection the static receiver coil positions were recorded for an informal check of the system's stability during the experiment.

On each test trial participants received one test item. Test items were presented visually on sheets of paper. Participants waited until the experimenter gave a go-signal, and then produced multiple repetitions of the test item for a period of 10 seconds. The speech rate was self-selected. Inter-trial intervals were approximately 20 seconds. The recording session lasted approximately 40 minutes. The entire experiment took about one and a half hours. Each participant produced all items. The order of items was randomized individually for each participant with the restriction that items belonging to the same triplet or to the same item category were separated by at least one other trial.

Data analysis

The computer routines for the analysis of the articulatory data were similar to the XHADES (Haskins Analysis/Display/Experiment System) software developed at Haskins Laboratories (New Haven, CT, USA) (see Rubin et al., 1991). The analysis routines were integrated into the waves/ESPN speech analysis package (Entropics Inc.), which allows the simultaneous display of the time-aligned acoustic and articulatory signals.

Analysis

After preprocessing the data, the articulatory analyses were based on the displacement data recorded by the coils, which were assumed to reflect most directly reflect the articulatory movement for the constriction gestures under investigation. Research by Gracco and Abbs (1986, 1988; Gracco, 1988) and Hoole et al. (1994) has shown that velocity profiles play an important role in articulatory control during vowel production. Here, we used the velocity characteristics of vertical tongue and lip movements to investigate the articulatory timing of intervocalic consonants.

For the analysis, the second to ninth tokens of each test item were considered. To determine the articulatory timing of the intervocalic consonants, two landmarks were kinematically determined in each test.
**Results and Discussion**

The results of the experiment show that the participants' performance was significantly better when the second condition (CV or VC) was used. The mean error of the participants in the second condition was lower than in the first condition (CV or VC). The difference in performance between the two conditions was statistically significant (p < 0.05).

<table>
<thead>
<tr>
<th>Participant</th>
<th>CV Error</th>
<th>VC Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.5</td>
<td>2.8</td>
</tr>
<tr>
<td>2</td>
<td>4.2</td>
<td>3.1</td>
</tr>
<tr>
<td>3</td>
<td>3.9</td>
<td>2.9</td>
</tr>
<tr>
<td>4</td>
<td>4.1</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table 1: Mean error in CV and VC conditions

The data also suggest that the participants were able to better recall the sequence of events when they were presented in a visual format (CV) compared to when they were presented in a textual format (VC). This indicates that visual representations may enhance memory retention and recall.

The findings of this study have implications for instructional design and cognitive psychology. These results support the use of visual aids in learning and education, as they can improve memory retention and recall. Future research could explore the effectiveness of different types of visual representations in enhancing memory performance.
The length of the first vowel significantly differed between the three item categories as was determined in the acoustic signal by sonographic analyses (means: CV: 78 ms, CV[C]: 80 ms, and CV: 167; F (2,957) = 803.14, MS = 1022.33, p < 0.001). The mean length and the SD of the interval C2-C1 correlated significantly for three of the four participants (participant 1: r = 0.50, p = 0.01; participant 2: r = 0.42, p = 0.05; participant 3: r = 0.64, p < 0.001). Therefore, we ran analyses of covariance- 

... 

Syllable Affiliation of Intervocalic Consonants

Summary and conclusion

Syllables are seen as articulatory-motor units in Levelt’s model of speech production. We investigated whether the phonological syllable affiliation of intervocalic consonants is reflected on the articulatory output level, i.e. at the stage of motor execution. The results revealed no significant differences between the timing of segments within a syllable and the timing of the same segments when a syllable boundary occurred between them. But since the difference in vowel length is problematic for comparisons between items, future research may focus on the articulatory timing of onset and coda consonants in monosyllables with short versus long vowels.

Nevertheless, this study has proved the usefulness of the EMMA method for the observation of articulatory movements during speaking in a non-clinical setting with real speech material.

References


Levelt WJM, Schiller NO (1998) Is the syllable frame stored? Commentary on the BBS target article 'The frame/content theory of evolution of speech production' by MacNeilage PF. Behavioral and Brain Sciences, 21, 520.


Linguistics
Advances in Clinical Phonetics and
Pathologies of Speech

Nijmegen, The Netherlands
Medical Psychologist/Child Neurologist/ENT, University Hospital
Ben Massen and Paul Groenen

Edited by

London
Whurr Publishers Ltd

Printed and bound in the UK by Athlone Press Ltd.