

Investigators continue to search for effective treatments for acquired apraxia of speech (AOS). One difficulty for investigators interested in developing treatment approaches is that the mechanisms underlying AOS are still not completely understood (e.g., Ziegler, 2002). Locke (1972) performed a study to examine the ease of articulation of English speech phonemes by having adults rate phonemes according to how easy or difficult they were to produce. He found that rated ease of articulation had a strong correlation with the order of phoneme acquisition in children. Phonemes that adults perceived to be easier to produce were acquired earlier by children, and those they perceived to be more difficult to produce were acquired later by children. Moreover, he found that children tended to substitute phonemes that adults rated as easier for those they rated as more difficult. AOS is considered to be a motor speech disorder, so perhaps ease of articulation may play a role in the nature of the problems individuals with AOS demonstrate. The purpose of this study was to determine whether there is a relationship between the phonemes that are selected for treatment or are reported to be in error in persons with AOS and the phonemes that are rated as more difficult to produce by normal speakers.

Method

Search Method – We searched for articles published in peer-reviewed journals on the topic of AOS. The following databases were searched: CINAHL (1982-2012), Google Scholar (1969-2012), and PubMed (1955-2012). In addition, reference lists from articles identified in the search were inspected for additional pertinent articles. Titles and abstracts of journal articles were viewed. If seemingly relevant, the full text version of the article was obtained.

Selection Criteria - We considered all articles that referenced treatment for apraxia of speech or phoneme errors in apraxia of speech. Articles that listed specific phonemes in error or phonemes used in treatment studies were selected.

Data Collection and Analysis - For each of the articles, we recorded all of the phonemes that were being treated or were reported to be in error. If there were multiple participants who produced the same error, the error was recorded that number of times. For example, if one study reported on three participants who all had problems with /p/, the number listed for /p/ for that study was three. For treatment studies, we recorded the initial percent accuracies for each phoneme that was treated, as well (when these data were available). We compared our data to the ease of articulation reported by Locke (1972). Locke limited his study to the 20 phonemes for which there were data on children's mastery of phonemes from Templin (1957), so we report data only for those 20 phonemes.

Results

To date, we have identified twenty-seven articles that listed specific phonemes that were being treated or were reported to be in error in individuals with AOS. Here, we report on the data from the 19 treatment studies with a total of 106 participants. The phonemes and their error frequencies are shown in Table 1. Table 1 also shows motor ease ratings by Locke's participants for the 20 phonemes. He employed a scale from 1-9, with 1 being

the easiest to say and 9 being the most difficult to say. Statistical analysis using Spearman's rho revealed a negative correlation between ease of articulation and the number of times the phoneme was targeted for treatment or produced in error ($r_s = -.57$, $t = -2.96$, $df = 18$, $p = .008$). That is, the phonemes that were more frequently selected for treatment or were reported to be in error tended to be those that Locke's participants rated as easier to produce.

Conclusions

Our data suggest that phonemes that are rated as easier to produce by normal speakers tend to be those that are targeted more frequently in treatment studies of AOS. At this time, it is not clear why this is the case. One hypothesis is that some of the sounds that are easier to produce are also those that are more visible for the client and for which phonetic cues are more easily provided. The phoneme /f/ was the most frequently cited phoneme for treatment and is also a very visible phoneme, with the upper teeth on the lower lip. However, an exception to the trend we observed is the /tʃ/, which has low frequency in treatment studies, and was rated as the most difficult to produce by Locke's participants. We will discuss these findings in the context of theories of the treatment and underlying pathophysiology of AOS.

References

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- Locke, J.L. (1972). Ease of articulation. *Journal of Speech and Hearing Research*, 15, 194-200.
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Table 1
*Number of Participants Who Produced Each Phoneme in Error
and Ease of Articulation Ratings by Phoneme*

Phonemes	# Participants Who Produced the Sound in Error	Motor Ease Rating*
j	1.000	4.981
w	5.000	4.773
z	7.000	5.390
tʃ	8.000	6.207
dʒ	8.000	5.698
v	11.000	4.943
n	12.000	3.788
l	12.000	4.226
g	12.000	5.622
ʃ	13.000	4.981
b	15.000	4.226
k	15.000	4.886
h	16.000	2.603
m	17.000	4.301
r	21.000	5.283
t	22.000	4.288
d	23.000	3.735
p	29.000	4.735
s	33.000	3.754
f	35.000	4.283

(easiest) to 9 (most difficult)

*on a scale from 1