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Norman Garber *(Ohio University)*
Mary E. Reynolds *(Ohio University)*

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IAOM INTERNATIONAL ASSOCIATION of OROFACIAL MYOLOGY

# An Examination of Alveolar Stop Retraction During Pacifier Use

Norman Garber, PhD
Mary E. Reynolds, MA
*Ohio University*

**Employing a single subject A-B-A experimental design, a four year old female with normal articulation and a history of pacifier use was observed to demonstrate alveolar stop retraction more than fifty percent of the time while using her orthodontic device. Contextual factors appeared to have played a role in this variability. Upon confirming this phenomenon in the four year old subject, a follow-up investigation was undertaken with seven children between the ages of three and five years. All subjects had age appropriate articulation skills with no evidence of alveolar stop retraction without the pacifier in place and only rarely with the pacifier in place (.85%). Implications of these findings and the need for further research are discussed.**

During the past few decades, speech scientists have investigated the effects of oral structural modifications on the speech signal. Sensory deprivation studies, in which nerve-block anesthesia was applied to the supraglottal structures, demonstrated phonetic and phonemic changes, with speech remaining intelligible. Deviations included slowness of rate and minor modifications of consonants, including retracted points of closure (Scott and Ringel, 1971; Gammon, Smith, Daniloff, and Kim, 1971). Studies investigating the effects of prosthetic devices on speech reported that individuals utilized varying motor speech acts in order to approximate the appropriate acoustic result. These compensatory motor acts included temporary changes in lingual contacts and target locations without perceived phonemic shifts (McNeil, Rosenbek, and Aronson, 1984; Hamlet, 1988).

The pacifier is a common device used by many young children which may function as an alveolar block. Research on pacifier use has focused on its relationship to dental anomalies such as malocclusions (Silva, Goncalves, and Maia, 1991; Svedmyr, 1979; Adair, Milano, and Dushku, 1992). Little is known about the effect pacifiers have on speech production, although it is generally believed they are associated with a more anterior lingual posturing, and may promote the fronting process often seen in the production of alveolar fricatives. Anecdotal reporting by speech-language pathologists suggests some children exhibit compensatory acts of lingual retraction during alveolar production while using the pacifier. However, no documentation of such a phenomenon has been reported.

The present study grew out of observations of a four year, one month old female with normal articulation, who demonstrated the pattern of backing alveolar stops to the velar region, but only with the pacifier in situ. The initial effort to present detailed documentation of her backing led to a follow-up investigation of whether or not this pattern was to be found in other pacifier users as well. The purposes of the initial case study were:

1) to validate these informal case observations by examining systematically the subject's articulatory posturing with and without the pacifier;

2) to determine what contextual factors might be contributing to any inconsistencies in production, if such inconsistencies existed;

3) to examine other pacifier users to determine whether lingual retraction or other speech modifications were widespread.

## CASE STUDY

### METHOD

A single subject A-B-A research design was used. The speech of the four year, one month old female subject, who was a native speaker of English and had been using a pacifier since infancy, was analyzed during three separate conditions: First without the pacifier (A1), then with the pacifier in place (B), and finally again without the pacifier (A2). During each condition the subject was asked to spontaneously name forty-nine age appropriate pictures of objects, the names of which contained both alveolar and velar stops in various word positions and in clusters. Of the forty-nine pictures, thirty-nine contained words with alveolar stops. A spontaneous conversation sample, during which fifty words containing alveolar stops were produced, also was obtained. The conversation sample is believed to be a more representative indicator of speech patterns than are isolated speech productions since previous research shows that phonological deviations are more common in connected speech than in isolated conditions (Faircloth and Faircloth, 1970; Andrews and Fey, 1986; Johnson, Winney, and Pederson, 1980). The subject's productions during each condition were independently phonetically transcribed either by two certified speech-language pathologists or by a certified speech-language pathologist and a graduate student in speech pathology. Interjudge agreement for all productions was 95.5%. Disagreements were resolved by eliciting the questionable production from the subject a second time. Interjudge agreement for each second production was 100%.

### RESULTS

Without the pacifier, the subject produced all phonemes, including alveolar and velar stops, correctly. With the pacifier, the subject demonstrated lingual retraction during production of alveolar stops both when naming pictures and during the conversation sample (Figure 1).

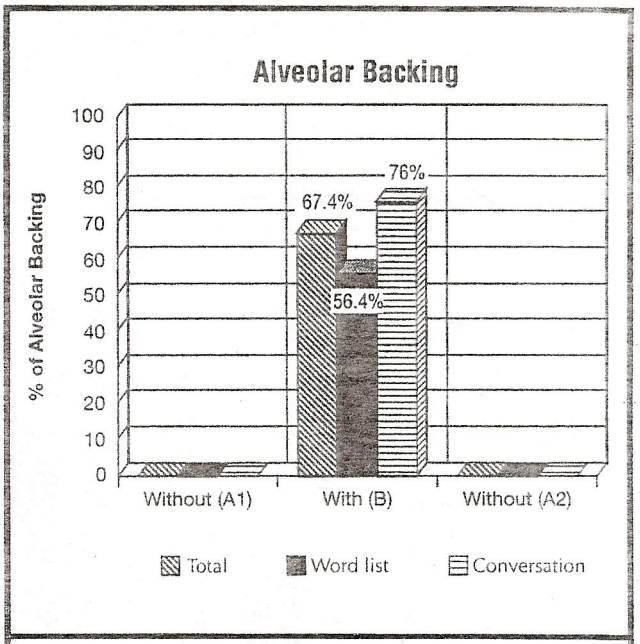


*Fig. 1: Percentage of alveolar backing with and without the pacifier in words and conversation demonstrated by the four year old female subject. Backing to the velar region was predominant, as glottal replacement accounted for only 5.6% of backing in the total sample, 10.3% in the word list, and 2% in the conversation sample.*

Backing of alveolars occurred more frequently in conversation (76%) than in single word productions (56.4%) and was observed in all positions examined: Prevocalic, medial, postvocalic and in clusters (Figure 2). In clusters, retraction was observed during production of the alveolar stop component, but did not occur on alveolar fricatives during [s] cluster productions.

Alveolar stops which occurred in the medial word position were backed more frequently than those which occurred in other positions, although alveolar backing was a high frequency occurrence in all positions during connected speech (Figure 2).

In the initial and medial positions, alveolar stops were replaced primarily by velar stops. Glottal replacements occurred in the postvocalic position of the word list more frequently than did velar replacements (36.4% as compared to 27.3%). Glottal replacements occurred much less frequently than did velar replacements in the

postvocalic position of the conversation sample (7.7% as compared to 61.5%). Glottal replacements never occurred in any position other than postvocalic.

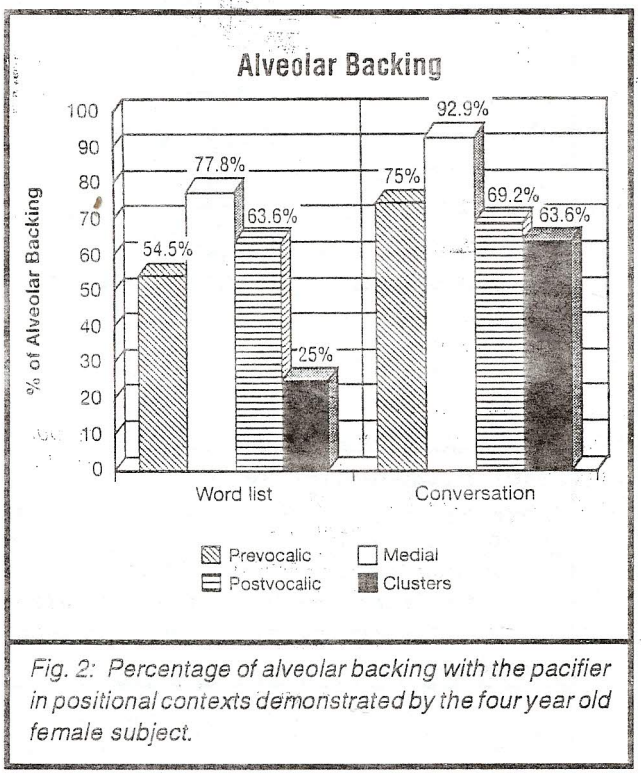


*Fig. 2: Percentage of alveolar backing with the pacifier in positional contexts demonstrated by the four year old female subject.*

## DISCUSSION

The subject of this case study, a four year, one month old female with normal articulation, exhibited articulatory retraction of alveolar stops to velar or glottal stops 67.4% of the time when using an orthodontic pacifier (Figure 1). This reposturing appears to have been a consequence of the obstruction to the alveolus, usually resulting in lingual dorsum or body contact to the mid-palatal (perceived as velar) or velar region resulting in the production of phonemically distinct velar sounds. The subject perceived the difference between alveolar and velar stops 100% of the time when given an informal minimal pair contrast task.

Previous research (Scott and Ringel, 1971; Horii, House, Li, and Ringel, 1973) noted retraction of alveolar stops which did not result in phonemic shifts or loss of intelligibility. This appeared to be attributed to allophonic variations within a phoneme class.

Lingual retractions which occurred in the present study, however, did result in phonemic shifts, from alveolar to velar. One might speculate that a child of four years, with limited metalinguistic sophistication, might be less sensitive to the effects these place shifts have on the listener. It should be noted that the phonemic shifts evidenced by the subject of the present study were noted by the authors after careful observation and were not reported by individuals casually interacting with her. The subject remained an effective communicator at all times, as listeners made closure on message meaning, ignoring her articulatory changes. Apparently, even certain phonemic shifts, in this instance shifts from alveolar to velar stops, did not disrupt message intelligibility, as contextual speech helps eliminate ambiguity in language.

## PRELIMINARY FOLLOW-UP STUDY

A follow-up investigation was undertaken to determine whether backing production of alveolar stops to the velar region was widespread among pacifier users.

### METHOD

#### Subjects

Seven children between the ages of three and five years (6 female, 1 male) participated in the study. The subjects were recruited from a University Day Care Center and each had used a pacifier regularly since infancy. All parents who were approached agreed to allow their children to participate in the study, thus eliminating any selectivity factors in subject selection. All subjects were native speakers of English and were judged by the experimenters to have age-appropriate articulation skills. The method used to obtain data from these subjects was identical to that used with the four year old reported in the case study. A total of 471 words were examined with

the pacifier in place: 272 in the word list and 199 in the conversation sample.

## RESULTS AND DISCUSSION

As in the previous case study, without the pacifier, subjects demonstrated no backing of alveolar stops. With the pacifier in place, phonemically distinct alveolar backing was noted in only two of the seven subjects and accounted for only .74% of alveolar stops produced in the word list and 1% of alveolar stops produced in the conversation sample.

These results suggest that alveolar stop retraction may not be a widespread phenomenon among pacifier users. A study employing a larger sample would be necessary to confirm this finding.

Although only a small percentage of alveolar backing resulting in phonemic changes occurred during the follow-up investigation, the alveolar backing which was observed occurred only with the pacifier in place. Previous studies regarding lingual shifting, including retraction, during nerve-block anesthesia and use of prosthetic appliances, found that lingual shifts were often phonetic rather than phonemic in nature (Scott and Ringel, 1971; Gammon, Smith, Daniloff, and Kim, 1971; Hamlet, 1988). Might children using pacifiers demonstrate lingual retraction which results in phonetic rather than phonemic shifts? Physiological measurements, such as palatography, might be used in an attempt to answer this question.

## SUMMARY, CONCLUSIONS AND IMPLICATIONS

One of the authors observed a four year, one month old female who appeared to back production of alveolar stops when speaking with a pacifier. This child produced alveolars correctly without the pacifier. This pattern was more common in connected than in single word speech samples and more common in medial than prevocalic or postvocalic positions of words in the case study. The susceptibility of medial sounds to potential conditioning sounds might have been a factor in this pattern. The resulting velar replacements did not lead to any communicative breakdowns, nor was the change evident to the subject's parents or teachers.

Backing of alveolars resulting in phonemically distinct velar sounds was rare in the follow-up investigation, occurring minimally in two of the seven subjects only when the pacifier was in place.

Most researchers have reported velar fronting to be suppressed or velars to be produced correctly between three and four years of age (Grunwell, 1987; Kahn-Lewis, 1986; Templin, 1957; Lowe, Knutson, and Monson, 1985; Prather, Hedrick, and Kern, 1975). When velar fronting persists beyond age four years it frequently is addressed by the speech-language pathologist, making the availability of effective therapeutic methods for its suppression important.

Various clinical techniques have been used to help children correct velar deviations, including the application of a tongue depressor for repositioning the tongue to the velar region of the mouth (Pendergast, 1986; Nemoy and Davis, 1969). Even chewing gum placed behind the upper central incisors has been successful in achieving a more posterior lingual positioning for palatal sounds (Shuey, 1992). It seems reasonable to investigate the possible effects a temporary device, such as a pacifier, might have on a child's ability to produce back oral consonants. With proper training, such a device might conceivable be used clinically with children exhibiting velar deviations in an effort to encourage velar placement. Caution should be taken so that glottal replacements are not promoted.

*Address correspondence to:*
*Norman Garber, PhD*
*School of Hearing and Speech Sciences*
*Ohio University*
*Athens, Ohio 45701*

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