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Effect Of Prolonged Pacifier Use On Speech Articulation

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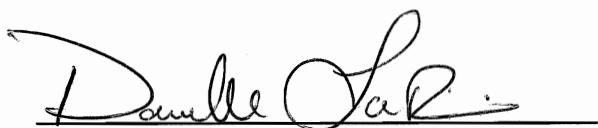
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Effect of Prolonged Pacifier Use on Speech Articulation

BY

Danielle LaPrairie

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Science in Communication Disorders and Sciences

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

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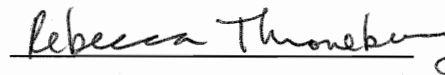
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Abstract

The hypothesis of the current research study was that children who frequently use pacifiers past the age of 2 years would display more articulation errors and patterns than children with limited or no pacifier use. The specific research question was whether there was a difference in articulation errors between children who used a pacifier and children who did not use a pacifier for a prolonged duration and frequency. Experimental subjects included seven children who had used a pacifier for at least 2 years and who were either currently using a pacifier or who had discontinued using a pacifier within 6 months. Seven control subjects were matched to within 3 months of each experimental subject's age and had either no history or less than a year of previous pacifier use.

All subjects were administered the *Goldman-Fristoe Test of Articulation-Second Edition* (GFTA-2) (Goldman & Fristoe, 2000). Subtests of the *Second Contextual Articulation Tests* (S-CAT) (Secord & Shine, 1997) were also administered. The word imitating tasks for the phonemes /s/, /z/, /d/, /t/ and /l/ were administered to probe alveolar phoneme articulation. These specific phonemes were evaluated due to expected age emergence of these phonemes. Garber and Reynolds (1994) examined alveolar stop retractions during pacifier use and Van Norman (2001, p. 65) examined "speech distortion of the sibilants /s/ and /z/ and lingual alveolar consonants /t/, /d/, and /l/" in children who used pacifiers.

The results showed that the pacifier and non-pacifier users' mean standard scores on the GFTA-2 were within the average range and similar between the groups; however, the pacifier group scored more than 10 percent lower on their mean accuracy of alveolar stops and fricatives on S-CAT probes than the control group. The non-pacifier users as a

group consistently obtained greater percent accuracies and standard scores on all articulation tasks (i.e., GFTA-2 and S-CAT probes).

Keywords: pacifier use, pacifiers, articulation patterns

Table of Contents

Chapter	Page
I. Introduction.....	7
II. Review of Literature.....	9
Overview.....	9
History of the Pacifier.....	9
Advantages of Pacifier Use.....	10
Pacifier Use and the Calming of Infants.....	10
Pacifier Use and Preterm Infants.....	10
Pacifier Use and Sudden Infant Death Syndrome (SIDS).....	11
Disadvantages of Pacifier Use.....	12
Pacifier Use and Breastfeeding.....	12
Pacifier Use and Acute Otitis Media (AOM).....	13
Pacifier Use and Dental Anomalies.....	14
Pacifier Use, Otitis Media and Speech Production.....	16
III. Methods.....	20
Subjects.....	20

Measurement of Articulation Skills.....	23
Reliability.....	24
Data Analysis.....	24
IV. Results.....	25
V. Discussion.....	34
Summary of Results.....	34
Relation to Past Research.....	34
Limitations.....	35
Clinical Implications.....	36
Future Research.....	37
References.....	39
Appendix A.....	47
Appendix B.....	49
Appendix C.....	52

List of Tables

TABLE

1	Gender, Age, Duration of Pacifier Use, Frequency of Pacifier Use, Time of Day of Pacifier Use, History of Otitis Media, History of Digit Sucking, History of Family Speech Issues and PPVT-4 Standard Scores.....	21
2	Individual GFTA-2 Standard Scores and Group Means (standard deviations) of the GFTA-2.....	27
3	S-CAT Group Percent Accuracy Means (standard deviations).....	31
4	Articulation Norms for the phonemes /t/, /d/, /s/, /z/, /l/.....	32
5	Gender, Age, Duration of Pacifier Use, Frequency of Pacifier Use, Estimated Number of Total Hours of Pacifier Use, Time of Day of Pacifier Use, GFTA-2 Standard Scores, S-CAT Total Percent Accuracy for the Group of Pacifier Users.....	33

Chapter I

Introduction

Speech is comprised of four vital components, which include respiration, phonation, resonance, and articulation. All four processes must function normally in order to produce adequate speech. During speech emergence, it is typical for young children to have developmental articulation errors because specific phonemes emerge at different times in childhood. Although some articulation errors may reflect normal developmental differences, there are other external factors that can contribute to the emergence of certain types of articulation errors.

There has been speculation that the use of pacifiers may contribute to articulation errors because the presence of a pacifier in the mouth may interfere with the development of lingual movements, although there is no concrete evidence to support this claim (Garber & Reynolds, 1994). The use of pacifiers is an accepted practice in many societies. A pacifier, by definition, is something that pacifies or calms a person. As used with infants, a pacifier is a nipple-shaped object made of rubber or plastic on which a baby sucks (Schwartz & Guthrie, 2008). A review of the literature reports both advantages and disadvantages to pacifier use.

Pacifier research has predominately focused on its relationship to dental anomalies, but little is known about the effects pacifiers have on speech production (Garber & Reynolds, 1994). Although it is generally believed that there is some association of pacifiers with a “more anterior lingual posturing which may promote the fronting process often seen in the production of alveolar fricatives,” there is only anecdotal evidence to support these views (Garber & Reynolds, 1994, p.22). The hypothesis of the current

research study was that children who use pacifiers frequently past the age of 2 years would produce more articulation errors and patterns than children with limited or no pacifier use. The specific research question was whether there was a difference in articulation errors between children who had limited or no pacifier use compared to children who frequently used pacifiers to 2 years and beyond.

Chapter II

Review of Literature

Overview. Several topics are summarized in the literature review of the current study.

First, information about pacifier terminology, use and origin is presented. Second, advantages of pacifier use are summarized. Possible advantages of pacifier use include calming and soothing of infants, aiding in sucking reflex in preterm infants, and increasing weight and growth in preterm infants. Additionally, disadvantages of pacifier use are reported. Possible disadvantages of pacifier use include decreased breastfeeding, increased risk of acute otitis media, increased risk of dental abnormalities, and possible increased risk for speech errors. Finally, the limited research studies that have investigated a possible link between speech production and pacifier use are summarized.

History of the Pacifier. Typically developing infants are born with an “inherent biological drive for sucking” (Bishara, Warren, Broffitt, & Levy, 2006, p. 31). Sucking is a reflexive behavior that is innate. This reflex is vital for newborns because it facilitates nourishment (Hall, 2001). Breastfeeding and bottle-feeding are considered a form of nutritive sucking (NS) because the purpose of NS is to obtain nutrition. Conversely, nonnutritive sucking (NNS) allows the infant to suck without ingesting nourishment. Sucking on a pacifier and digit sucking are common methods of NNS (Hall, 2001). NNS is a normal widespread behavior in infants and used for the purpose of calming, state regulation, and pacifying (Hall, 2001). In Western countries, it is estimated that 75 to 85 percent of children use a pacifier (Niemela, Uhari, & Hannuksela, 1994). More specifically, Howard et al. (1999) found that 68 percent of infants 6 weeks of age and younger use a pacifier.

The use of a NNS device, such as pacifiers, dates back to the 15th century (Cornelius, D'Auria, & Wise, 2008). These early pacifiers were manufactured from clay, silver, coral, and pearl (Poyak, 2006). Nearing the end of the 19th century and the beginning of the 20th century, the modern infant pacifier of today was introduced (Schwartz & Guthrie, 2008). Around 1900, the first latex rubber nipple-shaped pacifier with its distinctive guard and handle was patented in the United States. The purpose of these pacifiers was to soothe colicky or cranky babies, reduce pain of teething, and promote and continue restful sleep (Schwartz & Guthrie, 2008). Pacifiers of today are similar to the first patented pacifiers except pacifiers are now made of silicone rather than latex, due to latex allergies present in some children.

Advantages of Pacifier Use.

Pacifier use and the calming of infants. One prominent and often cited advantage of pacifier use in the current literature is that pacifiers facilitate calming and soothing in young infants (Adair, 2003; Boshart, 2001; Cinar, 2004; Pansy et al., 2008). The act of NNS, in particular with pacifiers, is one of an infant's first methods of self-organization and self-soothing that is repetitive and rhythmic in nature and fills both neurological and psychological needs (Boshart, 2001). A pacifier can provide comfort in times of stress, promote sleep, decrease pain associated with teething, and may decrease the likelihood of digit sucking (Adair, 2003; Cornelius et al., 2008).

Pacifier use and preterm infants. Research has shown positive outcomes with preterm infants and the use of pacifiers. In preterm infants of less than 32 weeks gestation, the sucking reflex is often not present at birth and infants' ability to suck may be ineffective to sustain nutrition through oral feeding. These ineffective sucking patterns may

lead to temporary tube feedings. In the neonatal intensive care unit, pacifier use is considered a routine practice for preterm infants (Cornelius et al., 2008). Pacifiers are beneficial in stimulating the sucking reflex and in facilitating a preterm infant's ability to "coordinate [the] process of sucking, swallowing and breathing to feed orally" (Boshart, 2001, p. 84). Additionally, preterm infants who used pacifiers demonstrated more rapid weight gain and increased growth and maturation than infants who did not use pacifiers (Bernbaum, Pereira, Watkins & Peckham, 1983; Field, 2003). Anderson and Vidyasagar (1979) stated that pacifiers facilitated neuromuscular coordination, activity, and deep sleep in preterm infants. Moreover, preterm infants who used pacifiers also had a lower occurrence of necrotizing enterocolitis, a gastrointestinal disease that is common in preterm infants causing inflammation and destruction of the bowel (Field, 2003). Pacifier use in preterm and other sick hospitalized infants has also been found to significantly reduce the length of time in the hospital (Bernbaum et al., 1983; Field, 2003).

Pacifier use and sudden infant death syndrome (SIDS). Pacifier use in young infants can potentially be a preventive measure in Sudden Infant Death Syndrome (SIDS) (Franco, Chabanski, Scaillet, Groswasser, & Kahn, 2004; Hauck, Omojokum, & Siadaty, 2005). SIDS is defined as the sudden death of an infant less than one year of age which remains unexplained after a thorough case investigation, autopsy, and clinical history (Adair, 2003). It has been suggested that pacifiers prevent the infant's tongue from falling back into the pharynx and blocking the airway and that pacifiers may reduce the gastroesophageal reflux period which could possibly facilitate SIDS (Cinar, 2004). The American Academy of Pediatrics (AAP) Task Force on SIDS (as cited in Cornelius et al., 2008) recommended pacifier use as protection against SIDS. It was recommended that

infants younger than one year of age use the pacifier while falling asleep, because this time period is the age at which the risk of SIDS is greatest.

Mitchell et al. (1993) published research linking pacifier use as a protective aid against SIDS. This case-control study investigated 485 deaths attributed to SIDS and compared them to 1800 randomly selected control infants. Parent interviews were conducted to examine pacifier use in these infants. Results indicated that pacifier use at sleep times was associated with a greater than 50 percent reduction in the risk of SIDS, revealing that pacifiers may be preventative against SIDS.

Disadvantages of Pacifier Use.

Pacifier use and breastfeeding. One concern of pacifier use is that it may be related to a decrease in breastfeeding duration. The American Academy of Pediatrics (AAP) (as cited in Clifford & McIntyre, 2008) recommends breastfeeding over formula due to health, nutritional, immunologic, and developmental advantages of breast milk consumption. Several studies have found a correlation between early pacifier use and decline of breastfeeding (Barros et al., 1995; Howard, et al., 1999; Howard et al., 2003). Barros et al. (1995) examined the relationship between pacifier use and breastfeeding during the first 6 months of life. Six hundred and five infants and their mothers were recruited from a local hospital in Brazil to participate in this longitudinal study. During the 6 month time period, parent interviews were conducted to examine breastfeeding and pacifier use and frequency. Breastfeeding patterns at one month were strongly associated with pacifier use. Eighty-six percent of nonbreastfed infants used a pacifier. Conversely, approximately 40 percent of exclusively breastfed infants used a pacifier. This study concluded that pacifier use was highly correlated with early weaning.

In two recent studies, Howard et al. (1999) and Howard et al. (2003) examined the relationship of early pacifier use and breastfeeding. Howard et al. (1999) conducted 265 maternal interviews at 2, 6, 12, and 24 weeks post birth to examine use and frequency of breastfeeding and pacifier use. Results concluded that pacifiers introduced by 6 weeks of age were associated with a significantly increased risk for shortened duration of breastfeeding. Overall, women who introduced pacifiers tended to breastfeed their infants fewer times per day, with significant differences noted at 2 and 12 weeks postpartum. Pacifier use was independently associated with a significant decline in the duration of full and overall breastfeeding. Howard et al. (2003) examined the introduction of early pacifier use (2 to 5 days post birth) versus introduction at 4 weeks post birth. Results indicated pacifier use in the neonatal period was detrimental to exclusive and overall breastfeeding. Exclusive breastfeeding at 4 weeks was less likely among infants exposed to a pacifier. Early pacifier use, as compared with later pacifier use, was related to shortened overall duration of breastfeeding.

Pacifier use and acute otitis media (AOM). Several studies have investigated the impact of pacifier use and the occurrence of acute otitis media (AOM) (Niemela, Pihakari, Pokka, Uhari, & Uhari, 2000; Niemela, Uhari, & Mottonen, 1995). Niemela et al. (1995) examined the occurrence of AOM and the use of pacifiers in 845 children attending day care centers during a 15-month period. Results indicated that more than three attacks of AOM occurred in 29.5 percent of the children younger than 2 years of age using pacifiers and in 20.6 percent of children not using pacifiers. The use of a pacifier was correlated with an annual increased incidence of AOM from 3.6 to 5.4 episodes in children younger than 2 and from 1.9 to 2.7 in children 2 to 3 years of age. The study concluded that the use

of a pacifier is a significant risk factor for recurrent AOM and stated that pacifiers should only be used during the first 10 months of life when sucking behavior is strongest, and AOM is uncommon.

Niemela et al. (2000) reported a 15-month prospective, paired, controlled cohort trial of pacifier use by children in 14 daycare facilities and any change in frequency of occurrence of AOM. The control group consisted of 212 children under the age of 18 months. Children in the control group used pacifiers continuously through the day and night, as they always had, whereas pacifier use in the intervention group was limited to the times when the child was falling asleep. The intervention group with limited pacifier use consisted of 272 children under the age of 18 months. The occurrence of AOM per month was 29 percent lower among the intervention group with limited pacifier use. It was concluded that restricting the continuous use of pacifiers at any age, permitting infant pacifiers for night use and naps, and discontinuing them entirely by age 10 months, reduced episodes of AOM.

Pacifier use and dental anomalies. Numerous studies have investigated the correlation between pacifier use and the occurrence of dental anomalies such as anterior and posterior crossbites, open bites, overjet and dental arches (Larsson, 1994; Larsson, 2001; Scavone-Junior, Ferreira, Mendes, & Ferreira, 2007; Warren & Bishara, 2002; Zardetto, Rodrigues, & Stefani, 2002). Larsson (2001) conducted a longitudinal study on 60 females from birth to 3 years of age to examine the development of crossbite in pacifier users. Results indicated a significant difference in the arch development in pacifier users' aged 24 to 36 months when compared to those who stopped using a pacifier at 12 months. Larsson (1994) explained that sucking a pacifier is related to a posterior crossbite in the

deciduous dentition. When the pacifier is in the child's mouth, the teat occupies the upper part of the anterior and middle part of the mouth, which forces the tongue to a lower position. In the upper jaw, the teeth in the canine area lack palatal support from the tongue during the sucking activity of the cheeks. This "reduces the arch width and increases the risk of a transversal malrelation between the upper and lower arches" (Larsson, 1994, p.10). The lower tongue position widens the lower jaw, thus enhancing the probability of a posterior crossbite.

Scavone-Junior et al. (2006) also examined the prevalence of posterior crossbite among children who previously used pacifiers. Children ages 3 to 6 years were randomly selected. Parents filled out questions on children's pacifier use. Associations between age of pacifier use and prevalence of posterior crossbite were analyzed. Results revealed that the prevalence of posterior crossbite was significantly higher among pacifier users (20.4%), as compared to the control group who did not use pacifiers (5.2%).

Warren and Bishara (2002) studied the association between the duration of NNS behavior and various occlusal characteristics. Sucking behavior data were collected on 372 children followed longitudinally from birth. This was done through periodic questionnaires completed by parents. Molds of the oral cavity were obtained from the children at 4 and 5 years of age and assessed for posterior crossbite, anterior openbite, and overjet. Results concluded that prolonged pacifier habits resulted in changes to the dental arches and occlusal parameters. In addition, some change in the dental arch parameter and occlusal characteristics (i.e., prevalence of posterior crossbite and increased amount of overjet) extended well beyond the termination of the pacifier habit.

Zardetto et al. (2002) found similar results in their study. The authors evaluated the characteristics of the dental arch and oral structures in 36 to 60 month old children who currently sucked a pacifier, compared to children who did not use pacifiers. Results revealed that the use of pacifiers led to a larger incidence of anterior openbite. Moreover, the mean overjet was greater in the children who used a pacifier (3.6 mm) as compared to the children who did not use a pacifier (1.3 mm.) Additionally, the presence of a posterior crossbite was only present in children who had a pacifier-sucking habit.

Pacifier use, otitis media and speech production. Pacifier research has predominately focused on its relationship to dental anomalies, little is known about the effects pacifiers have on speech production (Garber & Reynolds, 1994). Several studies have been conducted on related issues, such as history of otitis media and speech production, tongue thrust and other conditions associated with bite abnormalities and articulation skills. Several studies have explored the correlation between otitis media and speech and language development (Lonigan, Fischel, Whitehurst, Arnold, & Valdez-Menchaca, 1992; Paul, Lynn, & Lohr-Flanders, 1990; Roberts & Henderson, 1984; Roberts, Rosenfeld, & Zeisel, 2004). These studies hypothesized that children with positive histories of otitis media would have more prevalent speech errors and language delays; however, they found no significant difference between children with positive and negative histories of otitis media (Lonigan, et al., 1992; Paul et al., 1990; Roberts & Henderson, 1984; Roberts et al., 2004).

Although it is generally believed that the use of a pacifier has some association with a “more anterior lingual posturing, and may promote the fronting process often seen in the production of alveolar fricatives,” there is only anecdotal evidence to support these

views (Garber & Reynolds, 1994, p.22). Reports from several speech-language pathologists suggest that some children “exhibit compensatory acts of lingual retraction during alveolar production while using the pacifier,” although no research has documented this phenomenon (Garber & Reynolds, 1994, p. 22).

A pacifier or thumb positions the tongue low in the mouth, which may hinder the tongue from “doing it’s refined, vertical movements” (Boshart, 2001, p. 140) required for speech production. As with the tongue for speech, the tongue moves vertically for swallowing. Chronic NNS may influence the tongue to move “anteriorly-posteriorly” during swallowing (Boshart, 2001, p. 140). This swallowing pattern is typically called a “tongue thrust.” Oral facial myofunctional disorder (OMD) is also commonly referred to as a tongue thrust (Van Norman, 2001). Repeated pressure of the tongue against and in between the teeth may exacerbate an open bite. OMD can lead to other problems, including recurrence of anterior open bite even after orthodontic correction and “speech distortion of the sibilants /s/ and /z/ and lingual alveolar consonants /t/, /d/, and /l/” (Van Norman, 2001, p. 65). Boshart (2001) also added that dental problems associated with prolonged pacifier sucking could lead to speech articulation problems; in particular, habitual pacifier sucking could lead to distortions of the fricative and alveolar phonemes.

Garber and Reynolds (1994) used a single subject A-B-A experimental design, with a 4 year old female who had normal articulation and a history of pacifier use. The participant was observed to demonstrate alveolar stop retractions more than 50 percent of the time while using a pacifier. The participant’s speech was first analyzed without the pacifier, then with the pacifier in place, and finally, again without the pacifier. During each condition, the participant was asked to spontaneously name 49 age-appropriate pictures of

objects. The pictures contained both alveolar and velar stops in various word positions and in clusters. A spontaneous conversation sample was also obtained. Within the conversation sample, 50 words containing alveolar stops were produced. Without the pacifier, all phonemes were produced correctly. With the pacifier, the participant demonstrated lingual retraction during production of alveolar stops both during naming activity and conversation. Backing of alveolar stops occurred more frequently in conversation (76%) than in single word productions (56.4%).

A follow-up investigation was conducted to determine whether backing production of alveolar stops to the velar region was widespread among pacifier users (Garber & Reynolds, 1994). Seven children between the ages of 3 and 5 years of age participated in the study. The same methods were used as in the preliminary study. As in the previous case study conducted by Garber and Reynolds (1994), without the pacifier, participants demonstrated no backing of alveolar stops. With the pacifier in place, “phonemically distinct alveolar backing” was noted in two of the subjects (Garber & Reynolds, 1994, p. 25). These results suggested that alveolar stop retraction may not be widespread among pacifier users and further research to confirm or refute these findings is needed. A weakness of both Garber and Reynolds studies is that with the presence of a pacifier during speech, one would be expected to present with lingual retraction.

Shotts, McDaniel and Neeley (2008) conducted a preliminary investigation into the impact of prolonged pacifier use on speech articulation. Participants included 68 children, 34 females and 34 males, between the ages of 24 and 79 months. Participants had no reported family history of speech disorders. Pacifier use duration ranged from zero to 56 months. Participants were assigned to one of three groups, depending on the extent or

duration of their pacifier use. Group one consisted of 30 children who had never used a pacifier. The second group consisted of 16 children who routinely used a pacifier from birth to 15 months. Last, the third group consisted of 22 children who had routinely used a pacifier beyond the age of 18 months. The Goldman-Fristoe Test of Articulation (GFTA-2) (Goldman & Fristoe, 2000) was administered to assess speech articulation. The results of this study found no significant differences among the articulation skills of the three groups.

Although there was no significant difference among the articulation skills of the three groups, there were numerous variables that were not accounted for in this study. There was no measure to quantify the amount of time that participants engaged in pacifier use during a typical day. Instead, participants were grouped on the basis of parent report regarding the duration of pacifier use in months. Furthermore, articulation was analyzed in isolation, sound, and word level, but did not measure speech errors in connected discourse and did not focus specifically on phonemes that would most likely be in error. A general articulation test might not be a sensitive enough measure to detect subtle articulation differences.

The hypothesis of the current research study was that children who use pacifiers frequently past the age of 2 years would display more articulation errors and patterns than children with limited or no pacifier use. The specific research question was whether there was a difference in articulation errors between children who had limited or no pacifier use compared to children who frequently used pacifiers to 2 years and beyond.

Chapter III

Methods

Subjects. Subjects were recruited from 2-year-old and 3-year-old central Illinois preschool and daycare classes and through central Illinois preschool screenings. Subjects' guardians were given an informed consent form (Appendix A) and all signed and agreed to the parameters of the study. Subjects' parents completed questionnaires that addressed frequency, duration and time of day of pacifier use, history of otitis media, history of family speech and language problems, and whether the child also engaged in digit sucking. Through questionnaire analysis, seven experimental subjects met the study qualifications of using a pacifier for at least 2 years and were either currently using a pacifier or had discontinued using a pacifier within six months. All control subjects had either not participated in digit sucking or had ceased digit sucking by 12 months of age and had never used a pacifier or stopped using a pacifier by 12 months of age. Twelve months of age was chosen as the ceiling because of the emergence of speech. Participant characteristics are summarized in Table 1.

All subjects were administered the *Peabody Picture Vocabulary Test-Fourth Edition* (PPVT-4) to assess receptive language and, more specifically, to validate typical age appropriate cognitive levels (Dunn, & Dunn, 2007). The PPVT-4 standard scores have a strong correlation to general cognitive development. All subjects scored within one standard deviation of the mean score of 100, indicating age appropriate receptive language abilities and implying normal cognition. In addition, through parent and teacher report, subjects had normal hearing sensitivity.

Table 1

Gender, Age, Duration of Pacifier Use, Frequency of Pacifier Use, Time of Day of Pacifier Use, History of Otitis Media, History of Digit Sucking, History of Family Speech Issues and PPVT-4 Standard Scores

Subject	Gender	Age Years: Months	Duration of Pacifier Use	Frequency of Pacifier Use	Time of Day of Pacifier Use	History of Otitis Media	History of Digit Sucking	History of Family Speech Issues	PPVT- 4 Stan- dard Score
Experimental Group									
Subject 1E	M	4:1	4 years; 0 months	12 hours daily	All day	Yes	No	Yes	107
Subject 2E	F	3:6	3 years; 6 months	12 hours daily	Night & naptime	No	No	No	112
Subject 3E	M	2:4	2 years; 4 months	Exceeding 12 hours daily	Night & naptime	Yes	No	No	111
Subject 4E	M	2:5	2 years; 0 months	Exceeding 12 hours daily	All day	Yes	No	Yes	128
Subject 5E	F	3:5	3 years; 0 months	3 hours daily	Night & naptime	Yes	No	No	109
Subject 6E	F	2:8	2 years; 6 months	Variable	Variable	No	No	Yes	107
Subject 7E	F	2:9	2 years; 4 months	Periodically past 4 months	Night	Yes	No	Yes	104
Pacifier Group Means		3:1	2 years; 10 months						111

Experimental subjects included seven children who had used a pacifier for at least 2 years and who were either currently using a pacifier or who had discontinued using a pacifier within 6 months. The pacifier group consisted of four females and three males. The mean age of the experimental group was 3 years; 1 month. The experimental group's PPVT-4 standard scores ranged from 104 to 128, with a mean of 111 (SD=7.90). Four of the seven pacifier subjects had a family history of speech issues (i.e., 7E, 6E, 1E, and 4E). Five of the seven pacifier subjects reported a history of otitis media (i.e., 7E, 5E, 1E, 4E, and 3E). The experimental group's mean duration of pacifier use ranged from 2 years; 0 months to 4 years; 9 months, with a mean duration of 2 years; 10 months.

Seven control subjects were recruited and matched within 3 months of each experimental subject's age. The mean age of the control group was 3 years; 0 months. The non-pacifier group consisted of three females and four males. Additionally, the control subjects had comparable standard scores on the PPVT-4. The PPVT-4 standard scores ranged from 102 to 116, with a mean standard score of 108 (SD=4.39). None of the control subjects reported a family history of speech issues. Two of the seven non-pacifier subjects reported a history of otitis media (i.e., 2C, and 4C). The control group's duration of pacifier use ranged from 0 years; 0 months to 0 years; 8 months, with a mean duration of 0 years; 2 months. Participant information, including gender, age, duration of pacifier use, frequency of pacifier use, time of day of pacifier use, history of otitis media and digit sucking is summarized for all subjects in Table 1.

Measurement of Articulation Skills. All subjects were administered the *Goldman-Fristoe Test of Articulation-Second Edition* (GFTA-2) (Goldman & Fristoe, 2000). The GFTA-2 was used to assess speech articulation development. Data regarding the subject's

articulation abilities were obtained through the Sounds-in-Words section of the GFTA-2, which uses 53 target words on 34 picture plates to elicit articulation of 61 consonant sounds in the initial, medial, and final position. Additionally, 16 consonant clusters in the initial position were evaluated in the Sounds-in-Words subtest of the GFTA-2. Results from the GFTA-2 were in the form of standard scores.

Subtests of the *Second Contextual Articulation Tests* (S-CAT) (Secord & Shine, 1997) were also administered. The word imitating tasks for the phonemes /s/, /z/, /d/, /t/ and /l/ were administered to probe alveolar phoneme articulation. These specific phonemes were targeted due to expected age emergence of these phonemes. Garber and Reynolds (1994) examined alveolar stop retractions during pacifier use and Van Norman (2001) examined “speech distortion of the sibilants /s/ and /z/ and lingual alveolar consonants /t/, /d/, and /l/” in children who used pacifiers.

Reliability. Testing of all subjects was recorded on a video camera to ensure accuracy of data. The primary investigator administered all testing. A speech-language pathologist with over 30 years of experience scored 25 percent of the testing so that inter-judge reliability could be evaluated. Scoring procedures were reviewed to validate measurement consistency. A Pearson Correlation was used to calculate the reliability between the investigators ($r=.92$).

Data Analysis. Means and standard deviations were calculated to explore possible differences in the experimental and control groups’ performance on articulation tasks. Means and standard deviations were calculated for the GFTA-2 standard scores for both the experimental and control groups. Additionally, means and standard deviations were calculated for each S-CAT probe, as well as the total alveolar S-CAT score.

Chapter IV

Results

The standard scores for the GFTA-2 were calculated for the individual subjects and standard score means were calculated for the experimental and control groups. Results of the GFTA-2 are summarized in Table 2. Additionally, the mean percent accuracy for each S-CAT probe (i.e. /t/, /d/, /s/, /z/, and /l/) as well as total alveolar S-CAT scores were calculated for the experimental and control groups. Results of the S-CAT probes are summarized in Table 3. S-CAT raw scores for phoneme by position for each subject are presented in Appendix C.

The pacifier users as a group averaged a standard score of 106.43 (SD=12.96) on the GFTA-2. Standard scores on the GFTA-2 ranging from 85 to 115 are considered to be average. Six of the seven pacifier users' standard scores were within the average range. One pacifier user (i.e., 4E) scored in the above average range on the GFTA-2 (SS=129). The non-pacifier users as a group averaged a standard score of 115.57 (SD=3.31) on the GFTA-2. Three of the seven non-pacifier users' standard scores were within the average range (i.e., 7C, 4C, and 3C). Four non-pacifier users (i.e., 5C, 6C, 2C, 1C) scored in the above average range on the GFTA-2 (5C: SS=118, 6C: SS=117, 2C: SS=120, 1C: SS=117).

Results of the alveolar phoneme accuracies from the S-CAT are presented in Table 3. Since the S-CAT is not a normed measure, Table 4 summarizes previous research pertaining to percent accuracies of phonemes at various preschool ages for comparison purposes. The mean age of children in the current study was 3 years old. Other studies (Fabio-Smith & Goldstein, 2010; Irwin & Wong, 1983; Smit, Hand, Freiling, Bernthal,

& Bird, 1990) have also found high percent accuracies on the phonemes /t/, /d/, /s/, /z/, and /l/ for 3-year old children.

As shown in Table 3, the pacifier group's percent accuracies on the S-CAT /t/ phoneme probe ranged from 50% to 100% with a mean of 79.61% (SD=5.38). The non-pacifier group's percent accuracies on the S-CAT /t/ phoneme probe ranged from 82.14% to 100% with a mean of 89.79% (SD=2.12). The pacifier group's mean percent accuracy was 10% lower on the S-CAT /t/ probe as compared to the non-pacifier group. Previous studies (shown in Table 4) reported the mean accuracy for the /t/ phoneme with normally developing 3-year olds between 88%-98% accuracy (Fabio-Smith & Goldstein, 2010; Irwin & Wong, 1983; Smit et al., 1990). The non-pacifier group scored similarly to normal expectations from past studies with their mean /t/ accuracy of 89.79%, while the pacifier group scored below past reports with a mean /t/ accuracy of 79.61%.

The pacifier group's percent accuracies on the S-CAT /d/ phoneme probe ranged from 48.15% to 92.59% with a mean of 74.07% (SD=4.24). The non-pacifier group's percent accuracies on the S-CAT /d/ phoneme probe ranged from 81.48% to 100% with a mean percent accuracy of 92.59% (SD=2.00). The pacifier group's mean percent accuracy was 18% lower on the S-CAT /d/ probe as compared to the non-pacifier group. Previous studies reported the mean accuracy for the /d/ phoneme for normally developing 3-year olds between 87%-99% accuracy (Fabio-Smith & Goldstein, 2010; Irwin & Wong, 1983; Smit et al., 1990). The nonpacifier group's mean accuracy of 92% was similar to normal expectations reported in past studies, while the pacifier group's accuracy was much lower at 74%.

Table 2

Individual GFTA-2 Standard Scores and Group Means (standard deviation) of the GFTA-2

Subjects	GFTA-2
Experimental Group: Pacifier Users	Standard Score
1E	117.00
2E	89.00
3E	101.00
4E	129.00
5E	103.00
6E	106.00
7E	100.00
Pacifier Users Group Mean	106.43
	(12.96)
Control Group: Non-Pacifier Users	
1C	117.00
2C	120.00
3C	112.00
4C	111.00
5C	118.00
6C	117.00
7C	114.00
Non-Pacifier Users Group Mean	115.57
	(3.31)

The pacifier group's percent accuracies on the S-CAT /s/ phoneme probe ranged from 23.08% to 100% with a mean of 64.85% (SD=7.90). The non-pacifier group's percent accuracies on the S-CAT /s/ phoneme probe ranged from 84.62% to 96.15% with a mean percent accuracy of 91.77% (SD=1.07). The pacifier group's mean percent accuracy was 26% lower on the S-CAT /s/ probe as compared to the non-pacifier group. Past studies (Fabio-Smith & Goldstein, 2010; Irwin & Wong, 1983; Smit et al., 1990) of /s/ accuracy by 3-year olds ranged from 75%-98% accuracy, with the exception of 3 year old boys from the Smit et al. study producing /s/ with only 48% accuracy. The trend continued with the non-pacifier group's similar /s/ accuracy (91%) to past studies (75%-98%) and the pacifier group achieving lower accuracy (64%).

The pacifier group's percent accuracies on the S-CAT /z/ phoneme probe ranged from 20.83% to 95.83% with a mean of 60.13% (SD=7.59). The non-pacifier group's percent accuracies on the S-CAT /z/ phoneme probe ranged from 58.33% to 100%, with a mean of 84.54% (SD=3.20). The pacifier group's mean percent accuracy was 24% lower on the S-CAT /z/ probe as compared to the non-pacifier group. Past studies (Fabio-Smith & Goldstein, 2010; Irwin & Wong, 1983; Smit et al 1990) of /z/ accuracy by 3-year olds had a large range from 41%-98% accuracy. In this instance, although the pacifier group's mean accuracy for /z/ of 60% was considerably lower than the non-pacifier groups mean of 84%, both groups were within the range reported in past studies.

The pacifier group's percent accuracies on the S-CAT /l/ phoneme probe ranged from 57.14% to 100% with a mean of 81.11% (SD=4.61). The non-pacifier group's percent accuracies on the S-CAT /l/ phoneme probe ranged from 60.71% to 100% with a mean of 87.25% (SD=4.20). The pacifier group's mean percent accuracy was 6% lower on

the S-CAT /l/ probe as compared to the non-pacifier group. Past studies (Fabio-Smith & Goldstein, 2010; Irwin & Wong, 1983; Smit et al., 1990) of /l/ accuracy by 3-year olds ranged from 70%-93% accuracy, with the exception of 3 year old boys from the Smit et al. study producing /l/ with only 36% accuracy. The pacifier group's mean accuracy of 81% and the non-pacifier group's mean accuracy of 87% were both within the range reported by past studies.

The pacifier group's percent accuracies for alveolar phonemes on the total S-CAT ranged from 44.36% to 96.24% with a mean of 72.50% (SD=28.14). The non-pacifier group's percent accuracies on the total alveolar S-CAT ranged from 76.69% to 98.50% with a mean of 89.26% (SD=10.19). The pacifier group's mean percent accuracy was 16% lower overall on the alveolar phonemes measured by the S-CAT as compared to the non-pacifier group.

The pacifier users as a group consistently obtained lower percent accuracies and standard scores on all articulation tasks (i.e., GFTA-2 and S-CAT probes), however both the pacifier and non-pacifier users' mean standard scores on the GFTA-2 were within the average range. The pacifier users as a group obtained percent accuracies that ranged from 64.85 to 81.11 on the S-CAT probes of alveolar phonemes while the non-pacifier users as a group obtained higher percent accuracies that ranged from 84.54 to 92.59. Additionally, the pacifier group demonstrated accuracies lower than the range reported by past studies for several of the alveolar phonemes. Therefore, the data seems to indicate that pacifier use may have affected articulation skills for this group of subjects. To further investigate the relationship between individual participant's pacifier use and their articulation skills, Table 5 was developed and presents mean alveolar phoneme accuracy on the S-CAT and

general articulation skills on the GFTA as well the duration and time of pacifier use for each of the subjects in the pacifier group.

The first trend that was investigated was whether children who spent more total hours over a period of years using pacifiers had more articulation errors than children who had fewer hours of pacifier use. Four children (subjects 1E-4E) used pacifiers between approximately 10,000-17,000 hours during their short lifetime. All four children had standard scores within normal limits on the GFTA. Two of these subjects (2E and 3E) demonstrated the lowest accuracies on the alveolar phonemes measured by the S-CAT, however the other two of these subjects (1E and 4E) demonstrated the highest accuracies on the alveolar S-CAT phonemes. Therefore, there does not appear to be a direct relationship between the number of hours of pacifier use and the degree of difficulty with alveolar phoneme articulation. However, pacifier use may not effect speech development when it is used only during sleep because the most detrimental use of the pacifier may occur for children in wakeful periods when attempting babbling and speech. It is difficult to test this hypothesis because only two subjects reported frequent daytime pacifier use (1E and 4E), however these two subjects had the highest GFTA standard scores and S-CAT percent accuracies in the pacifier group and higher than most of the subjects in the control group. Therefore, although the pacifier group as a whole produced alveolar phonemes less accurately than the non-pacifier group in the current study and less accurately than means reported in past studies, there does not seem to be a direct relationship between the number of hours of pacifier use or time of day of pacifier use and individual children's articulation skills for the subjects in this study.

Table 3

S-CAT Group Percent Accuracy Means (standard deviations)

Subjects	Subject's Age	S-CAT /t/ Probe Percent Accuracy	S-CAT /d/ Probe Percent Accuracy	S-CAT /s/ Probe Percent Accuracy	S-CAT /z/ Probe Percent Accuracy	S-CAT /l/ Probe Percent Accuracy	S-CAT Total Percent Accuracy
Pacifier Group:							
1E	4:3	96.43%	92.59%	96.15%	95.83%	100.00%	96.24%
2E	3:5	50.00%	62.96%	34.62%	33.33%	71.43%	51.13%
3E	2:7	57.14%	48.15%	23.08%	33.33%	57.14%	44.36%
4E	2:5	100.00%	88.89%	100.00%	91.67%	100.00%	96.24%
5E	3:2	89.29%	77.78%	73.08%	87.50%	89.29%	83.46%
6E	2:11	85.71%	66.67%	46.15%	20.83%	67.86%	59.40%
7E	3:0	78.57%	81.48%	80.77%	58.33%	82.14%	76.69%
Pacifier Users Group Mean & SD	3:1	79.61% (5.38)	74.07% (4.24)	64.85% (7.90)	60.13% (7.59)	81.11% (4.61)	72.50% (28.14)
Control Group:							
1C	4:3	100.00%	100.00%	96.15%	100.00%	96.43%	98.50%
2C	3:5	96.43%	100.00%	96.15%	95.83%	100.00%	97.74%
3C	2:7	85.71%	88.89%	84.62%	83.33%	96.43%	87.97%
4C	2:5	82.14%	81.48%	88.46%	58.33%	71.43%	76.69%
5C	3:2	96.43%	85.19%	92.31%	83.33%	60.71%	83.46%
6C	2:11	82.14%	96.30%	92.31%	87.50%	92.86%	90.23%
7C	3:0	85.71%	96.30%	92.31%	83.33%	92.86%	90.23%
Control Group: Mean & SD	3:0	89.79% (2.12)	92.59% (2.00)	91.77% (1.07)	84.54% (3.20)	87.25% (4.20)	89.26% (10.19)

Table 4
Articulation Norms for the Phonemes /t/, /d/, /s/, /z/, /l/

Normal Expectations	/t/ Norms Percent Accuracy	/d/ Norms Percent Accuracy	/s/ Norms Percent Accuracy	/z/ Norms Percent Accuracy	/l/ Norms Percent Accuracy
Irwin & Wong ¹ (1983)					
2 years	55 %	64%	54%	33%	27%
3 years	98 %	99%	98%	98%	93%
4 years	89 %	68%	87%	89%	85%
5 years	99 %	93%	93%	94%	95%
Fabio-Smith & Goldstein(2010) ²					
3 years	95%	87%	88%	93%	70%
Smit et al., (1990) ³					
3 years	F 95% M 88%	F 97% M 95%	F 75% M 48%	F 41% M 44%	F 77% M 36%
3:6 years	F 92% M 93%	F 99% M100%	F 71% M 75%	F 50% M 69%	F 79% M 69%
4:0 years	F 100% M100%	F 98% M 98%	F 69% M 71%	F 54% M 65%	F 82% M 58%
4:6 years	F 100% M 98%	F 100% M 98%	F 74% M 69%	F 71% M 68%	F 86% M 75%

¹ Irwin & Wong- 10 boys and 10 girls each age group; accuracy in conversational speech

² Fabio-Smith & Goldsten- 3 males, 3 females age 3;0-3;11, M= 3;3 accuracy in single word picture naming task

³ Smit- Percentage of acceptable productions of phonemes by group of children. Single word naming task, phoneme in the initial position. Number of children in each group = 3:0 22 female, 25 males; 3:6 26 females and 29 males; 4:0 37 females and 54 males; 4:6 51 females, 44 males

Table 5

Gender, Age, Duration of Pacifier Use, Frequency of Pacifier Use, Estimated Number of Total Hours of Pacifier Use, Time of Day of Pacifier Use, GFTA-2 Standard Scores, S-CAT Total Percent Accuracy for the Group of Pacifier Users

Subject	Gender	Age	Duration of Pacifier Use	Frequency of Pacifier Use	Estimated total hrs of pacifier use	Time of Day of Pacifier Use	GFTA-2 Standard Scores	SCAT Total% accuracy
1E	M	4:1	4 years; 0 months	12 hours daily	17520 hrs	All day	117.00	96.24%
2E	F	3:6	3 years; 6 months	12 hours daily	15330 hrs	Night & naptime	89.00	51.13%
3E	M	2:4	2 years; 4 months	More than 12 hours daily	11055+ hrs	Night & naptime	101.00	44.36%
4E	M	2:5	2 years; 0 months	More than 12 hours daily	9490+ hrs	All day	129.00	96.24%
5E	F	3:5	3 years; 0 months	3 hours daily	3285 hrs	Night & naptime	103.00	83.46%
6E	F	2:8	2 years; 6 months	Variable	N/A	Variable	106.00	59.40%
7E	F	2:9	2 years; 4 months	Periodically past 4 months	N/A	Night	100.00	76.69%
Pacifier Group Means	4 F; 3 M	3:1	2 years; 10 months				106.43	72.50%

Chapter V

Discussion

Summary of Results. The research question addressed whether there was a difference in articulation errors between children who used a pacifier and children who did not use a pacifier for prolonged duration and frequency. The results showed that both the pacifier and non-pacifier users' mean standard scores on the GFTA-2 were within the average range; however, the pacifier group scored more than 10 percent lower with regards to mean accuracy of alveolar stops and fricatives on S-CAT probes, and lower than other reported normal expectations for articulation of several alveolar phonemes. The pacifier users as a group consistently obtained lower percent accuracies and standard scores on all articulation tasks (i.e., GFTA-2 and S-CAT probes). Within the experimental group, individual variability on articulation tasks was evident. Additionally, the pacifier group demonstrated accuracies lower than the range reported by past studies for several of the alveolar phonemes. Therefore, the data seemed to indicate that pacifier use may have affected articulation skills for this group of subjects. However, there did not seem to be a direct relationship between the number of hours of pacifier use or time of day of pacifier use and individual children's articulation skills for the subjects in this study.

Relation to Past Research. The current study expanded on Shotts' et al. (2008) research in exploring the impact of prolonged pacifier use on speech articulation. Just as Shotts et al. (2008) discovered, there was no substantial differences among the articulation skills of pacifier and non-pacifier users as measured by the GFTA-2 in this limited sample. Both the pacifier users and the non-pacifier users' mean standard scores were within the average range, which parallels results of the current study.

However, unlike Shotts et al. (2008), the current study probed production of specific phonemes. The word imitating tasks of the S-CAT for the phonemes /s/, /z/, /d/, /t/ and /l/ were administered to probe alveolar phoneme articulation. These specific phonemes were evaluated due to their age of emergence. Moreover, Garber and Reynolds (1994) examined alveolar stop retractions during pacifier use and Van Norman (2001) explored “speech distortion of the sibilants /s/ and /z/ and lingual alveolar consonants /t/, /d/, and /l/” in children who used pacifiers. The current study suggested that prolonged pacifier use may increase the probability of alveolar errors. In the current study, the pacifier group scored more than 10 percent lower on their mean accuracy of alveolar stops and fricatives. Additionally, in the current study, the largest discrepancy between the groups was on the phonemes /s/, with the pacifier group averaging 64.85% and the control group averaging 91.77% accuracy.

Several past studies have investigated the impact of pacifier use and the occurrence of acute otitis media (AOM) (Niemela et al., 2000; Niemela, Uhari, & Mottonen, 1995) and found a higher occurrence of otitis media in pacifier users. Although this was not the specific focus of the current study, it is interesting to note that 71% of the children who used pacifiers in the current study reported episodes of otitis media, while only 28% of participants in the control group reported otitis media.

Limitations. One major limitation to this study was the small number of subjects. The majority of the subjects were from one county in Central Illinois. In order to generalize results, a more diverse and larger population would need to be included in the study. In addition, a greater number of subjects would allow for the use of inferential statistics, which could validate correlations between variables.

Another limitation to this study was the validity of information that was obtained by the parent questionnaire in regards to typical daily pacifier use. Obtaining valid data regarding the actual amount of time that a pacifier was used during a typical day from the mother's recollection may be problematic. Until some reliable method can be devised to quantify the amount of time the pacifier was actually in the mouth, the accuracy of the mother's estimate cannot be verified.

Assessment of speech in a naturalistic context was not conducted in this study. Examining speech articulation in young children in a more natural context may prove to be more valid in future studies designed to explore the impact of pacifier use on articulatory development. The GFTA-2 and S-CAT did not analyze speech sound production beyond the word level. Additionally, the S-CAT was a direct imitation task. Articulation errors might have emerged had connected discourse been analyzed.

In the current study, no qualitative data was obtained to identify the types or brands of pacifiers used by subjects. Although commercially available pacifiers are designed to fit the physiological and orthodontic contour of the oral cavity, no attempt was made in the current study to introduce type, style, or brand as an experimental variable.

Clinical implications. A speech language pathologist (SLP) evaluating a young child's articulation, must consider many factors to consider in determining the cause of phoneme errors. When considering articulation therapy for a child with a history of prolonged pacifier use, the SLP may need to take into account that prolonged pacifier habits can result in changes to the dental arches and occlusal parameters. Warren and Bishara (2002) noted that some change in the dental arch parameter and occlusal characteristics (i.e., prevalence of posterior crossbite and increased amount of overjet) extended well beyond

termination of the pacifier habit. A thorough case history and oral peripheral exam can assist in articulation remediation. This study suggested great variability in articulation abilities of children with extended pacifier use. Clinically, when consulting with parents, SLPs can present both documented advantages and disadvantages of pacifier use and explain possible correlations between prolonged pacifier use and speech production errors.

Future research. Future research should expand on exploring the style, type, or brand of pacifiers used by subjects, since pacifiers are variable in how they anatomically contour the oral cavity. Specific styles or brands of pacifiers may yield stronger correlations to specific articulation patterns. In addition, future research should expand to simultaneously explore both the correlation between pacifier use and the occurrence of dental anomalies and the effects of those dental anomalies on articulation.

Future research should also consider other forms of non-nutritive sucking (NNS) (i.e. digit sucking) and their effects on articulation. Future studies could compare prolonged digit sucking and pacifier sucking to explore if both yield similar dental anomalies and articulation patterns. Additionally, future longitudinal research should consider examining speech patterns of pacifier users after termination of pacifier use. By looking at later speech patterns, one could explore the possible long-term speech characteristics associated with prolonged pacifier use.

Additionally, future research should explore subjects' attempts at speech and articulation abilities with prolonged daytime pacifier users versus nighttime pacifier users. By investigating subgroups of pacifier users, one could explore possible articulation differences related to time-of-day for pacifier use and subjects' attempts at speech.

Future research should also investigate parents, dentists, and speech pathologists' views of pacifiers and their beliefs on ideal age for termination of pacifier use. By expanding the current research and investigating beliefs about pacifiers and other NNS habits, one could explore current perspectives from a variety of professionals on advantages and disadvantages of pacifier use.

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Appendix A

CONSENT TO PARTICIPATE IN RESEARCH

You are invited to participate in a research study conducted by Danielle LaPrairie and Mr. Frank Goldacker from the Communication Disorders and Sciences Department at Eastern Illinois University. Your participation in this study is entirely voluntary. Please ask questions about anything you do not understand before deciding whether or not to participate.

- **PURPOSE OF THE STUDY**

The purpose of this research is to investigate whether there is a significant difference in speech sound development depending on duration and frequency of pacifier use.

- **PROCEDURES**

If your child is to participate in this study, you will be asked to:

Complete a questionnaire on your child's pacifier use. Additionally, depending on questionnaire analysis, your child may participate in less than an hour of one-on-one articulation testing and overall language testing. Results of findings will be summarized and sent home.

- **POTENTIAL RISKS AND DISCOMFORTS**

Overall risks are considered minimal. Participant may become mildly fatigued during testing. However, this should be minimal and of short duration. This study will not pose any safety or health concerns. Breaks will be given during testing, as needed.

- **POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

Potential benefits include information on your child's articulation and overall language abilities.

- **CONFIDENTIALITY**

Any information that is obtained from this study that can be identified with your child will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of storing observation data in a locked office at the EIU Speech-Language-Hearing Clinic. When presenting results of the study, pseudonyms will be used to protect the identity of the participant.

- **PARTICIPATION AND WITHDRAWAL**

Participation in this research study is voluntary and not a requirement or a condition for being the recipient of benefits or services from Eastern Illinois University or any other organization sponsoring the research project. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits or services to which you are otherwise entitled.

You may also refuse to answer any questions you do not want to answer. There is no penalty if you withdraw from the study and you will not lose any benefits to which you are otherwise entitled.

- **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about this research, please contact Danielle LaPrairie or Mr. Frank Goldacker at 217-581-2712, EIU Speech-Language-Hearing Clinic, 600 N. Lincoln Ave, Charleston, IL 61920.

- **RIGHTS OF RESEARCH SUBJECTS**

If you have any questions or concerns about the treatment of human participants in this study, you may call or write:

Institutional Review Board

Eastern Illinois University

600 Lincoln Ave.

Charleston, IL 61920

Telephone: (217) 581-8576

E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

I hereby consent to the participation of _____, a minor/subject in the investigation herein described. I understand that I am free to withdraw my consent and discontinue my child's participation at any time.

Signature of Minor's Parent or Guardian

Date

I, the undersigned, have defined and fully explained the investigation to the above subject.

Appendix B

Parent Questionnaire

Child's name: _____

Child's date of birth: _____

Age of child: _____ (specifically in years and months)

Gender: (please circle) Male or Female

1. Does your child have a history of ear infections?

Yes or No

-If Yes, how many episodes? _____

- At what age did these episodes occur?

Does your child have current or previous Pressure Equalization (PE) tubes?

Yes or No

-If Yes, when did your child have PE tubes?

-At what age did your child have PE tubes?

2. Is there a family history of speech problems?

Yes or No

-If Yes, please explain: _____

3. Has your child ever used a pacifier? (please circle)

Yes or No

If "yes" please complete the rest of the questionnaire. If "no", respond only to question number *eight*.

4. When did your child start using a pacifier? (specifically age)

5. How long has/had your child used a pacifier? (please answer in approximate years & months)

6. Does your child still use a pacifier? (please circle)

Yes or No

7. Has your child used a pacifier in the last six months? (please circle)

Yes or No

8. Does/did your child also suck his/her thumb? (please circle)

Yes or No

a. If yes, does your child still suck his/her thumb? (please circle)

Yes or No

b. At what age did your child stop sucking his or her thumb? (specifically year and/or months)

9. How often does your child use a pacifier daily? (please answer in approximate minutes and/or hours)

10. What times of day does your child use his/her pacifier? (e.g. morning, afternoon, evening, before bed, during sleep etc.)

Thank you for completing this questionnaire!

Appendix C

Subjects' Individual Scores on the PPVT-4, GFTA-2, & S-CAT Raw Scores

Name	1E	2E	3E	4E	5E	6E	7E	1C	2C	3C	4C	5C	7C	6C
Gender	M	F	M	M	F	F	F	F	M	M	M	M	F	F
CA	4:1	3:6	2:4	2:5	3:5	2:8	2:9	4:3	3:5	2:7	2:5	3:2	3:0	2:1 1
PPVT: SS	10 7	11 2	11 1	12 8	10 9	10 7	10 4	11 6	10 6	10 6	10 6	10 7	11 0	102
GFTA: SS	11 7	89	10 1	12 9	10 3	10 6	10 0	11 7	12 0	11 2	11 1	11 8	11 4	117
S-CAT Raw Scores														
/t/ pre (14)	13	6	5	14	12	12	9	14	13	12	11	13	13	11
/t/ post (14)	14	8	11	14	13	12	13	14	14	12	12	14	11	12
/t/ sum (28)	27	14	16	28	25	24	22	28	27	24	23	27	24	23
/d/ pre (13)	11	7	6	13	11	8	11	13	13	11	9	11	12	12
/d/ post (14)	14	10	7	11	10	10	11	14	14	13	13	12	13	14
/d/ sum (27)	25	17	13	24	21	18	22	27	27	24	22	23	26	26
/s/ pre (13)	12	4	2	13	10	10	10	13	12	13	12	13	13	13
/s/ post (13)	13	5	4	13	9	3	11	12	13	9	11	11	11	11
/s/ sum (26)	25	9	6	26	19	12	21	25	25	22	23	24	24	24
/z/ pre (9)	8	3	1	9	9	2	8	9	9	9	5	9	7	8
/z/ post (15)	15	5	7	13	12	3	6	15	14	11	9	11	14	13
/z/ sum (24)	23	8	8	22	21	5	14	24	23	20	14	20	20	21
/l/ pre (14)	14	10	8	14	13	7	12	14	14	13	11	4	13	13
/l/ post (14)	14	10	8	14	12	12	11	13	14	14	9	13	13	13
/l/ sum (28)	28	20	16	28	25	19	23	27	28	27	20	17	26	26
Sum of SCAT (133)	12 8	68	59	12 8	11 1	79	10 2	13 1	13 0	11 7	10 2	11 1	12 0	120