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Preference for infant-directed speech in preterm infants

Samantha C. Butler[a], Laura P. O'Sullivan[a], Bhavesh L. Shah[b], Neil E. Berthier[a,*]

[a] Department of Psychology, University of Massachusetts Amherst, United States
[b] Division of Newborn Medicine, Baystate Children's Hospital, Springfield, MA, United States

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ABSTRACT

The current study explores the effects of exposure to maternal voice on infant sucking in preterm infants. Twenty-four preterm infants averaging 35 weeks gestational age were divided randomly into two groups. A contingency between high-amplitude sucking and presentation of maternal voice was instituted for one group while the other group served as a yoked control. No significant differences were observed in sucking of the two groups, but the degree of pitch modulation of the maternal voice predicted an increase in the rate of infant sucking.

1. Introduction

Full term newborn infants show a preference for their mother's voice over an unfamiliar female voice (DeCasper & Fifer, 1980; Fifer & Moon, 1995), and they prefer infant directed speech (IDS) compared to adult directed speech (ADS; Cooper & Aslin, 1990; Fernald, 1985; Pegg, Werker, & McLeod, 1992). The prosodic exaggerations of maternal speech give it a song-like quality that infants find attractive (Fernald et al., 1989; Papousek & Hwang, 1991).

In the normal uterine environment, maternal speech provides a unique source of auditory, vibratory, and vestibular stimulation for the developing fetus. Fifer (1987) hypothesized that the frequency level, expression, and repeated exposure of the maternal voice in the womb allows the full term newborn to recognize, distinguish, and prefer their mother's voice. Preferring mother's voice and IDS is likely advantageous for bonding and survival, in regulating attention, enhancing learning of linguistic structure, and for providing for communication of emotional intent between the mother and infant.

The infants of the original studies on IDS were full term, healthy newborns who were in close physical contact with their mothers both pre- and postnatally. In contrast, the preterm infant is deprived of the evolutionarily promised womb and developmentally appropriate stimuli, including the mother's voice (Hofer, 2004), because of their early birth. Intensive care technology and treatment are necessary to reduce mortality, but these treatments disrupt the mother-child relationship (Als et al., 2004; Butler & Als, 2008). The availability and access of parents in the newborn intensive care environment varies across hospitals. Thus, studies of preterm infants responsivity to maternal voice and to IDS are limited in number (Bozzette, 2008; Krueger, Parker, Chiu, & Theriaque, 2010). At the time of birth, most preterm infants are born with an auditory system that is well developed with functional hearing from as early as 24 weeks gestational age (Amin, Orlando, Dalzell, Merle, & Guillet, 1999; Ruben, 1997). Research shows that the fetus in the last eight weeks of pregnancy responds to subtle auditory cues such as speaker gender, pitch, intensity, and musical tone (Kisilevsky & Hains, 2011; Lecanuet, Granier-Deferre, Jacquet,

* Corresponding author. Tel.: +1 413 545 0535; fax: +1 413 545 0996.
E-mail address: berthier@psych.umass.edu (N.E. Berthier).

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& Busnel, 1992; Lecanuet, Granier-Deferre, Jacquet, & DeCasper, 2000). Following early birth, the preterm infant responds to IDS with increased visual attention and alertness (Eckerman, Oehler, Medvin, & Hannan, 1994), and increased calmness and lowering of heart rate (White-Traut, Nelson, Silverstri, Cunningham, & Patel, 1997). In addition, tape recordings of maternal voice result in increased muscle tone and improved responsiveness (Katz, 1971), improved weight gain (Malloy, 1979), and decreased crying (Segall, 1972).

The current study investigated whether preterm infants would learn to suck a pacifier in order to hear their mother's voice. Learning has previously been described in fetuses, preterm infants, and newborns. For example, fetuses as young as 30 weeks gestation have been shown to habituate to a vibroacoustic stimulus (Dirix, Nijhuis, Jongsma, & Hornstra, 2009; Morokuma et al., 2008; van Heteren, Boekkooi, Jongsma, & Nijhuis, 2001). Twenty-eight to thirty-two week gestational age premature infants learned a contingency between behavior and pain (Goubet, Clifton, & Shah, 2001) and 33-week premature infants demonstrated instrumental learning by actively seeking contact with a comforting stimulus (Thoman & Ingersoll, 1993). Furthermore, full term infants can learn a sucking paradigm (Werner & Siqueland, 1978) and even suck to hear their mother's voice (Mehler, Bertoncini, Barriere, & Jassik-Gerschenfeld, 1978), but it is unclear whether preterm infants have that same ability

Overall, little is know about the sensitivity of the preterm infant to maternal voice and the sucking response of healthy preterm infants to a recording of their mother's voice. The current study set out to investigate whether maternal voice quality and use of IDS varied across mothers of premature infants and whether it affected their infant's responding. Previous research has shown that infants respond differently at differing ages to IDS vs ADS, whether produced by mother or another (Cooper, Abraham, Berman, & Staska, 1997). In addition, maternal voice quality and IDS varies across mothers.

We employed a high amplitude sucking paradigm where criterion sucks were rewarded by short voice recordings of the infant's mother. Our goal was to investigate the effects of maternal voice and voice quality on premature infant sucking and to determine if maternal speech could be used as a reinforcer to increase preterm infant sucking.

2. Methods

2.1. Participants

Twenty-four low-risk, preterm infants and their parent(s) constituted the study sample. The participants were recruited as sequential cases from the Continuing Care Unit (CCU) of Baystate Hospital in Springfield, MA, a level-III Neonatal Intensive Care Unit (NICU) with an exclusively inborn population. The institutional review boards for research with human subjects of both Baystate Hospital and University of Massachusetts Amherst approved the study protocol. The study recruitment period extended over 8 months, from July 2000 to February 2001. Infants were preselected by medical staff as healthy and without significant medical complication. Study selection infant criteria included gestational age at birth of 32–34 weeks; weight and head circumference at birth appropriate for gestational age (>5th, <95th percentile); no mechanical ventilator support; and absence of congenital or chromosomal abnormality, congenital or acquired infection, and brain lesions.

The infants were initially cared for in the NICU, but at the time of data collection all infants resided in the CCU of the hospital in open cribs. Most infants were discharged from the hospital within a week of the last day of testing. Half of the infants were randomly assigned to an experimental group ($n = 12$) and half to a control group ($n = 12$). Blocking by gender (male/female) and ethnicity (Caucasian/other) was imposed a priori. Consent was obtained soon after admission into the CCU and consenting families were immediately randomized to the experimental or control group.

Of the participants in the experimental group, seven were male and six were members of minority groups, and of the participants in the control group, six were male and five were members of minority groups. Characteristics of the sample are found in Table 1. Medical and demographic background information did not statistically differ between the two groups.

Table 1
Description of the participants.

	Experimental	Control	*t*-Test or Fisher exact test
Gestation age at birth	227 (15.3) days	228 (16.1) days	$t(22) = 0.12$, $p = .91$
Postmenstrual age at start of testing	244 (7.7) days	246 (7.2) days	$t(21) = 0.90$, $p = .38$
Birth weight	1922 (412) g	1849 (528) g	$t(21) = 0.38$, $p = .71$
Weight at start of testing	2032 (274) g	2010 (280) g	$t(22) = 0.19$, $p = .85$
Weight on day 5 of testing	2115 (274) g	2091 (244) g	$t(22) = 0.23$, $p = .82$
Apgar score 1 min[a]	6.4 (2.4)	6.6 (2.2)	$t(19) = 0.19$, $p = .85$
Apgar score 5 min[a]	7.6 (1.8)	7.9 (1.6)	$t(18) = 0.44$, $p = .67$
Vaginal/cesarean delivery	7/5	8/4	$p = 1.0$
Males/females	6/6	7/5	$p = 1.0$
Caucasian/Black/Hispanic/other	7/2/3/0	6/2/3/1	$p = 1.0$

Means with standard deviations in parentheses; *t*-test with Welch's degrees-of-freedom correction for possibly unequal variances.
[a] Two Apgar scores are missing for the experimental group.