

BINKIES DO MORE THAN PACIFY

Bouvé Researcher Studies Infant Sucking as a Window into Development

Like many mothers, researcher Emily Zimmerman, PhD, has depended on pacifiers at times to soothe her two young daughters. But her interest in these parental sanity-savers is far from typical: Zimmerman, who is also a speech-language pathologist, has spent her career studying what babies' sucks can tell us about risks to their development.

“When a giraffe is born, it begins to walk immediately, but a human baby lies there like an adorable sack of potatoes,” says Zimmerman, an assistant professor in the Department of Communication Sciences and Disorders and director of the Speech and Neurodevelopment Lab at Bouvé College. The non-nutritive suck (NNS) that occurs on pacifiers and thumbs, she explains, is one of the first motor tasks babies perform and serves as a window into their growing central nervous systems.

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Sucking typically begins in utero around 15 weeks and provides important practice for the oromotor activities—those involving movement of the mouth—that await after birth. “If babies are good suckers and subsequently good feeders, then we hypothesize that they may also develop good babbling skills because these behaviors share neural pathways,” says Zimmerman. “Can problems with suck serve as a biomarker—a predictor of problems to come?”

She believes the answer is “yes,” and hopes to soon begin a study examining these early oromotor behaviors in detail across patient populations. The study will be a natural outgrowth of other research Zimmerman has done into the interplay between

feeding and the cardiopulmonary and nervous systems, as well as the factors that influence sucking, from pacifier type to environmental stimuli to genes.

PACIFIERS ENHANCE SUCK

Pacifiers are often blamed for a host of things, like nipple confusion, a claim Zimmerman debunks in a “State-of-the-Art” review she published in the *Journal of Perinatology*. Instead, she says pacifiers can be beneficial because they help infants practice one of their most important jobs: sucking. “The non-nutritive suck promotes oral feeding, makes babies more alert, and improves gastric motility—the contraction of the gastrointestinal muscles necessary for digestion,” she explains. Zimmerman also notes that the American Academy of Pediatrics recommends

that babies use pacifiers at night to reduce the risk of Sudden Infant Death Syndrome.

Sitting in her office on the second floor of the Forsyth Building, she dumps a mugful of pacifiers onto her desk and fingers them one by one, pointing out the differences in nipple shape and stiffness. One of her recent studies, a collaboration with her master’s thesis student Jaclene Forlano, MS, CFY-SLP’16, and Andrew Gouldstone, PhD, an associate professor in the Mechanical and Industrial Engineering department, used a pressure-sensitive device called a transducer to test how well different pacifiers promote healthy sucking. Designed by Zimmerman and a former NU mechanical engineering student, the device resembles a small microphone that is attached to the pacifier. The transducer is connected to a machine that records how hard and long the baby sucks,

The transducer is connected to a machine that records how hard and long the baby sucks, as well as the patterned bursts and pauses of oral activity.





as well as the patterned bursts and pauses of oral activity. This yields a graphic that looks like the peaks and valleys of an electrocardiogram. “Healthy babies can modify their suck patterning fairly quickly, but this isn’t true with babies who are medically fragile; to them these pacifier differences matter,” says Zimmerman. “If we know more about the effects of pacifier properties, the neonatal intensive care units (NICUs) will be able to offer pacifiers that are more supportive of sucking and feeding development.”

All of the research Zimmerman conducts on healthy babies is done with an eye toward how the findings can help babies who struggle with sucking and feeding, particularly those who are premature,

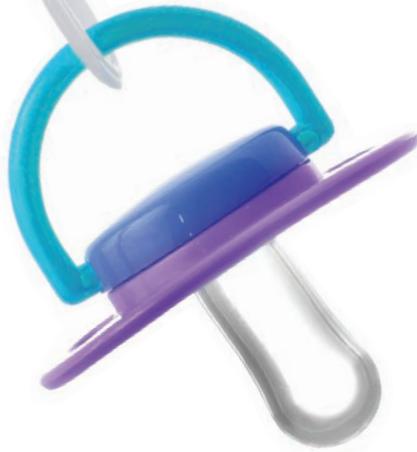
have Down syndrome, or are born with cleft palates.

OTHER INFLUENCES

Pacifier type is just one “environmental” variable Zimmerman has studied; she also investigates sensory inputs—particularly the sounds, images, and smells babies are exposed to while sucking. In one study published this year in *Acta Paediatrica*, Zimmerman recorded herself imitating a baby’s “well organized” sucking clicks and then played it to her small research subjects, hypothesizing that babies would try to mimic her patterns. They didn’t, and she theorizes that they were already proficient suckers and didn’t need auditory coaching. But she’d like to repeat

the experiment with babies in the NICU, and surmises that the results will be different. “Those babies, especially the preterm ones, are isolated in incubators and crave appropriate sensory sensation, such as sound,” she says. “My goal is always to find therapies that can translate back to the NICU and help these babies catch up to their peers developmentally.”

Zimmerman is now studying how visual stimuli affect non-nutritive suck. Because vision is the last sense to develop, there have been fewer investigations exploring the connections between sight and suck. In this study, babies are exposed to their mother’s scent (research has shown that maternal scent makes babies linger longer



on a human face), and then shown separate images of cars and women's faces. Based on preliminary data, infants suck more when looking at the faces. The study suggests ways that babies in NICUs might be helped, perhaps by exposing them to their mother's photo—not to mention scent, voice, or other forms of sensory stimulation.

ENVIRONMENTAL TOXINS AND DEVELOPMENT

Further from Bouvé, Zimmerman is involved in a transdisciplinary research collaboration in Puerto Rico, called the Center for Research on Early Childhood Development and Exposure—or CRECE, Spanish for “grow.” This multi-university center is directed by NU's Akram Alshabkeh, PhD, Snell Professor of Engineering, and José F. Cordero, MD, MPH, Patel Distinguished Professor of Public Health at the University of Georgia. The center investigates how mixtures of environmental exposures and other factors affect the health and development of low-income, underserved infants and children living in the heavily contaminated

island of Puerto Rico. Zimmerman visits Puerto Rico annually and the center is using her suck assessment on babies to measure the health of their central nervous systems.

MOTHERHOOD AND RESEARCH

Zimmerman obtained her BA, MA, and PhD from the University of Kansas, working as a speech-language pathologist while earning her doctorate. A post-doctoral fellowship in newborn medicine at Brigham and Women's Hospital brought her to Boston and eventually to Northeastern in 2013.

“I was drawn to Bouvé because of its emphasis on interprofessional work—the ability to work across disciplines and colleges,” explains Zimmerman. “These collaborations have enabled me to expand my research in ways that I could not have imagined, and that is very exciting.”

Zimmerman has always loved anatomy, physiology, neuroscience, and babies, so researching oromotor development in infants has been the perfect way to combine her passions. She says that becoming a mother has influenced her professional life—beyond the typical struggles of work-life balance. In addition to sometimes using her own two children (four-year-old Clara and one-year-old Margo) as research subjects, Zimmerman said her daughters have occasionally served as research muses.

Zimmerman describes how, after noticing an increase in baby Clara's arm movements prior to feeding, she began designing a study that explored signs of

feeding readiness. That investigation eventually morphed into one that examined changes to the autonomous nervous system, which controls unconscious functions such as breathing and digestion, before, during, and after feeding. Zimmerman has also formulated research ideas through conversations with other parents during play dates.

Having children has also made her more empathic toward parents whose babies aren't following a typical developmental trajectory, and more patient when things don't go as planned. “We ask the caregivers to come to the Speech and Neurodevelopment Lab an hour before feeding time, but inevitably, the baby ends up falling asleep or screaming the entire time. Or sometimes they get sick and can't come,” Zimmerman says with a smile, noting that visitors

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are amused by the huddle of graduate student research assistants attending to a single baby and the research equipment. “It definitely takes a village, and our priority is always how to best accommodate infant and caregivers.”

The overarching goal of Zimmerman's research is to identify oromotor problems as soon after birth as possible. “The earlier we identify problems, the quicker the babies can get the targeted therapy they need,” she explains. ■