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HMN 2026: How Eye contact may act as a learning “switch” for babies’ brains



Direct eye contact from an adult speaker appears to guide how infants choose which words to learn by aligning the baby’s brain activity with the adult’s. A new study suggests that this one-way neural coordination may help link an adult’s communicative gaze to an infant’s selective word learning. The findings were published in *Nature Communications*.

Infants grow up in busy environments where many sights and sounds compete for their attention, requiring them to figure out which information is worth learning. To navigate this challenge, babies rely on social signals known as ostensive cues, which are communicative acts like direct gaze or infant-directed speech that indicate an adult intends to share information. The central focus of the new study is interpersonal neural coupling, a measure of how much activity in one person’s brain predicts later activity in another person’s brain.

Past developmental research has shown that social cues play an active role in how young minds acquire language. For example, a 2003 study indicated that nine-month-old infants learned unfamiliar foreign speech sounds when interacting with a live person, but did not learn when watching identical recorded video lessons. Expanding on how social cues operate in the brain, a 2017 study found that when an adult made direct eye contact with a baby, their brainwaves synchronized more strongly than when the adult looked away.

Even so, scientists still faced an unresolved question about what this shared brain activity accomplishes. As the authors of a 2020 review noted, it remained uncertain whether brain-to-brain synchrony helps infants learn or represents an incidental byproduct of two individuals watching the same event. In a related vein, a study in 2024 showed that communicative infant-directed speech heightened attention-related brain activity in toddlers and was linked to better word learning.

The research team, which included first author Wei Zhang of Nanyang Technological University and Victoria Leong, a professor in the School of Social Sciences at Nanyang Technological University and the Department of Pediatrics at the University of Cambridge, set out to address this question. “We had previously published a seminal demonstration that eye contact modulates adult-infant neural synchrony,” Leong. “The current study replicates (across two countries) and extends these findings to show that neural synchrony underpins infants’ selective learning in social contexts.”

The researchers tested 47 infants who were roughly nine months old, with an average age of 286 days. The sample consisted of 29 infants from the United Kingdom and 18 infants from Singapore. All infants were developing typically, with the British infants coming from English-speaking households and the Singaporean infants coming from bilingual English-Chinese families.

During the experiment, infants sat facing a monitor that displayed pre-recorded video clips of a female speaker reciting three different artificial languages. Each artificial language was constructed from four three-syllable words, like “pe-tu-do” or “di-lo-ga,” spoken continuously at a steady pace without pauses or emotional inflections. In these sequences, syllables within a word always occurred together, while syllables crossing between words occurred together only a third of the time, mimicking how real speech contains statistical patterns that help infants identify word boundaries.

To isolate the impact of eye contact, the speaker wore glasses with polarizing lenses, paired with an adjustable polarizing filter on the camera, while looking straight ahead. In the full gaze condition, the glasses appeared transparent, leaving her eyes entirely visible. In the partial gaze condition, the lenses were darkened like sunglasses, and in the no gaze condition, the lenses were made completely opaque. Adjusting only the filter on the camera allowed the researchers to manipulate how visible her eyes were while her own view remained unobstructed, so her delivery would not differ between conditions.

Each experimental block included a familiarization phase and a testing phase for each gaze condition. During familiarization, babies watched the speaker recite an artificial language for 60 seconds while their visual attention and brain activity were recorded using electroencephalography, a non-invasive technique that detects electrical signals through sensors on the scalp. During the testing phase, the infants heard either valid

words from the language or artificial nonwords made by joining syllables that crossed word boundaries. The researchers measured how long babies looked at the screen, relying on the tendency of infants to look longer at less familiar sounds when they have recognized the underlying patterns.

The behavioral results showed that infants learned selectively depending on the speaker's gaze. Infants showed evidence of learning only for the language paired with the full gaze condition, looking an average of 1.22 seconds longer at nonwords than at words, a small to moderate effect. In contrast, learning was not statistically significant for the languages accompanied by partial gaze, where the difference was 0.76 seconds, or no gaze, where the difference was 0.34 seconds.

"We let the infants listen to all three languages and it turned out they were selective in what they learned," Leong said in a news release from the University of Cambridge. "They're not just passive sponges. They heard all three languages, but only learned the one, which was when they could see the speaker's eyes."

This learning preference did not stem from differences in general visual attention. Infants spent roughly equal amounts of time watching the speaker across all conditions, averaging about 23 seconds in the full gaze condition, 21 seconds in the partial gaze condition, and 23 seconds in the no gaze condition. In addition, statistical analysis showed that the link between total looking time and learning was not statistically significant.

Kaili Clackson, a study co-author from the University of Cambridge, described the gap between looking and learning this way. "Even when the infants seemed to be staring at a screen attentively, unless there was eye contact, nothing was going in – the information washed over them," Clackson said in the release. "The brain synchrony shows that it's a selection process." She added, "These cues are really powerful because when you preface new information with them, they tell the baby: this is important, you need to listen."

When comparing the two geographic groups, Singaporean infants watched the speaker on screen longer than British infants did, which the authors suggested might reflect an interest in a speaker with unfamiliar Western facial features. However, learning performance itself did not differ significantly between the Singaporean and British infants. Both groups responded similarly to the presence or absence of the speaker's gaze.

Leong noted that this pattern sheds light on early cognitive development across backgrounds. "This suggests that although there are already cultural differences in what we pay attention to or find novel from 9 months of age, the brain's learning mechanisms set infants up to learn in a fundamentally similar way across cultures," she .

To examine brain connections, the authors focused on alpha rhythms, a type of brainwave that in infants cycles about 6 to 9 times per second, using data from the 42 infants whose recordings were usable. Because the speaker's brain activity had been recorded while she filmed the videos, the researchers could test whether patterns in her brain activity predicted later patterns in the infants' brains as they watched.

This adult-to-infant coupling predicted learning better than chance, explaining about 25 percent of the variation in learning compared with about 20 percent for models built on shuffled data. The infants' own internal brain connectivity did not predict learning, but it was linked to their scores on a parent-reported checklist of early communicative gestures, explaining about 34 percent of the variation compared with about 22 percent for shuffled data.

The team also evaluated neural entrainment, which is the tendency of a listener's brainwaves to track the rising and falling loudness of speech. Full gaze strengthened this tracking at a few recording sites, but entrainment did not predict learning. A statistical mediation analysis suggested that adult-to-infant coupling may link the speaker's eye contact to infant learning: coupling was stronger with full gaze than with no gaze, though not reliably different from partial gaze, and stronger coupling went along with greater learning. The authors call this result preliminary, partly because the coupling measure was selected for how well it predicted learning.

"Eye contact helps the baby decide what is important to learn in a social context, acting as a 'switch' to synchronize their brainwaves with those of the speaker and facilitating learning," Leong .

The findings are in line with research in 2023, which found that eye contact promotes aligned brain activity between interacting individuals. However, that earlier study examined spontaneous synchrony between familiar adult pairs rather than adult-to-infant coupling during learning.

Beyond theoretical insights into early development, the authors noted practical takeaways for parents and caregivers. "As parents, we need to be conscious of the need to use social cues like eye contact and calling your child's name, as these cues don't just focus your child's attention, they activate the learning process," Leong said in the release.

"If you're on your phone and distracted when you're trying to give them instructions or teach them something, there's less of a likelihood that they'll take it seriously or learn compared to if you put your phone down and look them in the eye," Leong added in the release. "This is an important way of signaling your intentionality, your seriousness, that you want them to pay attention and learn something."

As with all research, there are some caveats to consider. The study involved a modest sample size of 47 infants for behavioral testing and 42 for brain recordings, meaning subtle effects in the partial gaze condition might be detected more reliably in larger groups. Additionally, the infants watched pre-recorded videos rather than interacting with a live adult, and the study did not test everyday interactions or phone use directly. Notably, infants in this study succeeded in learning statistical word patterns from video, in contrast to the 2003 findings where infants required live interaction to distinguish non-native speech sounds.

There are a few other things to keep in mind regarding the findings and measurements. The authors noted that eye contact may play a different role in communities where adult-infant interaction relies more heavily on touch and physical closeness, as observed in some Arab cultures. Methodologically, the researchers analyzed brainwaves within a single shared frequency band of 6 to 9 Hertz to meet computational requirements, even though adult alpha waves typically peak higher. Finally, while the statistical models highlight an association, experimental manipulations would be needed to establish whether neural coupling directly causes learning gains.

The study, “Adult-to-infant unidirectional neural coupling mediates selective social learning in infants from the United Kingdom and Singapore,” was authored by Wei Zhang, Kaili Clackson, Stanimira Georgieva, Lorena Santamaria, Vanessa Reindl, Valdas Noreika, Nicholas Darby, Vaka Valsdóttir, Priyadharshini Santhanakrishnan, and Victoria Leong.

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