

Babies sound off: The power of babble

There is more to the babbling of a baby than meets the ear. A handful of scientists are picking apart infants' utterances and finding that not only is there an ordered sequence of vocal stages between birth and the first words, but in hearing-impaired babies a type of babbling thought to signal an emerging capacity for speech is delayed and distorted.

"The traditional wisdom [among developmental researchers] is that deaf babies babble like hearing babies," says linguist D. Kimbrough Oller of the University of Miami (Fla.). "This idea is a myth."

Oller reported his latest findings on hearing and deaf infants last week at a National Institutes of Health seminar in Bethesda, Md. He and his colleagues demonstrated eight years ago that hearing babies from a variety of language communities start out by cooing and gurgling; at about 7 months of age, they start to produce sequences of the same syllables (for instance, "da-da-da" or "dut-dut-dut") that are classified as babbling and can be recorded and acoustically measured in the laboratory, with words or wordlike sounds appearing soon after 1 year of age. Babbling – the emitting of identifiable consonant and vowel sounds – usually disappears by around 18 to 20 months of age.

In a just-completed study, Oller and his co-workers found that repeated sequences of syllables first appeared among 21 hearing infants between the ages of 6 and 10 months; in contrast, these vocalizations emerged among 9 severely to profoundly deaf babies between the ages of 11 and 25 months. In addition, deaf babies babbled less frequently than hearing babies, produced fewer syllables and were more likely to use single syllables than repeated sequences.

The deaf infants, Oller notes, still vocalized quite a bit, employing about as many squeals, growls and raspberries (sticking out the tongue and blowing) as hearing infants. Yet while the latter group produced more and more repeated syllables soon after initial forays into babbling, the hearing-impaired babies tended to make sounds, such as "uh-uh-uh," indicating a lack of closure in the vocal tract that prevents transitions between syllables. These sounds, says Oller, may be a substitute for what he calls "canonical" babbling.

The Miami investigators use transcriptions of recorded vocalizations and maps of sound wave spectra to determine when an infant utters so-called canonical syllables. In their approach, a canonical syllable must have a consonant, a vowel of sufficient sound intensity, a duration of 100 to 500 milliseconds and a transition

between vowel and consonant lasting no longer than 100 milliseconds. When such a syllable is repeated, it becomes canonical babbling.

In the past 10 years, Oller has pioneered the use of acoustic rules to define the sounds that make up babbling. Most investigators, however, still transcribe infant utterances without the benefit of an acoustic analysis.

For instance, linguists Carol Stoel-Gammon and Kiyoshi Otomo of the University of Washington in Seattle recently evaluated sounds made by 11 hearing infants and 11 hearing-impaired infants, most of whom were followed from 4 to 18 months of age. Group differences in babbling similar to those described by Oller turned up, report the researchers in the February *JOURNAL OF SPEECH AND HEARING DISORDERS*, although vocalizations were transcribed without quantitative acoustic measurements.

But both Oller and Stoel-Gammon point out that auditory feedback appears to be critical for the development of canonical babbling. "It's not clear how important the practice of vocalization is," says Oller, "but hearing babies appear to be engaging in playful practice when they produce canonical syllables." In addition, a few reports on infants who cannot vocalize normally because of throat operations or cleft palates indicate that their speech acquisition is delayed.

The analysis of babbling, adds Oller, may eventually prove useful in identifying early language and hearing problems. Babies with hearing impairments and no other handicaps are difficult to diagnose, he explains, and often reach the age of 18 months before the problem is recognized and treated.

Hearing-impaired babies in his study were provided with hearing aids. By providing feedback, the devices help promote canonical babbling, says Oller, but the sounds that the babies hear are "a long way from audible speech transmission." Larger samples of deaf infants, he notes, will probably show that some engage in limited canonical babbling before 10 months of age, while others do not start babbling until after 25 months of age.

Research on infant vocalization is itself in its infancy, points out Oller. He plans to explore other differences in the sounds made by hearing and deaf infants, and wants to identify hearing babies who are babbling late so they can be checked for language problems as they grow older.

"The key point," says Oller, "is that canonical babbling gives us a way to say when an infant has reached the stage when rules for speech are being followed. This hasn't been considered important in studies of deaf babies, and many child development texts still portray as true the myth that deaf babies and hearing babies babble alike." — *B. Bower*

Scientists predict second Ruiz blast

Mass evacuation of the Nevado del Ruiz mountainside began June 13, the 39th day in a row that scientists detected ominous rumbling inside the volcano. Colombian officials – remembering the eruption on Nov. 13, 1985, when rivers of mud killed more than 22,000 people (SN:11/23/85,p.326) – want everyone out of the way before the next flare-up. They have told 25,000 people to move to refugee camps in Libano, 17 miles southeast of Ruiz.

The prolonged seismic activity in the mountain suggests that magma (molten rock) is moving near the surface. Increasing sulfur dioxide spewing from volcanic vents also indicates upward-moving magma. And recently, scientists have measured subtle changes in the volcano's shape, which may represent the heaving and sighing that precede a great volcanic cough.

"We think the likelihood of a further eruption within days or weeks is very high," says Hansjürgen Meyer, scientist in charge of the Observatorio Volcanológico de Colombia in Manizales, 18 miles northwest of Ruiz.

But scientists may be reading the signs wrong, Meyer says, because they know so little about Ruiz. "You can only do a very basic kind of forecast when you haven't been able to observe several cycles of a volcano's activity, and so far we have only seen one," he says.

Geologists try to infer the mountain's behavior from that of other subduction volcanoes – created by the melting of oceanic plates as they descend under continents – and from the geologic record in the rocks of Ruiz. They know, for example, that Ruiz belches clouds of ash and rubble, as Mt. St. Helens does, but it does not send out racing rivers of lava as do the rift volcanoes of Hawaii. They also know the 18,000-foot Ruiz has erupted 10 times in 10,000 years, and it almost always sets off mudflows, called lahars.

Direct measurements of Ruiz date only from late 1984, when mountain climbers began feeling earthquakes and seeing large plumes of gas. And it wasn't until July 1985 that four portable seismographs were put on the mountain.

On Sept. 11 there was a minor eruption of steam, ash and rock. Nobody was hurt, but the event led to increased surveillance of the volcano.

By October, geologists had installed additional seismographs and set up tiltmeters to record changes in the mountain's shape. But the volcano gave no sure signals that it would erupt. Even on Nov. 12, when geologists climbed to the summit to collect gas samples, they saw no signs of an imminent explosion.

The Nov. 13 eruption was much smaller



Nevado del Ruiz, in the Colombian Andes, erupted Nov. 13, 1985, setting off mudflows that killed more than 22,000.

in volume than the largest blast of Mt. St. Helens in 1980. But the lahars made it the second-worst volcano disaster of the century. (The worst was the 1902 eruption of Mt. Pelée in Martinique, in which 28,000 died.) Hot ash and gravel seared about 10 percent of the mountain glacier. Melted ice flooded down, gathering dirt and rubble on its way. In three hours, the towns of Armero and Chinchiná were washed out.

Ruiz then was quiet until late April, when seismic activity began to increase. On May 4, there began a series of harmonic tremors that lasted until June 14. On June 15 and 16, the tremors were replaced by a swarm of small earthquakes. On June 17, the tremors resumed.

It's difficult to tell exactly what the latest seismicity means, because it did not occur the same way last fall. Rumbling before the September eruption lasted only a week, according to David Harlow of the U.S. Geological Survey (USGS) in Menlo Park, Calif. Between Oct. 1 and Nov. 11, there was little seismicity. Tremors began again only two days before the Nov. 13 eruption.

Recent changes in the mountain's shape are puzzling as well, because there are few comparison data. Deformation measurements were taken for only one month before the November eruption. "We should have started measuring a year and a half ago so we would know how much the magma store grew before it erupted," says Norman G. Banks of the Cascades Volcano Observatory in Vancouver, Wash., who is project chief of the USGS team studying Ruiz. "We don't know if there is a much larger amount there still to be tapped." Generally, the more magma present, the more volcanic activity expected.

Some scientists have speculated that the lahars could be worse next time because they can flow through fresh, clean pathways. On the other hand, the ash layer from November might protect the ice cap from melting as quickly next time. Ultimately, the lahars will be determined by the size of the eruption, which scientists cannot predict, Harlow says.

As scientists study signs of eruption, Colombian government and Red Cross

officials try to persuade mountain residents to move. "Some insist on staying where they are, and some wait for government promises that they will be given other homes," Meyer says. Once the people are resettled, he adds, they are likely to stay away for years, until Ruiz completes its volcanic cycle. — M. Murray

Blitzing to win at computer chess

It took more than speed and processing power to win the world computer chess championship this week in Cologne, West Germany. After its first two games in a five-game tournament, CRAY BLITZ, the defending champion, was in trouble. It had just lost a game to a lightly regarded opponent. But a mid-tournament correction—the removal of four lines in a 28,000-line computer program—saved the day and the title. CRAY BLITZ became the first program in the tournament's 12-year history to repeat as world champion.

In the tournament, four of the 23 competing chess computers finished at the top with identical 4-win and 1-loss records. CRAY BLITZ won the championship over Hitech, BEBE and Sun Phoenix in a tie-breaking scheme.

CRAY BLITZ's initial problems stemmed from four lines that program developer Robert Hyatt, a graduate student at the University of Alabama in Birmingham, had inserted after testing some parts of his program on a VAX minicomputer and finding an apparent weakness in the way the computer evaluated pawn movements. But when the modified program was run on a CRAY supercomputer, which is fast enough to allow a much deeper search than a VAX, the effect was not unlike "putting glue on the bottoms of all the pawns," says Hyatt. That change probably led to the losses at last year's North American computer chess championship (SN: 10/26/85, p.260) and in this tournament.

But after the offending lines were removed, CRAY BLITZ started playing like a world champion again. "The difference in its play was striking," says Hyatt. The program swept through its next two games and seemed ready for its climactic match with favored Hitech, developed by Hans Berliner and his colleagues at Carnegie-Mellon University (CMU) in Pittsburgh.

The match took more than six hours. After about 60 moves, Hitech finally resigned. "We could feel it slowly slipping away," says CMU's Murray Campbell. But, he adds, "we're looking for our revenge in Dallas." That's where the North American computer chess championship will be decided in November.

— I. Peterson

OSHA tightens asbestos rules

New federal regulations intended to reduce the risk of death and disease from exposure to asbestos by 90 percent have received mixed reactions from labor and industry. The regulations were announced last week by the Occupational Health and Safety Administration (OSHA) and are scheduled to go into effect next month.

According to OSHA, the reduced risk derives directly from a 90 percent reduction in the acceptable level of asbestos exposure, from 2 fibers per cubic centimeter (f/cc) of contaminated airspace to 0.2 f/cc—more than the 0.1 f/cc level wanted by labor and less than the 0.5 f/cc level wanted by industry. Covering 1.3 million U.S. workers exposed to the cancer-causing fiber, the OSHA regulations for the first time specifically protect construction workers, who encounter asbestos in the renovation and demolition of old, asbestos-ridden buildings and who therefore suffer the highest risk of exposure. Under the new regulations, all workers must receive training in working safely with asbestos and must wear protective masks in regulated areas.

But "no mask is 100 percent safe," argues Jack Keane, safety officer for the Washington, D.C.-based International Association of Heat and Frost Insulators and Asbestos Workers. According to Keane, workers frequently take off their masks in contaminated areas, inhaling dangerous quantities of asbestos. Robert Percival of the Environmental Defense Fund in Washington, D.C., agrees: "OSHA's own inspection standards show quite high rates of violations of using the respirators."

Industry representatives, however, say the construction trades already adequately regulate worker exposure to asbestos. "In the renovation business, we've been doing it for a long time," says Dennis Bradshaw of the Associated General Contractors of America, based in Washington, D.C. The real problem of the new regulations, he says, is that they fail to recognize the variety of jobs encountered in construction. "They become a waste of time and money without any real benefit to the worker who isn't exposed to asbestos," he says.

Union leaders and environmentalists argue that no level of exposure to asbestos is safe and that the stricter regulations are only a stopgap measure. "The only way to protect the public," says Percival, "is to do what the Environmental Protection Agency [SN:2/1/86,p.70] is trying to do: Phase out asbestos products completely."

— T. Kleist

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