Behavior

Infants tune in to the sounds of music

The next time you go to a concert or crank up your stereo, consider this: Unconscious tendencies to perceive some types of music as more melodic and "in tune" than others may have taken root before your first birthday.

Just as previous research indicates that infants are born with the ability to perceive speech sounds from any language in the world, new data suggest that 6-month-olds innately perceive the structure of musical scales from a variety of cultures, report psychologist Michael P. Lynch of the University of Miami and his co-workers in the July PSYCHOLOGICAL SCIENCE.

By age 1, however, exposure to the music of one's own culture begins to shape musical perception, Lynch asserts. "People rapidly develop an unconscious cultural knowledge of what to expect when they hear music — what sounds reasonable and what sounds weird," he says.

Lynch and his colleagues composed computer-generated, seven-note melodies based on Western major and minor scales and the Javanese pelog scale. Each musical note corresponds to a certain number of sound waves per second, known as its frequency. Musical notes sound higher as their frequency climbs. In melodies based on Western scales, specific acoustic intervals between notes, called frequency ratios, regularly occur. Many Western scales exist, but popular and classical music rely predominantly on the major and minor scales. Javanese music often sounds strange to Western ears because it features different, more complex frequency ratios.

The Miami scientists studied 20 6-month-olds, 10 musically inexperienced adults, 10 amateur musicians and 10 professional musicians, all of whom live in the United States. Participants were tested in distinguishing a well-tuned version of a major, minor or pelog melody from one in which the fifth note was mistuned by raising its frequency. Adults first heard the well-tuned melody played continuously, with the fifth note periodically raised and played louder than the other notes. They then heard random presentations of well-tuned and mistuned melodies and raised their hands when they thought a mistuned version occurred.

Before testing, 6-month-olds were trained to notice a frequency increase of the fifth note in either the pelog or major melody. They identified fifth-note changes by turning their heads toward a loudspeaker, where an animated toy was activated after a correct response. The infants then heard both renditions of all three melodies and turned their heads to indicate mistuned versions.

Six-month-olds correctly classified melodies based on all three scales two-thirds of the time, regardless of whether they first heard the pelog or major tunes. But adults performed better overall on the two native Western scales, correctly classifying nearly three-quarters of them versus two-thirds of the pelog presentations. Professional musicians correctly noted pelog mistunings almost as often as major and minor deviations. "Experienced musicians may develop special abilities to deal with novel musical information," Lynch says.

In an unpublished study, his team has found that 1-year-olds often recognize mistuned melodies based on the major scale but are less successful with melodies derived from either the pelog or the Western augmented scale. The latter scale is rarely used except by a few jazz musicians. Between 6 months and 1 year of age, infants regularly exposed to specific musical scales apparently begin to perceive them as more "music-like" than other scales, Lynch maintains.

On the other hand, the success of 6-month-olds in perceiving pelog scales challenges the assumption of many music theorists that Western scales are inherently easier for the brain to process because they rely on mathematically simpler relationships between the frequencies of musical notes.

Earth Sciences

Icy sign of polar warming?

During the winter of 1987, ice covering the Arctic Sea north of Greenland was significantly thinner than during the winter of 1976, according to submarine measurements reported in the June 28 NATURE. From a single comparison like this, it's impossible to tell whether global warming is actually thinning Arctic ice. But scientists say the finding underscores the importance of monitoring ice thickness for early signs of the predicted climate change.

Peter Wadhams of the University of Cambridge in England examined data from upward-looking sonar on two British submarines that took similar routes across the Arctic Sea. One sailed in May 1987, the other in October 1976. From the sonar data, Wadhams estimates that the ice over a region about the size of Nevada had a mean depth of 5.3 meters in 1976 and 4.5 meters in 1987.

Some scientists have suggested that thinning ice in the Arctic would emerge as one of the first signs of global warming. However, Wadhams says the difference in thickness between 1976 and 1987 does not represent a general thinning due to warmer temperatures, but instead stems from a radical change in the pattern of ice drift. During the earlier period, he suggests, wind had blown ice toward Greenland, building up the ice cover in that region. But winds during the later observation period didn't blow the same way, and the ice cover did not thicken to the same extent.

Oceanographer Alfred McLaren from the University of Colorado in Boulder calls the new report intriguing, but mentions that the two submarines traveled during different seasons and did not follow exactly the same track. In general, he says, "we still don't know enough about what's going on up there to make sense out of it."

McLaren captained the U.S. nuclear submarine *Queenfish* in August 1970 when it measured ice extent across the Canada basin, following the course made by the U.S.S. *Nautilus* in August 1958. Last year, he reported that the mean ice cover was thinner in 1970 by 0.69 meters, though it remains unclear whether the difference reflects a long-term trend or just the normal variability between two years. McLaren thinks an answer to that question lies buried somewhere in the reams of submarine data taken over the last 32 years.

Superhot fluids from ocean bottom

Off the coast of Washington state, a field of seafloor geysers spews extremely hot brine out into the near-freezing ocean water. Just how hot the fluids are no one knows. While scientists aboard the submersible *Alvin* have measured temperatures above 400°C from a few of the vents, the great majority of such attempts have revealed temperatures below 350°C, leading researchers to question the accuracy of the higher readings. The latest experiment, however, supports the idea that vent fluids reach 400°C.

Margaret K. Tivey of the Woods Hole (Mass.) Oceanographic Institution and colleagues from the University of Washington in Seattle used a device containing 12 temperature gauges, or thermocouples, which they stuck directly on top of a seafloor vent. Over the next 46 days they measured the temperature of the gushing fluids. While the main portion of the flow showed a stable temperature of 353°C, several thermocouples recorded maximum temperatures between 365°C and 405°C, the researchers report in the July 5 NATURE. To explain their results, they suggest the vent had two outlets: one steady at 353°C and another one both hotter and more variable.

Tivey, who says the experiment was the first to monitor temperatures over a long period, hopes the new findings will help scientists improve their understanding of where and how vent fluids form deep below the seafloor.