

## THE CHRONICLE OF HIGHER EDUCATION

*Notes From Academe*

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<http://chronicle.com/weekly/v50/i11/11a05601.htm>**Listening Carefully**

By PETER MONAGHAN

San Diego

A short phrase of speech in Diana Deutsch's mellifluous voice, with its faded English accent, loops over and over from the loudspeakers in her sparse, windowless sound studio.

"Sometimes behave so strangely," comes the phrase.

"Sometimes behave so strangely."

And, strangely, after only a few repetitions, a striking effect emerges. With the rhythms and cadences of her voice, the sounds become undeniably musical.

"It matches to a simple melody playing in B major," exclaims Ms. Deutsch, still surprised years after she first noticed the effect.

"It shows that speech and music connect," she says, and then speculates: "It makes sense to me to think that originally speech" -- all speech, she means -- "was pitched as tones," the way Chinese and Vietnamese are today.

The auditory illusion is one of many that Ms. Deutsch, a professor of psychology here at the University of California at San Diego, has included on two compact discs, *Phantom Words and Other Curiosities* (Philomel Records), which has just appeared, and *Musical Illusions and Paradoxes* (Philomel Records, 1995).

The illusions range from the beguilingly simple to, as she says, "true weirdness, the twilight zone." Appropriately, then, her first disc's introduction has a tinge of Rod Serling as she intones: "In listening to this CD, you enter the curious and paradoxical world of illusion. The sounds as they appear to you are not only different from those that are really present, but they sometimes behave so strangely as to seem quite impossible."

In her laboratory, sitting at a bank of amplifiers, speakers, and other sound-system components, Ms. Deutsch cues up what she calls the "octave illusion." Through headphones, high tones sound in one ear, low tones in the other. But when the earphones are switched, the high and low tones are heard in the same ears as before.

In fact, Ms. Deutsch reveals, the same pattern of alternating high and low tones is sounding in each earphone. For some reason, the listener's ears create "the peculiar impression that the high tone has migrated from one earphone to the other," and the low tone, too, in the opposite direction. "It was a shock," she says. "It was unbelievable [to stumble on that illusion]. It wasn't known at the time. I thought, 'Am I crazy? Has the world

gone crazy?"

As simple as the pattern is, it is hardly ever heard correctly. Ms. Deutsch has found that, because of differences in which hemisphere of the brain dominates, right-handers tend to hear the high tones on the right, the low tones on the left, while left-handers' experience varies.

Another illusion, which Ms. Deutsch calls the "tritone paradox," is one that confuses even accomplished musicians. Her computer creates an organlike sound equivalent to, say, all six C's on the piano keyboard. That is followed by the sound of all six F sharps -- half of an octave away. When some subjects listen to that tritone, they hear an ascending pattern. Others, listening to the same tritone, hear a descending pattern.

"There is no correct answer," says Ms. Deutsch, "the ambiguity is built into the tones themselves." The effect, Ms. Deutsch believes, stems from the way people perceive and store musical scales in their brains. Each note in a particular scale resembles its counterpart in other octaves -- all the C notes, for example, sound like C notes. Whether or not they have any musical training, Ms. Deutsch conjectures, listeners have their own mental image, like a clock, of which notes of any octave are the "highest," regardless of actual pitch. So, when they hear two notes that are half an octave apart, the first may sound higher, or lower, than the second.

What is going on? Clearly, says Ms. Deutsch, when it comes to hearing, "we pick and choose how to bundle things together, rather than admit chaos." It would appear that some part of our hearing mechanism registers pitch, another where sounds are coming from. Sound may be thought of as a bundle of attributes that can fragment, she says, so that one may hear tones in the "wrong" ear. The human auditory system is apparently more loosely constructed than the visual system, so "in the lab you can propel it into absurdities, even though mostly, in everyday life, it works well."

Ms. Deutsch is tirelessly enthusiastic about hearing and sound. As a teenager, she hoped to become a professional pianist, but her parents persuaded her to pursue a more-certain financial future. She went to the University of Oxford and performed extremely well in psychology and philosophy, then came to California to earn a doctorate here at San Diego.

She arrived just when computers were beginning to be used to manipulate sound, facilitating researchers' ability to analyze what, and how, people hear.

The earliest illusion she wrote about, in the journal *Science* in 1970, may have implications for neuropsychology. "You'll hear two tones, with a series of tones, or words, intervening," she says, as she cues up another track of *Phantom Words*. "Try to remember whether the last tone is higher or lower in pitch than the first." The task proves much harder when other tones intervene than when words do. Cognitive and neuropsychologists have encouraged Ms. Deutsch to pursue the implications of that finding for understanding memory and for diagnosing the early signs of Alzheimer's disease.

Some of Ms. Deutsch's research reveals the links among hearing, music, and language acquisition. She is, for example, studying the incidence of perfect pitch -- the ability to consistently recognize and repeat sounds of a particular pitch -- in speakers of languages such as Chinese, in which words have different meanings depending on whether the syllables rise or fall in inflection. She and colleagues are studying populations of students at the University of Rochester's Eastman School of Music and a music school in Beijing to see if the Chinese students, who acquired perfect pitch for speech as infants, later tend to possess it for music. "It doesn't ring true that only some people would have perfect pitch," she says. It may, she says, be possible to help infants acquire the ability.

The acquisition of toned speech, and of music, is strongly influenced by culture. A population of speakers

agrees that certain sounds constitute certain words. One of Ms. Deutsch's illusions with cultural aspects always confuses and even bothers her test subjects, including whole classes of her students here. In the "phantom words" illusion, she plays fragments of words over and over. Different listeners hear different words emerge from the mesmerizing sequences of garbled fragments. In fact, many insist that she must have implanted the words they hear in the patterns. "People really do believe their own perceptions," says Ms. Deutsch. "That's how magicians manage, isn't it? But perception is not as good as people think it is. When people are told they've heard something else, some think it's incredibly funny. But sometimes I get anger."

Subjects for whom English is a second, but fluent, language, often hear words in the language they first learned. Such is the power of early linguistic experience, Ms. Deutsch says.

She also finds interesting differences between men and women. Many women hear words related to romance, or "words like 'no pie,' and 'Diet Coke,'" she says. "You can tell who's dieting."

And the men? "They tend to hear things that make them ask me if it's OK to say them in polite company."

She is testing her belief that the phantom-words illusion acts like a kind of auditory Rorschach test, diagnostic of people's states of mind. People suffering from depression tend to hear words like "attack," "blood," and "I'm dying," she says. "The data so far is sufficient to convince me without any doubt that this is going on."

For another truly bizarre auditory illusion, or hallucination, she has no firm hypothesis, but is gathering data. Some people, usually elderly, constantly hear music -- not, say, the ringing of tinnitus, but actual tunes. In fact, of the dozens of people in several countries who have reported their experiences of this as-yet-unnamed syndrome to her, almost all hear male choirs singing patriotic songs, or a single male, baritone voice. Talk about a twilight zone.

Those with the syndrome show no signs of psychiatric illnesses or brain tumors; they simply hear singing. "It's externalized music; it's not tunes running around in your head," says Ms. Deutsch.

"Some people don't mind, and even find the music pleasant," she says.

"But with most people, it drives them nuts."

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