Striking the right note

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Perfect pitch is a rare talent possessed solely by the likes of Beethoven, Frank Sinatra and Ella Fitzgerald, right? Wrong, as Kathryn Brown discovers, it's turning up all over the place

ELIZABETH WEST MARVIN can always tell which music students have perfect pitch. They don't necessarily play any differently from her other students, and they may not always lead the chorus. But they are the ones who immediately get distracted when the fluorescent lights above their heads start vibrating with an electrical hum somewhere between B and B-flat.

The uncanny, if sometimes distracting, ability to name a solitary note out of the blue, without any other notes for reference, is a prized musical talent—and a scientific mystery. Musicians with perfect pitch—or, as many researchers prefer to call it, absolute pitch—can often play pieces by ear, and many can transcribe music brilliantly. That's because they perceive the position of a note in the musical stave—its pitch—as clearly as the fact that they heard it. Hearing and naming the pitch go hand in hand.

By contrast, most musicians follow not the notes, but the relationships between them. They may easily recognise two notes as being a certain number of tones apart, but could name the higher note as an F only if they are told the lower one is a C, for example. This is relative pitch. Useful, but much less mysterious.

For centuries, absolute pitch has been thought of as the preserve of the musical elite. Some estimates suggest that maybe fewer than 1 in 2000 people possess it. But a growing number of studies, from speech experiments to brain scans, are now suggesting that a knack for absolute pitch may be far more common, and more varied, than previously thought. "Absolute pitch is not an all or nothing feature," says Marvin, a music theorist at the University of Rochester in New York state. Some researchers even claim that we could all develop the skill, regardless of our musical talents. And their work may finally settle a decades-old debate about whether absolute pitch depends on melodious genes -or early music lessons.

Music psychologist Diana Deutsch at the University of California in San Diego is the leading voice. Last month at the Acoustical Society of America [Ref: Animals7:{Human capabilities of Echo removal}:Animals3 {Snap crackle and milli-pop}]meeting in Columbus, Ohio, Deutsch reported a study that suggests we all have the potential to acquire absolute pitch-and that speakers of tone languages use it every day. A third of the world's population-chiefly people in Asia and Africa-speak tone languages, in which a word's meaning can vary depending on the pitch a speaker uses.

Deutsch and her colleagues asked seven native Vietnamese speakers and 15 native Mandarin speakers to read out lists of words on different days.The chosen words spanned a range of pitches, to force the speakers to raise and lower their voices considerably. By recording these recited lists and taking the average pitch for each whole word, the researchers compared the pitches used by each person to say each word on different days.

Both groups showed strikingly consistent pitch for any given word-often less than a quarter-tone difference between days. "The similarity," Deutsch says, "is mind-boggling." It's also, she says, a real example of absolute pitch. As babies, the speakers learnt to associate certain pitches with meaningful words-just as a musician labels one tone A and another B-and they demonstrate this precise use of pitch regardless of whether or not they have had any musical training, she adds.

Deutsch isn't the only researcher turning up everyday evidence of absolute pitch. At least three other experiments have found that people can launch into familiar songs at or very near the correct pitches. Some researchers have nicknamed this ability "absolute memory", and they say it pops up in other senses, too. In a 1994 study, for example, Svein Magnussen and Stein Dyrnes of the University of Oslo in Norway found an absolute memory for visual images, showing that people could pick out complex black-and-white line designs they had seen hours or days earlier from a selection of very similar ones.

Given studies like these, the real mystery is why we don't all have absolute pitch, says cognitive psychologist Daniel Levitin of McGill University in Montreal. "I don't have to run to a rainbow and find red to tell you that a tomato is red," Levitin says. "There are 10 basic colours that everyone can name immediately. Well, there are 12 basic pitches. If we can label all those colours, why can't we label all those pitches?" Levitin suspects he knows the answer. Absolute pitch, he says, is really a two-step process: pitch memory and pitch labelling. It's not that people with absolute pitch are genetically endowed with a keener sense of pitch perception, Levitin says-after all, many of us can recall a note nearly perfectly immediately after we hear it. But people with absolute pitch automatically connect the memory of a pitch with a label. Some even describe different pitches as having distinct "colours" or "characters".

Lacking absolute pitch, most of us can't make that connection-labelling a note as "D", for example. But do the connections and labels get hammered in during music lessons, or are some babies just born with a flair for identifying pitch? That's a hard question to answer, since musical parents often pass a passion for music-as well as their genes-on to their children.

Over the past decade, researchers have confirmed that absolute pitch often runs in families. Nelson Freimer of the University of California in San Francisco, for example, is just completing a study that he says strongly suggests the right genes help create this brand of musical genius. Freimer gave tone tests to people with absolute pitch and to their relatives. He also tested several hundred other people who had taken early music lessons. He found that relatives of people with absolute pitch were far more likely to develop the skill than people who simply had

the music lessons. "There is clearly a familial aggregation of absolute pitch," Freimer says.

Blossoming talent

Freimer says some children are probably genetically predisposed toward absolute pitch-and this innate inclination blossoms during childhood music lessons.

Indeed, many researchers now point to this harmony of nature and nurture to explain why musicians with absolute pitch show different levels of the talent. "The early learning period-from about three to six years of age-is critical" says Marvin. But lucky genes probably help, she adds. Indeed, researchers are finding more and more evidence suggesting music lessons are critical to the development of absolute pitch. In a survey of 2700 students in American music conservatories and college programmes, New York University geneticist Peter Gregersen and his colleagues found that a whopping 32 per cent of the Asian students reported having absolute pitch, compared with just 7 per cent of non-Asian students. While that might suggest a genetic tendency towards absolute pitch in the Asian population, Gregersen says that the type and timing of music lessons probably explains much of the difference.

For one thing, those with absolute pitch started lessons, on average, when they were five years old, while those without absolute pitch started around the age of eight. Moreover, adds Gregersen, the type of music lessons favoured in Asia, and by many of the Asian families in his study, such as the Suzuki method, often focus on playing by ear and learning the names of musical notes, while those more commonly used in the US tend to emphasise learning scales in a relative pitch way. In Japanese preschool music programmes, he says, children often have to listen to notes played on a piano and hold up a coloured flag to signal the pitch. "There's a distinct cultural difference," he says.

If the right genes and music lessons do prompt people to label tones in a fundamentally different way, then this cognitive difference should show up in their brains. As indeed it does. In a 1998 study neuroscientist Robert Zattorre of the Montreal Neurological Institute in Canada ran positron emission tomography (PET) scans of musicians with and without absolute pitch while they listened to tones.

When asked to label a tone, the musicians lacking absolute pitch had a flash of brain activity in the right frontal cortex-an area associated with working memory and comparing incoming sensory information with memories. By contrast, the musicians who had absolute pitch could identify tones without accessing working memory at all. Instead, they showed a spark of brain activity high in the left frontal cortex-a region related to long-term memory. Zattore suggests that the absolute pitch users were tapping into a more deeply ingrained pitch template that they developed during childhood lessons.

A study led by musicologist Laura Bischoff of Shepherd College in West Virginia also shows that people with the strongest absolute pitch skills can name notes without working memory. Bischoff and her colleagues gave 32 music students-half of whom had absolute pitch-a series of tone tests while the students wore a jumble of scalp electrodes. The researchers were looking for a working memory marker: the P300, a positively charged waveform that flashes across the brain 300 milliseconds after a surprising stimulus. The P300 is thought to indicate a comparison of incoming sensory stimuli-such as a new tone-with memorised information, in this case a musical scale.

During one test, the students listened to a typical scale, trying to guess whether the note being played fitted within the scale. At first, the notes would build predictably, neatly forming a scale in the key of C. But then a tone would jump out of scale, falling unexpectedly flat or sharp. Scrambling to name that errant tone, the students without absolute pitch showed a P300 surge, as expected, while most of the students that had absolute pitch did not.

But the experiment also showed how varied a talent absolute pitch can be. Four of Bischoff's absolute pitch students showed brain wave patterns more like those in the control group. Further tests revealed that these absolute pitch students alternated between absolute and relative depending on the task at hand.

The lesson,Bischoff says, is that absolute pitch is not a one-fits-all talent. Some people have an acute sense of absolute pitch, while others show just a hint of the skill. And some absolute pitch possessors use it only occasionally, flipping back to relative pitch when that skill is more useful.

A bit of both

That doesn't surprise Philip Chang, a music theory graduate student at Rochester. While he's had absolute pitch since he was a child, Chang has also had training that hones relative pitch skills- practising scales, recognising intervals and so on. "I just use what's helpful," he says.

But can anyone develop absolute pitch? Bischoff thinks so. "Our studies tie right in with the idea that we all have this latent absolute pitch ability, but we can't get fully bloomed absolute pitch without early childhood training," says Bischoff.

But some scientists are more cautious. After all, if everyone remembered pitches, but just couldn't label them, we'd immediately know if something was played in an unusual key, or if two songs started on the same note, says psychologist Andrea Halpern of Bucknell University in Lewisburg, Pennsylvania. These feats, she says, are reserved for people with absolute pitch.

Similarly, linguists are wary of the idea that consistently speaking in a given pitch range somehow reflects absolute pitch. People naturally settle into a comfortable range while talking, says Rebecca Herman, a linguist at Indiana University. Deutsch counters that this "comfort zone"

argument can't explain the exceedingly small differences in pitch among her speakers.

Indeed, Deutsch predicts that further studies will reveal absolute pitch-in its imperfect, latent form-inside all of us. The Western emphasis on relative pitch simply obscures it, she contends. "It's very likely that scientists will end up concluding that we're all born with the potential to acquire very fine-grained absolute pitch. It's really just a matter of life getting in the way."