Tone deafness and perfect pitch

BY CHRIS ALDREN

If you think you are tone deaf, do not despair. Singing tuition should help but it is probably too late to hope to develop perfect pitch. Consultant otolaryngologist and keen musician, **Chris Aldren**, discusses the complex and fascinating subject of amusia and music perception.

Sitting in my kitchen writing this article, listening to Mahler Symphony No.2 it is hard to imagine the world of a patient suffering from amusia. As a violinist and otologist with three professional musician children, all with perfect pitch, I find the world of musical disability, and all it tells us of our higher auditory functions, troubling but fascinating. A recent introduction to the work of Diana Deutsch on auditory illusions has been enlightening [1].

Amusia

Tone deafness is the inability to distinguish musical pitch and is a form of amusia. It is less common than generally thought, at around 4%. Many people who say they are tone deaf have just never been taught to read music or encouraged to sing. Indeed, many may have been told they were tone deaf at an early age and unfairly confined to the choral dustbin. With training, many of these people can sing in tune - so if that is you, don't give up. The TV work of Gareth Malone has produced amazing vocal results from groups of initially unpromising singers.

Amusia can be congenital or acquired, the latter as a result of brain injury. Right hemisphere strokes tend to lead to problems of pitch perception whilst left sided lesions can lead to inability to recognise rhythm without affecting pitch.

Whilst amusia includes abnormalities of pitch perception, patients can also have discrete deficiencies in other musical abilities such as rhythm, melody and harmony.

Isabel Peretz in Montreal has done lots of work on amusia: media advertising allowed her to recruit a group of lifelong congenital amusics [2]. All were graduates and had had formal musical education in childhood. They were self-reported as having no musical ability for as long as they could remember. Screening removed those who were just underestimating their own ability. The test group showed significant and specific defects in ability to differentiate pitch and rhythm when compared to normal controls who were not actively involved in music. The amusical group also lacked ability to remember tunes. They were unable to distinguish which of a series of well-known tunes had an incorrect pitch placed within it. They lacked the ability to recognise dissonance. Interestingly however, they were able to recognise speech-including where pitch variation was essential to meaning-and environmental sounds as well as the controls, suggesting they had a specific musical disability.

Amelodia or tune deafness

In his excellent book *Musicophila*, neurologist and amateur musician, Oliver Sacks, describes some fascinating cases of acquired amusia [3]. One was a professor of music in his 90s who had played double bass in the New York Philharmonic under Toscanini. He suffered a stroke of his right hemisphere and found, although he still had excellent recognition of pitch and rhythm, he was unable to recognise melody. Even simple melodies such as *Happy Birthday* were unrecognised. He was however, able to read music and could recognise melody from the musical score and even hum the tunes. He therefore appeared to have an acquired amelodia due to an auditory processing anomaly.

Dysharmonia

Sacks describes another gifted musical performer and composer who was in a coma for some days following a road traffic accident and severe head injury. When she came around she had lost the ability to integrate harmonies. Whilst she had fortunately retained her intellectual abilities and her linguistic skills, she heard a string quartet as four independent 'laser beams of music', unrelated to one another. She describes in detail this agonising inability to integrate individual musical voices and recounts hearing an orchestra as 20 separate tunes.

Perfect or absolute pitch is the ability to recognise the pitch of a note and name it without reference to an external known source. Whilst rare in the general population at one in 10,000 it is much more common in trained musicians, especially if they started their musical training early in life. It is thought that most people have the ability to have absolute pitch if trained in the first few years of life. It is found more frequently in countries with tonal languages, such as Mandarin. Diana Deutsch studied music students in New York and Beijing, all of whom had had formal music training from the age of five. She found rates of perfect pitch of 60% in the Chinese speakers and 14% in the US non-tonal speakers.

Some studies have shown perfect pitch rates of up to 50% in children born blind or blind from infancy.

Do we all hear the same?

We are all aware that colour perception is not absolute. Remember the 2015 Twitter storm over the gold / white black / blue

"Many may have been told they were tone deaf at an early age and unfairly confined to the choral dustbin."

"What we perceive appears to be related to our native language and dialect and there are considerable differences between different groups."

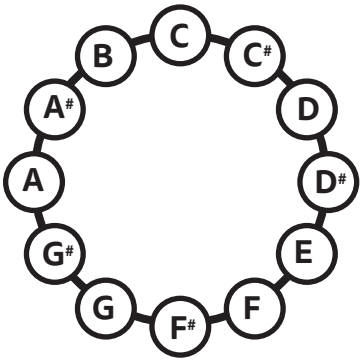

Figure 1: The pitch class circle. This corresponds to the 12 semitones within the octave. In experiments on the Tritone Paradox, pairs of tones are played that are opposite each other along the circle, such as A to D#, or F to B.

wedding dress [4]? You may not therefore be surprised to learn that the same is true for pitch perception.

When teaching the Garsington opera chorus, I was fascinated to see their reaction to Diana Deutsch's Tritone Paradox [1]. In this test, listeners are played computer generated tones followed by another, separated by half an octave or opposite on the pitch class circle (Figure 1). They are then asked to say whether the notes rise or fall. The notes themselves are not pure tones but Shepard tones, which are a careful blend of octave related notes. For example the note A may be a blend of 440Hz with 880Hz, 1760Hz, 220Hz and 110Hz. Whilst most individuals, especially musicians, can clearly detect whether the notes they hear go up or down, there is considerable variation between them, much to the consternation of the Garsington chorus. I asked them, "How can you hope to sing together if you can't even agree which way the notes are going?"

What we perceive appears to be related to our native language and dialect and there are considerable differences between different groups. Deutsch compared English speakers who had grown up in California with those who had grown up in the South of England. These two groups differed substantially in how they heard the Tritone Paradox: frequently when a Californian subject heard a pattern as ascending, a subject from the South of England heard the identical pattern as descending, and vice versa (Figure 2).

Conclusion

Whilst, as ENT surgeons and audiologists, we tend to concentrate on the mechanics of the ear, the interesting stuff is how the brain processes the auditory signal. The perception of music is complex and fascinating and our understanding is currently rudimentary.

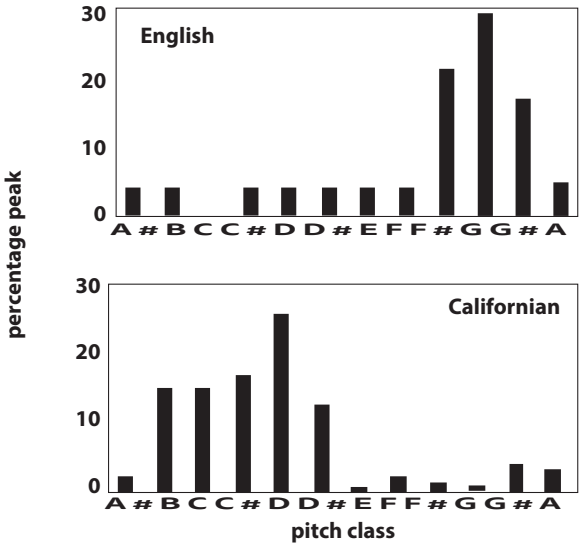

Figure 2: Distributions of peak pitch classes in two groups of subjects. One group had grown up in the South of England, and the other group had grown up in California. The two groups heard the Tritone Paradox in strikingly different ways.

Summary

- True amusia is rare at 4%.
- Most so called tone deaf people can sing in tune with tuition.
- Perfect pitch is probably innate and is more common in adults who have received musical tuition early in life.
- Pitch perception is not uniform and is influenced by native language and dialect.

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None declared.

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Chris has a special interest in otology, especially stapedotomy and ossiculoplasty. He is currently President of the British Society of Otology and past President of LION (Live International Otolaryngology Network). He is a keen musician with three professional musician sons. Chris is an amateur violinist and plays in the European Doctors Orchestra. He is ENT advisor to the London Philharmonic Orchestra and is on their Advisory Council.