Singing is a Human Right for a Child (Part One)

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In the first part of my book *A Choir in Each Classroom* I detailed the reasons for my statement that *every child that can speak can also sing*.

In September 1978, the International Conference on Primary Health Care was held in the city of Alma Ata (now Almaty) in Kazakhstan, organised by the UN, UNESCO and UNICEF. 134 countries and 67 non-governmental organisations took part, and the end result was a declaration expressing the urgent need for action by all governments, health workers and the international community to protect and promote primary health care for all people.

The first article of the declaration establishes:

> *The Conference strongly reaffirms that health, which is a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is a most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector.*

By extension it is fair to say that singing is a human right for a child as it meets all the requirements of physical, mental and social wellbeing, factors which each play a full part in the development of a human being capable of living in a society, being accepted by it and contributing to its development. You may perhaps respond by saying that there are many ways to generate physical, mental and social wellbeing, and that communal singing may not be the most complete way of doing so. If this is your response, allow me to disagree.

An immense number of investigations have been carried out in this field, resulting in a wide range of sources demonstrating that communal singing is a crucial tool in the development of an individual. To this I would add that it is, in fact, the best and most complete tool to achieve it.

The SAT is a standardised test for entry into many colleges in the US. The College Board, a non-profit organisation founded in 1900, has carried out many of these investigations and found that students who participated in musical activities and choirs achieved language scores 63% higher and maths scores 44% higher than those who did not have this experience. In 2009 the SAT scores showed a difference of 91 points between students who had 4 years of musical and choral experience and those who had none.

Harvey’s Interactive, a US business, found that college students who took part choral and musical activities graduated at a rate of 90.2%, whereas the graduation rate for students who did not was 72.9%.

These statistics demonstrate the impact choral singing and musical experience can have, but it has much more to offer in terms of social wellbeing. More than anything else, it is awareness of the scientific reasons established by researchers from all around the world that is key in convincing teachers, educational authorities and governments of the benefits of implementing schemes which will indisputably improve children’s learning and further their social development.

It is interesting to review some of the significant numbers of studies which have given us valuable insights into this area and made contributions of great significance. We have had the good fortune to correspond and consult with some of the researchers, and for others the extracts we have from their publications in scientific journals tell us everything we need to know. My aim here is to show you, dear readers, some of the research used to make the case that singing is a human right for a child as a result of everything it contributes to their intellectual, social and evolutional development.

Musical sounds, like all aural signals, are produced in time. This makes it necessary for the auditory system to connect one sound with another to produce logical patterns which are perceived as music. To recognise rhythmical patterns and a succession of connected sounds in musical patterns, aural signals are temporarily stored in a person's memory, which combines them into one single perception. Memory, then, is needed to understand and perceive music and it is used every time we listen to or make music.

Recently, Vanessa Sluming and other researchers[1] from the University of Liverpool found that musicians have a larger amount of grey matter in the frontal cortex, which is known to contain neural networks involved in various important processes relating to working from memory, than non-musicians. One might conclude that there is some kind of positive transfer between musical practice and verbal memory functions; in other words, that the process of learning music improves learning verbal objectives. But how do these functions relate to each other?

Firstly, according to a study conducted by Dr Wong[2] and other researchers from the Northwestern University in Illinois, "In the multisensory process of musical training, the brain carries out the same communication skills necessary for speaking and reading." That is to say, the neural pathways used in speech (Fig. 1) are the same as those used in singing. This establish a major initial link.

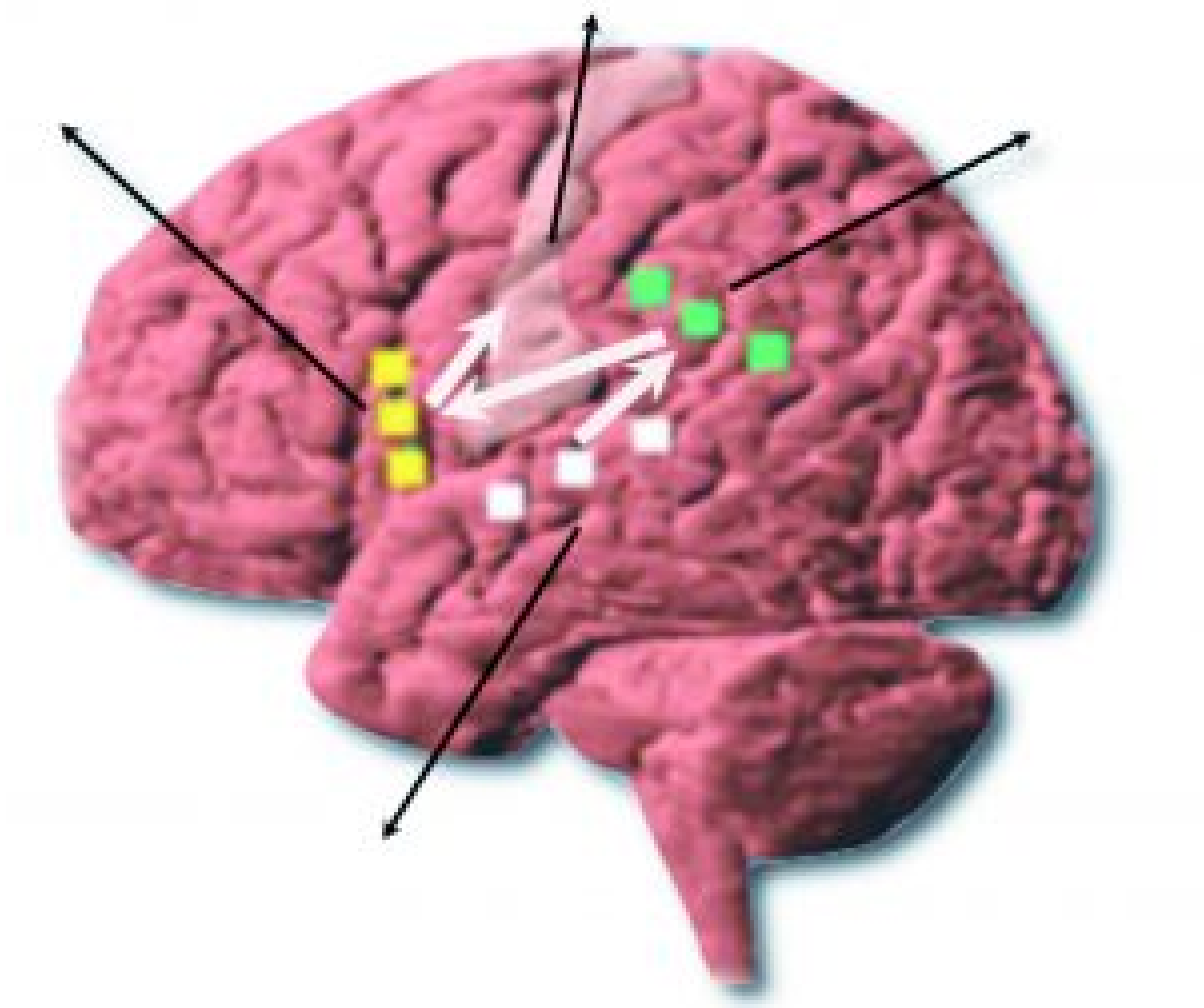

Figure 1: Neural pathway for speech

The image shows the pathway for the production of speech, where we can see the areas which are involved, the route which the stimulus takes and the functions performed by each area. This is how, once they have passed through the ear drum, aural stimuli are recorded by the organ of Corti and transformed into a neural language. This travels to the auditory cortex, responsible for receiving information, from where it is sent to Wernicke’s area to be decoded. The information is then sent to Broca’s area to be processed, and finally it reaches the motor cortex, where commands are generated and directed to the muscles necessary for producing both sounds, for speech, and tones, for singing.

From an anthropological point of view, articulated speech constitutes one of the main differences between humans and their inferior related species. Irrational animals do not think; they act on their instincts and on their conditioned and unconditioned reflexes. By contrast, individual humans can consider and resolve situations by thinking about their individual and collective experience. As such, unlike all other animals, humans can plan their actions and carry them out using language, as without language all thinking can only be rudimentary. Abstracting language is necessary to discern, associate, unify concepts and draw conclusions. In short: it is the tool which requires the brain to think, perceive, reason, imagine and call on memory.

Unsurprisingly, there is a wide range of theories concerning language and thought, but in whichever case, whether you believe there is an "innate system" of language structuring as proposed by Noam Chomsky which he calls "generative grammar", you adhere to the cognitive hypothesis proposed by Jean Piaget, or you subscribe to the "simultaneous" theory which defines language and thought as inherently linked, the relation between the two has been established by psychologists, linguists and anthropologists. Generically speaking, the differences are based on the origin and development of these human abilities.

Our position, though, is closest to the simultaneous theory. Before or after the development of thought, it is language that is responsible for the evolution of thought:

If we plan to construct a wooden table, we need to think of the abstract object, which implies tree, wood, table, shape, length, width, height, thickness etc. Each of these concepts implies the use of words whose meaning we understand and can be stored in our memory, to be recalled when we need them. We can then put these concepts down in a drawing and use all means necessary to translate it eventually into the table object. This entire thought process uses language – without it, the planning would not have been possible.

Of course, language is not the only cognitive ability we have. Memory, perception, reasoning, thinking, the ability to perform calculations and all other abilities or intelligent behaviour constitute a combination of specialised systems interacting with each other. This theory of multiple intelligences was developed by US psychologist Howard Gardner in 1943[3], based on the fact that every human being has at least seven cognitive intelligences or abilities.

A programme is being developed at the University of Southern California by Dr Assai Habibi and other researchers, with the aim of finding the mechanisms through which musical training has been associated both with above-average development in language and mathematical skills and with better academic performance among those individuals with musical training compared with those without it.

The study, launched in 2012 in collaboration with the Los Angeles Philharmonic Orchestra and its children's/youth orchestral programme, looked at children before they began musical training and studied them systematically to establish how their brain activity changed in relation to their training. 80 children between the ages of 6 and 7 were tracked to document the effects on their development using electrical brain activity, emotional, cognitive and social measurements. These children were divided into three groups: one in the aforementioned orchestra, one given football training and the third with no specific activity.

The results obtained at the time of writing have been highly satisfactory, as frontal areas in the brain have been found which showed greater nerve activity during the performance of abilities in which executive motor functions were involved, and greater development in language, memory and social activity has been discovered.

"Emotion, expression, social skills, theory of mind, linguistic and mathematical skills, visuospatial and motor skills, attention span, memory, executive functions, decision making, autonomy, creativity, emotional and cognitive flexibility… all this converges simultaneously in the shared musical experience. People sing and dance together in every culture. We know that we do it today, and we will continue to do it in future. We can imagine that our ancestors, too, did it around the fire thousands of years ago. We are who we are with music and thanks to music, no more, no less." These powerful words were written by Dr Facundo Manes in Spanish newspaper El País on 11 November 2016 in a science column entitled What does music do to our brain?

However, some elements, many of them of great significance, seem to contradict this idea. There are disorders which damage the functional logic of singing, seemingly caused by the absence or incomplete development of neural connections.

One of these disorders, and perhaps the most frustrating, is *amusia*.

AMUSIA

The term *amusia* was coined in 1888 by German neurologist August Knoblauch, using the Greek negative *a* and *mousa* (music). *Amusia* is a congenital tonal deafness. A person with amusia lacks the ability to produce tones, and as such cannot make or recognise music. According to Catalan researcher Jordi Peña-Casanova[4], "*it is similar to aphasia and shares many of its characteristics.*" Listening to or playing music involves many processes, all related to perceiving, decoding and synthesising sound and time, and this means that there are many different forms of amusia. In 1977 Arthur Benson[5] identified more than a dozen. They are distinguished by the manner in which they manifest themselves: motor or expressive, e.g. loss of the ability to sing, whistle or hum a melody with a closed mouth (oral/expressive amusia), loss of the ability to play an instrument (musical apraxia or instrumental amusia), loss of the ability to write music (musical agraphia). These last two can only occur in trained musicians. On the receptive side there can be a loss of the ability to detect different known melodies (receptive or sensory amusia), loss of the ability to identify familiar melodies (amnesic amusia) or loss of the ability to read music having previously been able to (musical alexia). A change in the emotional response to music is also a form of amusia. Historically, a lot of attention has been paid in medical circles in recent times to this problem when it has appeared in patients with aphasia, who have lost some of these abilities in addition to losing their speech skills. However, there are also documented cases of amusia from the 19th century in patients who did not have aphasia, though they are fewer in number. When Benson described amusia in relation both to Broca’s and Wernicke’s area in 1977, he did not have the technology or knowledge necessary to enable him to make the same assertion as Peña-Casanova in 2007, thirty years later, regarding the similarity with aphasia. What is certain is that both centres integrate the neural pathway required for speech.

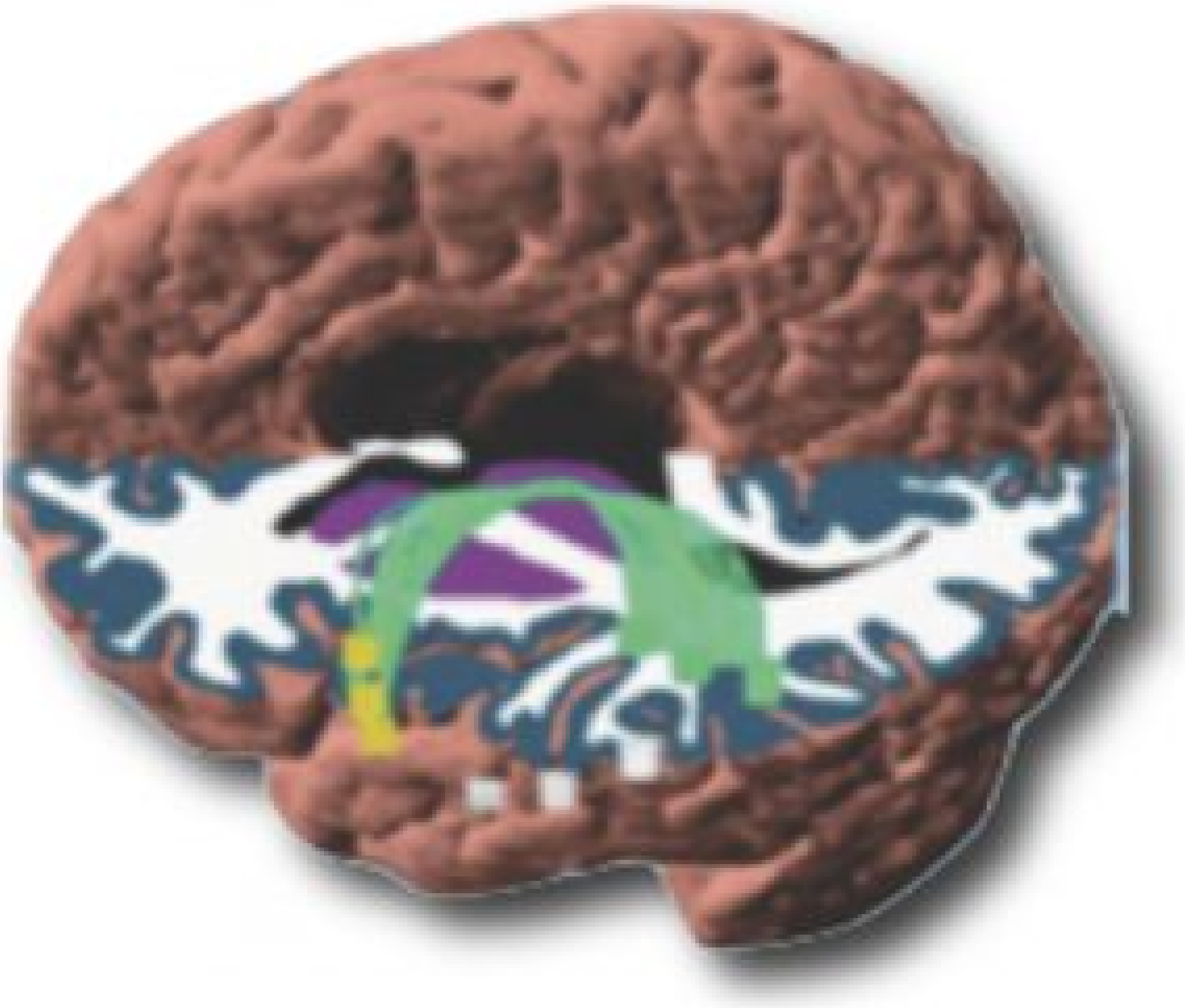

Figure 2: Arcuate fasciculus (in green)

According to Oliver Sacks[6],

“There are forms of rhythm deafness, slight or profound, congenital or acquired. Che Guevara was famously rhythm-deaf; he might be seen dancing a mambo while the orchestra was playing a tango (he also had considerable tone deafness). But, especially after a left-hemisphere stroke, one can develop profound forms of rhythm deafness without tone deafness (just as, after some right-hemisphere strokes, a patient may develop tone deafness without rhythm deafness). In general, though, forms of rhythm deafness are rarely total, because rhythm is represented widely in the brain.”

A paper written by Erin Hannon and Sandra Trehub[7] explores cultural forms of rhythm deafness. 6-month-old babies can easily detect all rhythmical variations, but at 12 months this variety has reduced. The same results were obtained in an investigation carried out by Clifford Madsen from the University of Tampa, Florida, which corroborated that a child hears all the sounds which surround them until the age of six months. They then only hear sounds which come from their mother. It seems that focusing on and reducing aural content is a product of the child's recognition of the cultural and family background transmitted to them through their social environment, as they can already internalise their culture's pattern of rhythms and the language of their mother.

Many people may think "I am incapable of singing or whistling in tune" although they do not suffer from amusia. In reality it is unlikely that they have amusia, as less than 5% of the population suffer from it. But those who do suffer from it can live their life unaware of their inability to sing in tune.

The investigation carried out by Dr Psyche Loui and other researchers from the University of Harvard[8] came to the conclusion that amusia is a product of incomplete development of the arcuate fasciculus[9]. (see Fig. 2)

This fasciculus is directly related to the pathway required for speech, as it forms part of the route joining Wernicke's area with Broca's area. It should be remembered that the former has the function of decoding the information coming from the auditory cortex, and the latter has the function of processing the information and sending it to the motor cortex.

It seems evident and logical to think that a function cannot be carried out if the bundle of nerves specifically designed to connect the areas involved the function is incorrectly or incompletely developed.

This was the question I asked Dr Loui when I read her article, as my personal experiences, as well as investigations carried out by other scientists and choral directors, had not found children incapable of producing tones – even in children with greatly difficult backgrounds – after sufficient training.

In his book *Musicophilia*, Oliver Sacks tells of how in New Scientist magazine Steven Mithen[10] discussed the question of whether anyone can learn to sing, and carried out his own experiments to find out.

> *"My research had persuaded me that musicality is deeply embedded in the human genome, with far more ancient evolutionary roots than spoken language"*

he wrote in a wonderfully honest article in New Scientist magazine in 2008,

> *"yet here I was, unable to carry a tune or match a rhythm". He continued by relating how he had been "humiliated" by being forced to sing in front of the class when he was at school, to the extent he avoided all musical activity for over 35 years. He decided to find out if, with a year of singing lessons, he could improve his tone, sound and rhythm, documenting the process with functional magnetic resonance imaging. Mithen learned to sing better – not spectacularly so, but enough – and the imaging showed an increase in activity in the inferior frontal gyrus and in two areas of the superior temporal gyrus (with more on the right-hand side). These changes reflected how he had improved his tone control when projecting his voice and when conveying musical phrasing. There was also a reduction in activity in certain areas, i.e. what had initially demanded great conscious effort was becoming more and more automatic."*

The answer Dr Loui gave me was more than stimulating, as my view had not only grabbed her attention – apparently it contradicted her findings – but she also suggested the possible causes to me which, in her opinion, had influenced the results my colleagues and I had obtained. That moment opened the door, making me aware of new scientific contributions such as neurogenesis and neuroplasticity. This gave me every reason to hope that the seemingly definitive quashing of my initial assertion that *every child that can speak can also sing* might not be so final after all.

Neurogenesis and neuroplasticity

In around 1983, Argentinian neurobiologist Fernando Nottebohm, professor and director of research at Rockefeller University in New York, made a notable contribution to overturning the long-established belief that the nervous system consisted of a set number of cells, and that this number did not change until the death of an individual.

This idea had been practically dogma since 1906, when Spanish scientist Santiago Ramón y Cajal had received the Nobel Prize for Medicine for his work on mechanisms governing morphology and the connective processes in nerve cells. Ramón y Cajal believed that, by contrast to the majority of other cells in an organism, standard neurons in an adult human did not regenerate.

Nottebohm's discovery blew this theory apart, and opened up a field which has been described by other researchers, including Canadian psychiatrist Norman Doidge, as "*one of the great discoveries of the 20th century*".

Nottebohm discovered that

> *"(…) canaries – especially male canaries – use their repertoire of songs as an element of sexual attraction. The combinations of sounds they produce vary from year to year. Nottebohm confirmed that these annual changes are produced by*

a seasonal increase and decrease in brain cells; he had discovered neurogenesis. He proved that neurons in canaries reproduce, generating twenty thousand new neurons every day. And the most surprising thing was that neurogenesis occurs in females too, and they acquire the ability to sing when they are injected with male hormones. Neurogenesis, the process by which neurons reproduce and nerve tissue regenerates, contradicts what had until that point been almost a fundamental tenet in neurology that neurons could only die and never reproduce."[11]

A paper was recently published in Nature magazine[12] which gives yet more reason to believe that everyone can be taught to sing.

The researchers, Ana Amador, Yonatan Sanz Perl and Gabriel Mindlin from the Dynamic Systems Laboratory of the Faculty of Exact and Natural Sciences at the University of Buenos Aires and Daniel Margoliash from the University of Chicago, wrote a paper on birdsong.

"Birdsong and human singing have many things in common. In fact, a large number of species learn to sing in a way similar to how a child learns their mother tongue, by interacting with the people who surround them. For this reason, studying the brain activity in birds when they produce their sounds can give insights into the way in which speech is codified in our neurons and, ultimately, how the brain can learn a complex task. In the same way as human speech, birdsong comprises neuronal aspects (instructions) and physical aspects (organs which act to produce the sound). New-born chicks do not sing, and only make sounds to ask for food. Subsequently, they go through a stage in which they hear their teacher or father sing, and then they start to practise in a way similar to a child's first attempts to pronounce words. After this practice, and by contrasting

their own song with the internal model they had acquired, they end up with their adult song.[13]

This is known as a sensory motor process. The sensory is fed back into the motor in the same way as in a child’s learning process and in development of tuning.[14]

The paper recently published in Nature enables us to view neuronal and physical aspects together, by explaining how neurons are activated to produce each one of the sounds that combine to produce song.[15]

Readers can access these highly stimulating investigations if they wish to explore the subject in greater depth. There is no need to go into such depth in this article as it is not a treatise on neurology. (See bibliography below)

Argentinian neurologist and neuroscientist Dr Facundo Manes believes that “New musical therapies can boost neuroplasticity – new connections and circuits – to partially compensate for deficiencies in damaged parts of the brain.”[16]

What can be said in conclusion is that the original premise is valid: *every child that can speak can also sing*. Even in cases of amusia it is possible, through both simple and complex Cartesian work, to develop another way which allows us to compensate for missing or incomplete development of the arcuate fasciculus. We definitely cannot say that the result will be a great singer, but perhaps this person will be able to enjoy music, not just on an emotional level but also in the increased number of neuronal connections which result from this process.

A plethora of specialisations exist to treat the wide range of human disorders. As shown by the schools for the blind, who learn to read, write and calculate, the schools for the deaf and dumb, who learn to speak and “listen” to their interlocutor through the movement of their lips or a system of hand gestures, and Paralympians, who can play sports with the help of technological adaptations without which such activity would be impossible, there is no limit to the goals that can be achieved, and the results speak volumes for the potential for complete individual development and the human right to realise it.

Medicine has shown great interdisciplinary potential for developing machines and medical instruments of enormous complexity, equipment which could never be made without the efforts of mechanical and electronic engineers, experts in synthetic materials and special metals, programming engineers, and so on.

The same is true of singing. There are techniques and modern developments which prove that it is possible to make significant breakthroughs in individuals with difficulties. Amongst others, the strategies being developed by language and speech therapy, physiatry and early stimulation may be of great help in tackling these disorders.

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Translated by Christopher Lutton, UK

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[8] Dres. Psyche Loui, David Alsop and Gottfried Schlaug, Harvard University – *Tone deafness: a new disconnection syndrome?* – The Journal of Neuroscience, August 2009

[9] A fascicle is a bundle of nerves made up of axons; these are the elongated part of the neuron.

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