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Wonderpedia

BLACK OUT

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After 5 days: **Food shortages**

After 10 days: **Europe-wide riots**

After 15 days: **Nuclear meltdown**

After 20 days: **???**

What happens when
the power cuts out?



++World War II Confidential++

SECRET FILES

UNCOVERED



The whale that's been
swimming for
200 years



This **PILL**
could **KILL YOU**

How **toxic** is our
medicine?

T

he unknown caller is on the other end of the line again. In a heavily disguised voice he demands £50,000 from John Keough*, or else he'll set fire to one of the tyre dealer's garages. But this time his luck has run out. Specialists from the National Crime Agency are recording the call. Later, these specialists will unmask his identity – even though the man spoke in a foreign language in an attempt to further disguise himself. They filter out noise from the 30-second recording, and from around 3,000 vocal characteristics create a kind of 'fingerprint' of the voice. "No two people in the world sound the same," explains phoniatrics expert Dr Markus Hess. By comparing the data the NCA team get the vital clue as to the culprit's identity. But how can a fleeting conversation identify a suspect? What does the spoken word reveal about you? To find out, we need to get closer to the source of the voice in the human body...

HOW DOES CLAPPING BECOME A CONCERT?

In the short time it takes you to say "one hundred and thirty", the windpipe's vocal chords open and close 130 times. If you're female, it's around twice that number. A pressure equivalent to that found under ten centimetres of water builds up 130 times a second in the larynx, before immediately being released like a burst balloon. A trained opera singer can even build pressure in their chest

* NAME HAS BEEN CHANGED

Scientists are revealing the secret codes of language

It unmasks criminals, exposes illnesses and can even decide presidential elections: the voice is one of the most powerful instruments we possess. Soon it could even function as an identity card, because a sentence reveals more about us than we could ever have suspected...

CAN MY

VOICE

BETRAY ME?

equivalent to a depth of one metre. The fundamental tone of a person's voice is produced by the opening and closing of the vocal chords, each of which is two centimetres long. For men, this would be like two hands clapping together 130 times a second, or 250 times a second for women. "In its pure state it sounds like a shovel scraping across the floor. It's a frightening noise that accident victims with injuries to the trachea make," explains Dr Hess. It's only when this sound echoes through the vocal tract (the throat, mouth and nose) that the scraping is transformed into the characteristic sound of our voice.

Every single sound is the result of this lightning-quick process of the vocal chords slicing through the exhaled air. Each of the two vocal chords moves by about one millimetre when opening and closing again. On average they collide about three million times every day, in the process moving a distance equivalent to two or three miles. Chatterboxes can easily do double that.

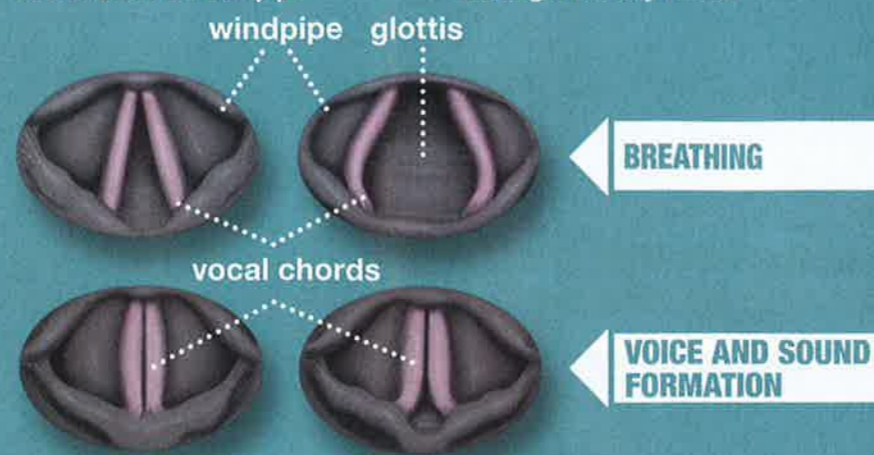
Nowhere else in the body are there as many nerves as in the 14 muscles of the larynx, which effectively form our voice. If we want to speak at a higher pitch, then the muscles tense up. These vibrate more quickly against the airflow and the sound becomes lighter. To sound deeper, the larynx relaxes the vocal chords and they vibrate more slowly. The result has no equal: the human voice can

A TENOR SINGS LOUDER THAN A ROARING LION.

▶ HOW DOES THE VOICE CREATE A SOUND?

At rest our vocal chords are relaxed (below left). When you breathe in deeply, they open wide (below right) in order to make space for the stream of air flowing towards the lungs. When we exhale the vocal chords close the windpipe

completely for a brief moment (bottom left) and subsequently open it again (bottom right). In men this happens around 130 times per second; in a women about twice as often. This extremely fast process is the origin of every sound.



produce sound on a spectrum from 80 to 12,000 hertz. No other mammal has such a wide range of low and high tones. And at 120 decibels, a trained tenor can even exceed the sound pressure of a roaring lion or a jackhammer.

What's amazing is that the vocal chords can actually manage this in spite of their soft texture, which acts in a different way to a rigid guitar string. "From the outside they look as soft as the tissue that the eyeball sits in," explains Dr Hess.

CAN 20 HERTZ DECIDE AN ELECTION?

Even tiny changes in the body have an effect on the voice. And we don't just mean sounding croaky when you have a cold. Research has revealed that people infer far more about a person from their voice than just their age or mood. Participants at a study by Leiden University in

the Netherlands were also able to reliably estimate a person's body size and physical stature from the way they spoke. Something as innocuous as a sprained ankle can affect the voice, because even minimal changes to your posture change the way you speak.

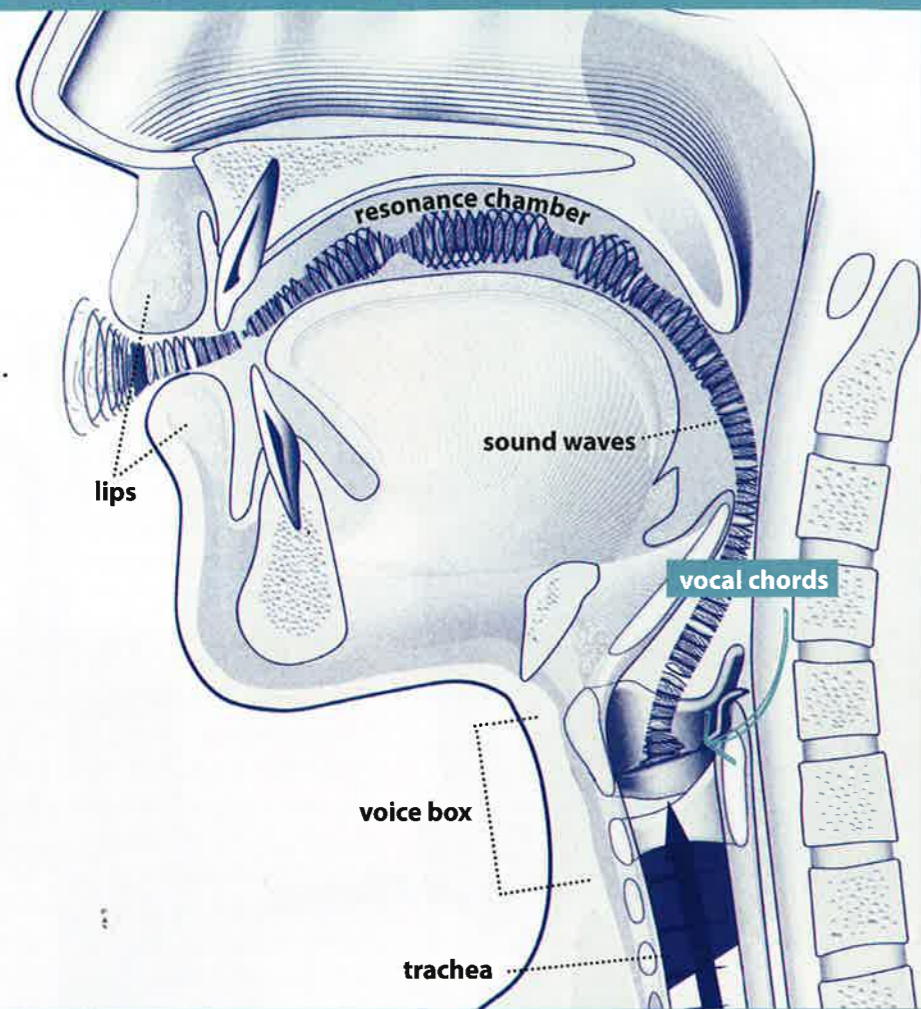
The tone of the human voice can carry even more significance than what's actually being said: men and women with deeper voices are automatically considered more competent, dominant and trustworthy. When a person with a higher or squeakier voice says the same sentence, the attention of the listener falls away rapidly – probably because it reminds them of childlike babbling. Canadian psychologist David Feinberg discovered that a voice lowered by just 20 hertz dramatically increased a candidate's chances of being elected as US president. >



HOW CAN I PROTECT MY VOICE?

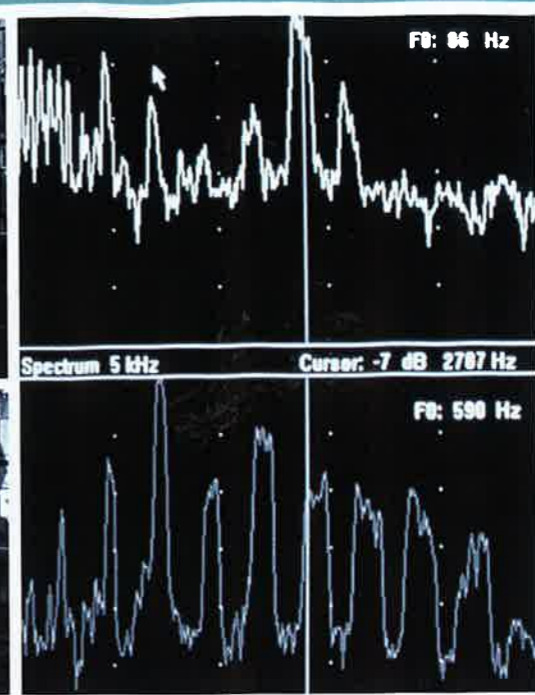
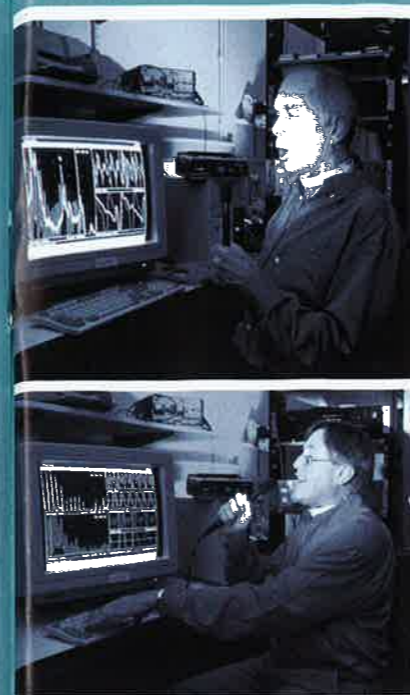
DR. MARKUS HESS, PHONIAICS EXPERT

Shrieking, shouting and even frequent coughing strain the voice. "Rasping is the younger brother of coughing, but both should be avoided because they strain the voice box," explains voice doctor Markus Hess. "Better to simply drink some water. In general, it's best to avoid anything that increases the stomach acid, like alcohol, cigarettes, coffee, spicy and sour food." Morning voice exercises, on the other hand, are good for the voice. Hess recommends seeing a specialist if you're hoarse for more than three weeks.



▶ WHAT MAKES OUR VOICE UNIQUE?

The vocal chords can only be stimulated to vibrate and produce sound by exhaling. For this purpose the muscles in the voice box tense the vocal chords in the air flow – the pull of the air causes the vocal chords to vibrate. If the chords don't close completely, a voice will sound hoarse or croaky. The more frequent the vibrations, the higher the pitch. The greater the pressure on the chest as a result of the exhaled air, the louder a voice is. The contraction of muscles in the larynx changes the tone of the voice. The end result – a spoken sentence, for example – only happens later when the mouth and pharynx (the cavity behind the nose and mouth) strengthen and modulate sounds from the larynx. The whole body contributes to the formation of sound – a unique vocal sound is created as a result of a person's individual anatomy.



▶ CAN YOU HEAR ILLNESSES?

Whether it's laryngeal cancer, drug addiction or depression: illnesses change the voice. During voice analyses, the volume and speed of speech are evaluated. Details of the sound curve of the speaker

(above right) are also measured. Diseases reveal themselves there in characteristic patterns. Doctors are convinced that lives can be saved when changes in the voice are picked up in time.

Perhaps Margaret Thatcher only succeeded in becoming the UK's first female prime minister thanks to the vocal training she underwent. It lowered her voice by half an octave.

CAN I JUMP THE QUEUE WITH MY VOICE?

As well as being unique, each voice is also very versatile. This presents a huge challenge for researchers wanting to use their traits in voice analysis. Criminologists have it especially hard. Unlike a DNA sample or a fingerprint, separate voice recordings from the same person always differ. "You can only work with similarity values of the

biometric characteristics, but they must be as high as possible," explains Gereon Tillenburg, a voice identification expert at Twinsoft Biometrics. The advantage of voice analysis is that while DNA samples or fingerprints require physical evidence, voice samples can be collected almost in passing – for example with recordings from the internet or telephone conversations. "This allows a whole 'terror database' to be set up, as already exists for fingerprints," says Tillenburg. Theoretically, this would come from millions of citizens, without their knowledge or permission. The "start of an

acoustic surveillance state" is the fear of sociologist David Lyon from Queen's University in Kingston, Canada. Today, secret services already rely on the revelatory power of sound: it's not only the video and audio messages from Osama Bin Laden that have been subjected to voice analysis to prove their authenticity, as the recent unmasking of Islamic State terrorist Mohammed Emwazi showed.

But that's only the start: comprehensive analysis of the voice is already far more entrenched in our everyday lives than many of us suspect. Are you ever kept waiting for different

lengths of time on customer hotlines trying to talk to an adviser, even when you ring at the same time of day about the same issue? If so, it could be to do with your mood. Some European companies are trialling software that automatically registers how annoyed a customer sounds: the more angry they sound, the faster they are transferred to a call centre employee. Barclays Bank, meanwhile, is unveiling its own voice recognition system. Software records a customer's voice which is then stored in a database. When the customer next calls the bank, their unique speech patterns are

compared against the initial recording. Security questions and PINs are redundant.

Our voice can reveal many things – even the body's well guarded secrets. It's often quicker than our conscious mind: by analysing slight variations in volume, rhythm, tempo, melody and timbre, computer algorithms can diagnose neurological disorders like Parkinson's – even before the disease takes hold. "These characteristics can be objectively described using mathematical methods and can't really be falsified by test subjects," according to psychiatrist Dr Michael Colla.

Scientists have only recently succeeded in precisely measuring the acoustic world, as up until now computers haven't had the processing power to analyse the 6,000 sonic characteristics of a single sentence at once. It's a huge step forward. "Up until a few years ago we could only judge a voice with subjective auditory impressions," explains psychologist Jarek Krajewski. Smartphone apps like Shazam, that recognise and identify music, use this technology on a smaller scale.

CAN A VOICE BE HACKED?

The algorithms are still learning to interpret the voice's distinguishing characteristics. "At the moment there's a balance between the human and the computer. But in a few years we'll have systems that will be able to analyse far better and more precisely than humans," Krajewski thinks. Then illness diagnosis won't be the only field where voice analysis will be used. It could be used to identify people attempting to drive while under the influence – and a computer in the car could then switch off the engine. "Everything that happens in the brain influences language and speech production," explains mathematician Joerg Langner. But even the voice is not immune to attack: voice hackers are working on synthetic or copied voices in order to gain control over technical systems. Virus expert Yuval Ben-tzhak from online security firm AVG warns: "We haven't experienced voice hacking on a massive scale yet. But it could happen quite easily." For the police, that would be a nightmare. Because after a threatening phone call, for example, it's possible that an entirely innocent person might end up on the list of suspects...