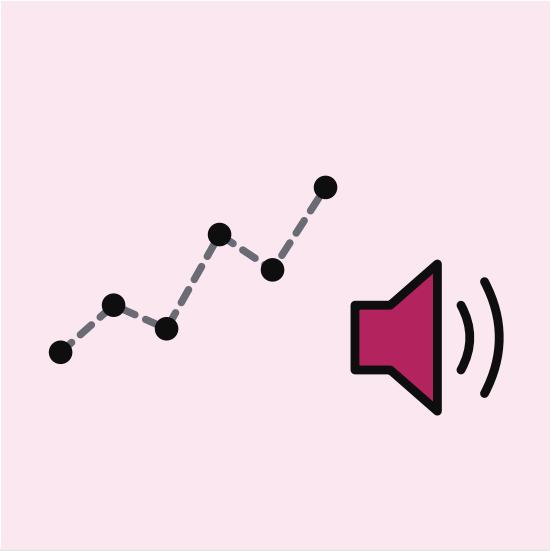
Concept

Sonification

Using non-speech sounds to show data: the value of a measurement changes the pitch, rhythm or timbre of what you hear.



In Spanish
Sonificación

Origin
Kramer et al. (1999); precedents: the stethoscope (1819) and the Geiger counter (1908, improved in 1928)

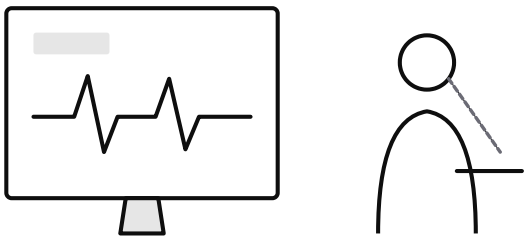
What problem it addresses

It lets you follow data without looking at a screen, which helps when your eyes are busy with another task, as in an operating room.

An example

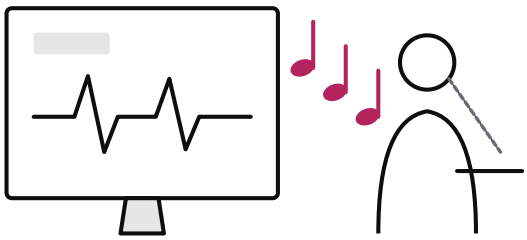
A pulse oximeter measures the oxygen in a patient's blood during surgery.

Screen only



The number changes on the monitor, but you have to look at it. **If your eyes are on the patient, the change goes unnoticed.**

With sound



Each heartbeat makes a tone, and on most devices the pitch drops when oxygen drops. **You notice the change without looking up.**

The data is the same; sonification brings it to the ear, which stays alert even when the eyes are busy.

Why it happens

1

The ear doesn't need to look, so it stays alert even when your eyes are on another task.

2

Each data point moves a feature of the sound, such as pitch, rhythm, loudness or timbre.

3

Changes grab your attention without having to search for them on a screen.

Applications in design

Use it like this

Use sonification to follow data that changes while the person is looking at something else.

Avoid

Showing precise values with pitch alone: small steps are hard to hear. Add another feature, such as timbre.

Don't fall for it

Test the sound with the real noise of the place and with other tasks at the same time: in silence everything seems to work.

57% → 87%



What the research says

Changes in oxygen range detected with the standard pulse oximeter sound and with an enhanced one, by 25 anesthesiologists and 28 people with no clinical training (Paterson et al., 2019).

●●● **Solid evidence.** Lab study, with operating-room noise and other tasks at the same time. An earlier study found similar results (Paterson et al., 2017).

Connections

Used in

- Multisensory design
- Design for health
- Data visualization

Authors and works

1999	**Gregory Kramer et al.**	Defined sonification as the use of non-speech sound to convey information from data.
2011	**Thomas Hermann, Andy Hunt and John G. Neuhoff**	Brought the field together in an open handbook and organized its techniques, from audification to auditory icons and earcons.
2016	**R. G. Loeb, B. Brecknell and P. M. Sanderson**	Analyzed 21 commercial pulse oximeters and found that each model lowers the pitch differently when oxygen drops.

Sources

Original sources

- Kramer, G., Walker, B., Bonebright, T., Cook, P., Flowers, J. H., Miner, N. et al. (1999). Sonification report: Status of the field and research agenda. International Community for Auditory Display.
- Loeb, R. G., Brecknell, B., & Sanderson, P. M. (2016). The sounds of desaturation: A survey of commercial pulse oximeter sonifications. Anesthesia & Analgesia, 122(5), 1395–1403. View source (https://doi.org/10.1213/ANE.0000000000001240)
- Paterson, E., Sanderson, P. M., Brecknell, B., Paterson, N. A. B., & Loeb, R. G. (2019). Comparison of standard and enhanced pulse oximeter auditory displays of oxygen saturation: A laboratory study with clinician and nonclinician participants. Anesthesia & Analgesia, 129(4), 997–1004. View source (https://doi.org/10.1213/ANE.0000000000004267)
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Academic reviews

- Hermann, T., Hunt, A., & Neuhoff, J. G. (Eds.). (2011). The sonification handbook. Logos Verlag. View source (https://sonification.de/handbook/)

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