Lore Thaler: Clicking into place

The use of reflected sounds to navigate, known as echolocation, is a behaviour most associated with bats, whales and dolphins, but other species also use the sensory technique — including humans. It was once thought that only blind people could excel at echolocation, but research has shown that anyone can learn the skill. Lore Thaler, a neuroscientist at Durham University, UK, spoke to *Nature* about her efforts to make echolocation training more accessible.

Neuroscientist Lore Thaler runs workshops to teach people how to echolocate.

JEREMY SUTTON-HIBBERT/PANOS FOR *NATURE*

How does human echolocation work?
It's essentially the same as in bats, but humans use audible clicks and taps, whereas bats typically make ultrasonic chirps. The sounds bounce back off surfaces, and that echo helps people to establish that something is there. The size and shape of the object affects what the echo sounds like, and the time the sound takes to come back provides an estimate of how far away the object is. People can also use the technique to work out direction — if something is on your right, the echo will be a bit stronger in your right ear than in your left, and arrive there a fraction earlier.

How do you teach someone to echolocate?
The first step is helping someone to find a good sound they can make. Some people use finger snaps; others prefer tapping feet or rattling keys. But people who are very good at echolocation use mouth clicks.

The second step is to teach someone what to listen for. To start with, we hold objects up in front of a person's face. In this case the echo is very fast, so you don't hear a separate echo, just a change in the quality of the sound. We ask them to make the sound with and without the object there, switching back and forth so that they can appreciate the difference in the sound. Once they're confident with that, we move on to placing objects to their right or left. And then we encourage people to move, starting with their head. Once you bring in movement, that makes it clear that you're in control of which part of space you're interrogating.

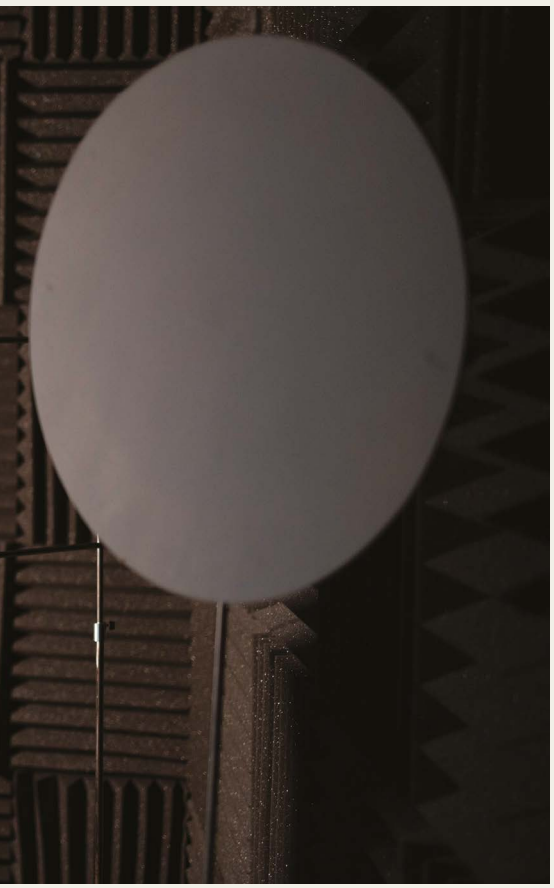
A first session like this might last an hour. Then it's mostly about repetition — you just practise. One thing to emphasize is that the more consistent your sound is, the easier it is to interpret the echoes coming back, so it's really worth it to find a consistent sound. And by practising that, you're also training the perceptual side, making your brain better at picking up on these sounds.

What evidence do you have that this works?
Our laboratory study in 2021 included three specific tasks that we could really put numbers on: judging the orientation of a plank; determining size; and navigating a virtual space using simulated sounds played through headphones[1]. We found that, during the ten-week study period, participants improved at all the tasks. By the end of the training, some people could perform these specific tasks just as well as those who've used echolocation for most of their lives.

What can an accomplished echolocator do?
Expert echolocators can do remarkable things with this skill. For example, they can work out whether an object one metre away has moved as little as five centimetres closer. This is almost as good as people can do with vision. They can also tell whether something is concave — hollowed out — or flat, and whether it is square or circular.

What's going on in the brain during echolocation?
We scanned people's brains while they were trying to navigate a virtual environment[2]. They were led acoustically through a set of corridors and had to judge the layout. We found that, after training, there were increases in activity in some parts of the brain associated with processing visual input. And this activity was specific to when people heard echoes, not sound in general.

What was really interesting was that this change in brain activity occurred both in people who were blind and in those with



sight. In the past, it was thought that you had to be blind to become really good at echolocation, but our data don't support that. There was no evidence that blind participants responded to training better than sighted participants did.

In the auditory cortex, which is of course also involved, we found that the training led to an increase in activity in response to sound in general. We also observed an increase in grey-matter thickness in the right auditory cortex.

What difference can echolocation make?

We did a three-month follow-up of the participants in our study[1], in which we asked people how the training had improved their mobility and independence. We found that the experience had brought about some big positive changes in their lives.

Echolocation gives people another way to explore their environment. It's an active mode of perceiving, because you're making the sound, you can make it louder and quieter, and you can send it in different directions. Mouth clicks don't sound loud because they're very brief, but we have measured peak intensities of up to 93 decibels SPL [sound pressure level] and heard clicks travel 100 metres. Your range of touch is perhaps a couple of metres if you have a long cane, so echolocation lets you sense the environment at a much greater distance.

How are you disseminating these skills?

There's very little of this training available at the moment, simply because there aren't enough people who can deliver it. We now have a project in which we train professionals who work with people with visual impairments. They then pass on their skills to the people they work with, so act as multipliers. It's very learnable, and costs little.

During 2018, we conducted one-day workshops around the United Kingdom that were attended by around 200 rehabilitation or habilitation workers, who help people with visual impairments to learn and maintain skills that will aid them in life. Before each workshop, we sent out a video about how to make the best click. Then, on the day of the training, we checked that participants' clicks are suitable and consistent. Next, we did the sensitization, by placing an object in front of them, to the side and so on, and then we gave them exercises that they can do with their visually impaired clients, such as locating an open door.

All of these rehab workers deliver long-cane training already, and with adults they usually work on specific routes. We teach them how they can integrate echolocation training alongside this. We always tell them that echolocation is not a standalone skill — it should be used along with other aids, such as a long cane or a guide dog.

How effective have these workshops been?

We don't know yet how this affects visually impaired people, because we don't yet have data from the rehab workers' clients. But three months after running the workshops, we asked a simple question of our professional attendees: did the training affect your practice? And if they said yes, we asked them to tell us how.

Nearly half of the respondents said that they had used what they had learnt to instruct people in echolocation[3]. That's ultimately what we want, but it's not the only good outcome. Another one-third of people said that it had helped them to understand their clients better. If a visually impaired person tells them that sometimes they can hear that there are open doors, that now makes perfect sense, whereas it might not have before. And if the rehab worker then says in response: "I think you're using echolocation — have you tried using a mouth click?", then they're providing useful information.

What comes next?

We know that we can measure benefits when we directly train blind people, but our study was quite a small sample in a very controlled research setting. We need to roll this out on a larger scale to confirm the results.

We're planning to start delivering more training sessions for rehab workers this month. To measure how effective the training is, we're going to encourage the rehab workers to ask their clients to tell us how their lives have been affected, using an anonymous online portal. We need data on the impact of the training on the blind people we ultimately want to help.

In the future, the ideal situation would involve having experts in the workforce who can train other people to teach echolocation. I can't always be the one doing the training! We've got an exciting new project with Guide Dogs UK, in which we will offer people the opportunity to train not just for one day, but for longer periods, until they can deliver training themselves. This will enable us to scale up the training and improve the lives of many more people. We want echolocation to become as accepted as long-cane training. That's where this is going.

Interview by Simon Makin

This interview has been edited for length and clarity.

1. Norman, L. J., Dodsworth, C., Foresteire, D. & Thaler, L. *PLoS ONE* **16**, e0252330 (2021).
2. Norman, L. J., Hartley, T. & Thaler, L. *Cerebral Cortex* **34**, bhae239 (2024).
3. Thaler, L., Di Gregorio, G. & Foresteire, D. *Front. Rehabil. Sci.* **4**, 1098624 (2023).