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Hear to see: New method for the treatment of visual field defects

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Patients who are blind in one side of their visual field benefit from presentation of sounds on the affected side. After passively hearing sounds for an hour, their visual detection of light stimuli in the blind half of their visual field improved significantly. Neural pathways that simultaneously process information from different senses are responsible for this effect.

"We have embarked on a whole new therapy approach" says PD Dr. Jörg Lewald from the RUB's Cognitive Psychology Unit. Together with colleagues from the Neurological University Clinic at Bergmannsheil (Prof. Dr. Martin Tegenthoff) and Durham University (PD Dr. Markus Hausmann), he describes the results in *PLoS ONE*.

To investigate the effectiveness of the auditory stimulation, the research team carried out a visual test before and after the acoustic stimulation. Patients were asked to determine the position of light flashes in the healthy and in the blind field of vision. While performance was stable in the intact half of their field of vision, the number of correct answers in the blind half increased after the auditory stimulation. This effect lasted for 1.5 hours. "In other treatments, the patients undergo arduous and time-consuming visual training" explains Lewald. "The therapeutic results are moderate and vary greatly from patient to patient. Our result suggests that passive hearing alone can improve vision temporarily."

If strokes or injuries cause damage to the area of the brain that processes the information of the visual sense, this results in a visual field defect.

The area most commonly affected is the primary visual cortex, the first processing point for visual input to the cerebral cortex. The more neurons die in this brain area, the bigger the visual deficit. Usually the entire half of the visual field is affected, a condition known as hemianopia. "Hemianopia restricts patients immensely in their everyday life" says Lewald. "When objects or people are missed on the blind side, this can quickly lead to accidents."

"There is increasing evidence that processing of incoming sensory information is not strictly separated in the brain", says Lewald. "At various stages there are connections between the sensory systems." In particular the nerve cells in the so-termed superior colliculus, part of the midbrain, process auditory and visual information simultaneously. This area is not usually affected by visual field defects, and thus continues to analyse visual stimuli. Therefore, remaining visual functions are retained in the blind half, which the patients, however, are not aware of. "Since the same nerve cells also receive auditory information, we had the idea to use acoustic stimuli to increase their sensitivity to light stimuli" says Lewald.

The team of researchers now aims to further refine their therapy approach in order to reveal sustained improvement in visual functioning. They will also investigate whether the stimulation of the sense of hearing also has an effect on more complex visual functions. Finally, they aim to explore the mechanisms that underlie the effect observed.

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