Perception disorders may throw those affected off balance

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Dr. Cecilia Ramaioli (left) checks if the weighted helmet fits correctly to a participant´s head. In the background, Professor Nadine Lehnen prepares the computer for the experiment. Credit: A. Heddergott / Technical University of Munich

Many patients with functional dizziness look back on a long odyssey to

numerous doctors, because no organic causes could be found. Now for the first time, an experiment at the Technical University of Munich (TUM) has identified possible causes of the disorder: problems with the processing of sensory-motor signals in the brain that resemble those associated with dizziness due to organic causes.

The Munich researchers had already postulated several years ago that functional disorders may be caused by faulty processing of sensory stimuli. The team, headed by Prof. Nadine Lehnen, senior physician for psychosomatic medicine at the TUM University Hospital rechts der Isar, was able to bolster this hypothesis with the results of an experimental pilot study.

Eight patients with functional dizziness and eleven healthy subjects who served as a comparison group participated in the study. The researchers also used data from dizziness patients with organic defects who had previously taken part in the same experiment. Those patients had either a cerebellar disorder or a complete loss of functioning vestibular (equilibrium) nerves.

Dizziness patients show marked deficits

During the experiment, the participants sat in a dark room in which points of light were flashed in rapid succession on the wall left and right of gaze straight ahead. They were asked to look in the direction of the light points. Their eye and head movements during the gaze shifts were recorded. They were then fitted with a weighted helmet to alter the inertia of their head. This resulted in significant head wobbling. The experiment was performed with and without the helmet.

With the help of special glasses, the scientists are able to record the head and eye movements of the participants. Credit: A. Heddergott / TUM

Whereas the healthy subjects quickly adapted their movements to the new circumstances and managed to stop their head from wobbling, all the subjects with functional dizziness found the task difficult to perform. What surprised the research team was the fact that the latter behaved in exactly the same way as subjects with dizziness due to massive organic defects.

"Our results clearly show that functional dizziness is manifested exactly like severe physical disorders, for example after complete functional loss of the vestibular nerves. This reflects how severely impaired these people are," Nadine Lehnen says.

Experiment provides possible explanation of functional dizziness

Based on previous experience, which is stored in the brain in the form of

learned models, people have a certain expectation about the sensory impressions evoked by a movement. This expectation is compared with information from the vestibular organs. If the head behaves differently than normal, the two sets of information no longer match. This creates an imbalance between expectation and reality, a state known as prediction error.

"Healthy people can easily perceive this error, process it and adapt their movements accordingly. Patients with functional dizziness, by contrast, do not appear to process sensory-motor impressions correctly. They rely primarily on their stored model, but it no longer matches the new reality," Nadine Lehnen explains, and adds: "We were excited to observe that they are still able to learn—albeit only to a limited degree." It would therefore be important to treat such patients using therapeutic approaches that take into account this processing deficit. A large-scale study is planned to corroborate the recent findings.

More information: Nadine Lehnen et al, Deficient head motor control in functional dizziness: Experimental evidence of central sensory-motor dysfunction in persistent physical symptoms, *Mathematical Modelling in Motor Neuroscience: State of the Art and Translation to the Clinic. Gaze Orienting Mechanisms and Disease* (2019). DOI: 10.1016/bs.pbr.2019.02.006

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