Neuro-Music Therapy enhances Task-negative Activity in Tinnitus Patients

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Background
- Neural Networks for Tinnitus: Tinnitus seems to comprise several neural networks in auditory and non-auditory areas.
- Resting State Network (RSN): The RSN comprises the medial prefrontal cortex (MPF), the posterior cingulate cortex (PCC) with an extension to the precuneus, and the lateral parietal cortex (LP).
- Impaired activity of RSN in tinnitus: The continuous tinnitus percept can be interpreted as a salient stimulus corrupting the state of mental rest which in turn reduces PCC/precuneus activity at rest.
- Heidelberg Neuro-Music Therapy (HNMT): HNMT is a short-term therapy lasting 5 days and combines auditory attention control tasks and guided exercises for mindfulness and distress regulation.
- Growth of Gray Matter (GM) Density after HNMT: has been found in the PCC and the precuneus, suggesting a potential influence of HNMT on RSN activity.

Objectives
- Structural vs. Functional Changes in RSN: While MRI data provided evidence for structural changes following HNMT longitudinally, this study aims to evaluate changes in the RSN activity induced by HNMT.

Methods
- Participants: 18 tinnitus patients ("treatment group", TG) → HNMT, 22 healthy controls (AC); TG → HNMT, 21 passive tinnitus controls (PTC) → no treatment
- Psychological distress: "Tinnitus Questionnaire" (TQ) (German version)
- Assessment of Task-negative Activity (fMRI): Two fMRI measurements before and after a one-week study period recorded changes of the BOLD effects during an ITI period (task-negative activity) of a word recognition condition (task-positive activity).

RSN activity change
1) Tinnitus-related Effect on the RSN: TG → Increase in RSN activity, PTC no change
2) Therapy-related Effects on the DMN (Fig. 1): TG → Increase in RSN activity compared to AC
3) Conjunction of Therapy-related and Tinnitus-related Effects: focused on a cluster in the PCC/precuneus area and isolated specific tinnitus-related effect among therapy-related effects (Fig. 2)
4) Functional and Structural Alterations due to HNMT: positive correlation between precuneus activity and structural GM alterations (Spearman-Rho: U.36; p < U.005)

Tinnitus distress
- TQ scores: Similar initial scores (TG: 38.50 ± 15.4; PTC: 36.2 ± 16.8, p = 0.4651) but significant difference in TQ decrease (TG decrease by 17.7 ± 13.6; PTC: n.s.; p < 0.00005).
- Lower levels of tinnitus distress: rising RSN activity (Fig. 3)
  n = 39; Spearman-Rho: -0.5; p < 0.005

Discussion
- Enhanced Task-Negative Activity: Patients seem to reactivate their RSN after the treatment
- Treatment Specific Changes: Whether the RSN changes rely on the explicit perception of frequency relations (auditory training) or emotional relaxation-related effects currently is an open question.