Modelling naturalistic spatial hearing.

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The objective of the study is to elucidate the neurocomputational mechanisms underlying naturalistic spatial hearing in ecologically valid listening scenes in normally hearing listeners.

Ethical review	Approved WMO
Status	Pending
Health condition type	Other condition
Study type	Observational non invasive

Summary

ID

NL-OMON56997

Source ToetsingOnline

Brief title Deep neural network models of naturalistic spatial hearing.

Condition

• Other condition

Synonym not applicable

Health condition

no condition, healthy volunteers

Research involving Human

Sponsors and support

Primary sponsor: Radboud Universiteit Nijmegen Source(s) of monetary or material Support: NWO Veni grant

Intervention

Keyword: deep neural network models, functional magnetic resonance imaging, spatial hearing

Outcome measures

Primary outcome

• Functional brain scans: Recording neural responses to naturalistic, spatial

sounds while participants perform a simple one-back memory task to ensure

attentive listening.

• Behavioural sound localisation task: Accuracy.

Secondary outcome

• Recording of spatial cues: Measurements of the head-related impulse response

(HRIR12,13).

• Structural brain scans: Map of brain anatomy in order to associate neural

responses to sound as measured with the functional brain scans to anatomical

locations in the brain.

• Hearing test: Hearing thresholds for pure tones.

Study description

Background summary

Our knowledge of the neurocomputational mechanisms underlying naturalistic spatial hearing in humans is limited. This is a consequence of the complexity and high-dimensional nature of spatial, naturalistic acoustic scenes, as well as the technological difficulty of obtaining measurements of neural sound processing in the small auditory nuclei in the human brainstem. Although recent developments in the field of artificial intelligence show that deep neural network models (DNNs) are highly successful at solving complex and high-dimensional problems, they have not yet been applied as neurobiological models of naturalistic spatial hearing. Furthermore, while technological

advances in the field of functional magnetic resonance imaging (fMRI) enable unprecendented functional measurements of neural sound encoding in small brainstem nuclei, these advances have yet to be used to study sound location encoding. In the present project, we therefore combine deep neural network models with ultra high-field functional magnetic resonance imaging (UHF fMRI, 7 Tesla) of the complete ascending auditory pathway from brainstem to cortex.

Study objective

The objective of the study is to elucidate the neurocomputational mechanisms underlying naturalistic spatial hearing in ecologically valid listening scenes in normally hearing listeners.

Study design

The present study is an observational study to assess sound location encoding in the human auditory pathway. The study consists of five session. In Session 1, we measure the participant*s hearing thresholds (audiogram) and record the participant*s spatial sound cues. Afterwards, participants perform a behavioral sound localisation test. In Session 2 - 5, we make structural and functional MRI brain scans. Participants listen to naturalistic sounds and perform a simple one-back memory task while the functional MRI scans are made.

Study burden and risks

Participants visit the laboratory sites five times during the course of the experiment. The experimental measures as well as the magnetic resonance imaging implicate minimal burden and risk to the participants. Participants can withdraw from the study at any moment. Participants do not benefit directly from their participation in the experiment. However, the research outcomes provide valuable knowledge about neural location encoding of real-life sounds in real-world listening environments, thereby paving the way for future studies involving hearing impaired listeners to guide the development of medical interventions and assistive hearing technology.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age Adults (18-64 years)

Inclusion criteria

- 18 50 years old.
- Normal hearing as assessed with the hearing threshold measurement in Session
- 1 (that is, hearing thresholds > -20 dB).

Exclusion criteria

- A history of neurological and/or psychiatric disorders.
- Participants that do not meet the MRI safety criteria will be excluded from the study:
- Epilepsy.
- Heart rhythm disorder.
- Diabetic.
- Large and/or ferromagnetic parts in the head (except for a dental wire).
- Active implant (e.g. pacemaker, neurostimulator, insulin pump, ossicle prosthesis, or residual

leads).

- o Claustrophobia.
- o Pregnancy.

Study design

Design

Study type: Observational non invasive		
Masking:	Open (masking not used)	
Control:	Uncontrolled	
Primary purpose:	Other	

Recruitment

NL	
Recruitment status:	Pending
Start date (anticipated):	01-11-2024
Enrollment:	15
Туре:	Anticipated

Ethics review

Approved WMO	
Date:	11-09-2024
Application type:	First submission
Review commission:	CMO regio Arnhem-Nijmegen (Nijmegen)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register

ССМО

ID NL86698.091.24