

Prior listening to binaural beats facilitates syntactic processing during auditory speech tasks

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Background

• Binaural beats are an auditory illusion generated by the dichotic presentation of two different pure tones¹.

• Binaural beats give rise to neural entrainment² and have been shown to improve cognition such as verbal working memory³ and long-term memory⁴.

- Beta and gamma oscillations reflect syntactic and semantic processing⁵.
- Theta oscillations index working memory during sentence processing⁶.

• Theta and beta oscillations have been associated with grammaticality judgments⁵.

Hypotheses

• Exp.1: Theta, beta, and gamma binaural beats will enhance sentence comprehension, particularly for sentences that are more difficult to process. Beta will have the strongest effect due to its documented functional role in syntactic processing⁷.

• Exp.2: Theta and Beta binaural beats will enhance grammaticality judgement, while gamma binaural beats will have less impact.

Methods

BINAURAL BEAT STIMULATION



Participants were randomly assigned to one of four auditory conditions (N=25 for each).

EXPERIMENTAL PROCEDURES



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Experiment 1

PARTICIPANTS: 100 UTD Students (mean age: 21.5 years, SD: 3.5)

SENTENCE COMPREHENSION

Sentences featured a subject or object relative clause. Subjects identified the gender of the people performing an **action**, while ignoring those who love/adore/dislike/hate others.

Sentence Type	Example
Subject relative	<u>Gentlemen</u> that
Object relative	Gentlemen tha <u>Gentlemen</u> tha

RESULTS

Sentence type, p < .001, Auditory condition, p = .043, Interaction, p < .001





Object relative

Discussion

- This is the first study to demonstrate the effects of binaural beats on auditory sentence processing. structure.

- Together, our study suggests that binaural beats can be used as a therapeutic means for language impairments.

Blocks Total

• Specifically, beta and gamma binaural beats embedded in music facilitated thematic interpretation governed by syntactic

• However, the binaural beat effect was not generalized to other types of syntactic operations (e.g., grammaticality judgment). • Currently, EEG studies are underway to elucidate the functional roles of binaural beats on auditory sentence processing.



Sentence Type	Example
Subject relative	The costumer that tips (<u>tip</u>) the waitress saddles horses every day. Every year , the criminals that avoid the police go (<u>goes</u>) to the jail. Yesterday , the father that keeps the boys wanted (<u>wants</u>) toothpaste.
Object relative	The student that the nephew trusts (<u>trust</u>) fixed the mistake yesterday . Every week , the ladies that the baby loves watch (<u>watches</u>) the movie. The animal that the children dislike hunted (<u>hunts</u>) a prey last month .

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Sentence type