

Interactive 3D audio: Enhancing awareness of details in immersive soundscapes?

Mikkel N. Schmidt¹, Stephen Schwartz², and Jan Larsen¹

This work was supported by the Network for Danish Sound Technology,
www.soundtechnology.dk.

Additional material can be downloaded from
www.imm.dtu.dk/pubdb/p.php?6322.

¹DTU Informatics, Technical University of Denmark

²SoundTales, Marienlyst Alle 41, 3000 Helsingør, Denmark

Abstract

Motivation Spatial audio cues and the possibility of interacting with the audio environment is thought to increase listeners' and attention (bottom-up and top-down) to details in a soundscape.

Abstract

Motivation Spatial audio cues and the possibility of interacting with the audio environment is thought to increase listeners' and attention (bottom-up and top-down) to details in a soundscape.

Problem This work examines if interactive 3D audio enhances listeners' ability to recall details in a soundscape.

Abstract

Motivation Spatial audio cues and the possibility of interacting with the audio environment is thought to increase listeners' and attention (bottom-up and top-down) to details in a soundscape.

Problem This work examines if interactive 3D audio enhances listeners' ability to recall details in a soundscape.

Method Nine different soundscapes were constructed and presented in either mono, stereo, 3D, or interactive 3D, and performance was evaluated by asking factual questions about details in the audio.

Abstract

Motivation Spatial audio cues and the possibility of interacting with the audio environment is thought to increase listeners' and attention (bottom-up and top-down) to details in a soundscape.

Problem This work examines if interactive 3D audio enhances listeners' ability to recall details in a soundscape.

Method Nine different soundscapes were constructed and presented in either mono, stereo, 3D, or interactive 3D, and performance was evaluated by asking factual questions about details in the audio.

Result Results show that spatial cues can increase attention to background sounds while reducing attention to narrated text, ...

Abstract

Motivation Spatial audio cues and the possibility of interacting with the audio environment is thought to increase listeners' and attention (bottom-up and top-down) to details in a soundscape.

Problem This work examines if interactive 3D audio enhances listeners' ability to recall details in a soundscape.

Method Nine different soundscapes were constructed and presented in either mono, stereo, 3D, or interactive 3D, and performance was evaluated by asking factual questions about details in the audio.

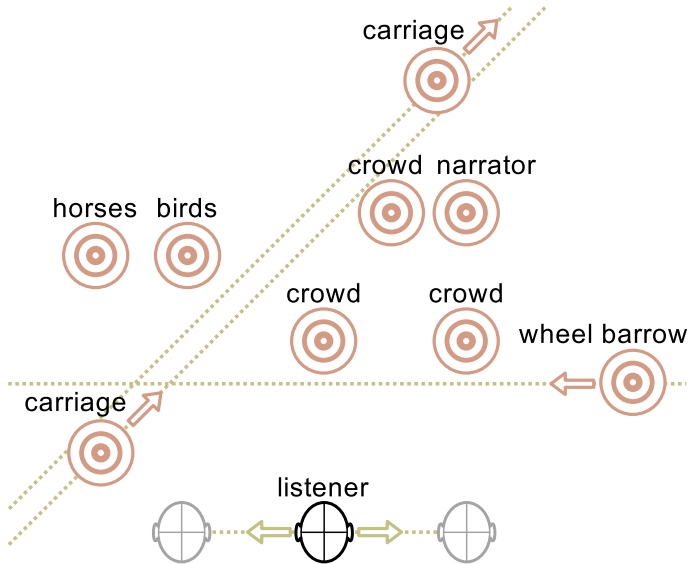
Result Results show that spatial cues can increase attention to background sounds while reducing attention to narrated text, ...

Conclusion ... indicating that spatial audio can be constructed to guide listeners' attention.

Interactive soundscape

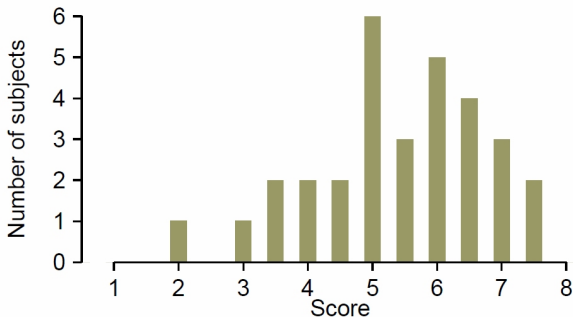
- Computed real time auralization
- Real time filtering and mixing according to relative position of listener and sound sources
- Lateral cues
 - Interaural time and level differences
 - We used: Head related transfer functions from dummy head
- Distance cues
 - Loudness and ratio between direct and reflected sound
 - We used: Attenuation and filtering by diffuse binaural room impulse response
- System hand-tuned to yield convincing 3D audio
- Listener can navigate (left and right) using computer keyboard

Interactive soundscape



Listening skill test

1. Presentation of 8 sound clips in random order for all 31 subjects (students, faculty and professional audio)
2. Free text answer to a specific question concerning the clip
3. Evaluation: Incorrect=0; Correct=1; Partly correct=0.5 point



Questions

1. Seven listening experience questions

Four-point unipolar rating scales mapped equidistant interval scale

Example: "To what degree were you captivated in the setting's space?"

Not captivated, Slightly captivated, Fairly captivated, Strongly captivated

Questions

1. Seven listening experience questions

Four-point unipolar rating scales mapped equidistant interval scale

Example: “To what degree were you captivated in the setting’s space?”

Not captivated, Slightly captivated, Fairly captivated, Strongly captivated

2. Narration

Multiple choice, three options, one correct

Example: “What is mentioned that the woman rescues from the fire?”

The fire wood, The fire place, The fire tongs

Questions

1. Seven listening experience questions

Four-point unipolar rating scales mapped equidistant interval scale

Example: “To what degree were you captivated in the setting’s space?”

Not captivated, Slightly captivated, Fairly captivated, Strongly captivated

2. Narration

Multiple choice, three options, one correct

Example: “What is mentioned that the woman rescues from the fire?”

The fire wood, The fire place, The fire tongs

3. Audio environment

Multiple choice, three options, one correct

Example: “Which game was played at the end?”

A: Chess, Backgammon, Cards

Listening experience

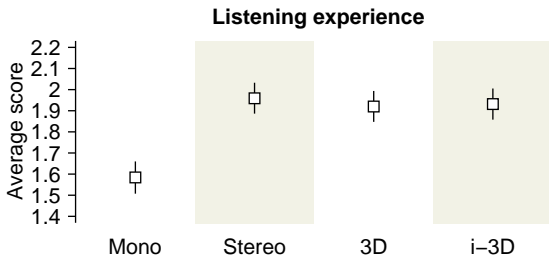


Figure: Average score on a 0–3 point scale on questions related to the listening experience.

Four-point unipolar rating scale mapped equidistant interval scale

Example: “To what degree were you captivated in the setting’s space?”

Not captivated, Slightly captivated, Fairly captivated, Strongly captivated

Listening experience

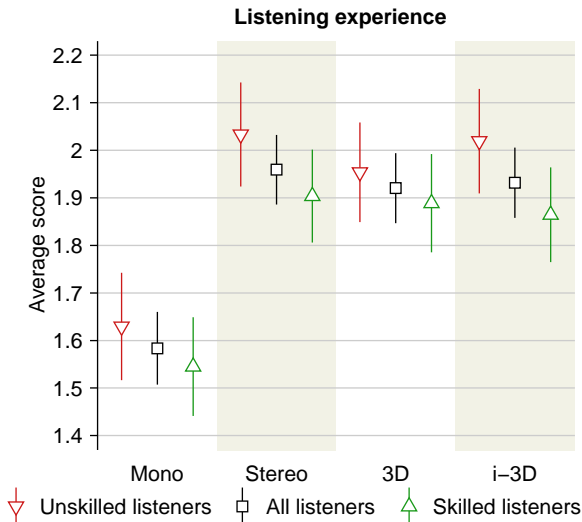


Figure: Average score on a 0–3 point scale on questions related to the listening experience.

Narration

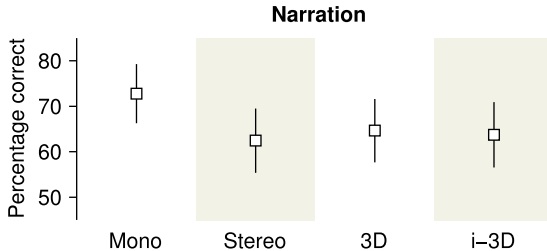


Figure: Fraction of correct answers to questions regarding the narration.

Multiple choice, three options, one correct

Example: “What is mentioned that the woman rescues from the fire?”
The fire wood, The fire place, The fire tongs

Narration

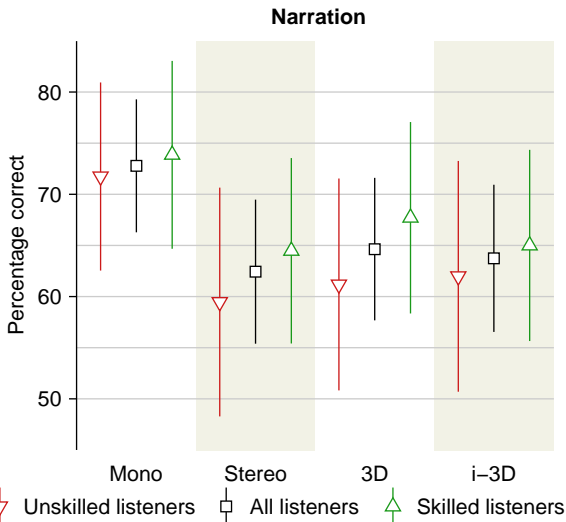


Figure: Fraction of correct answers to questions regarding the narration.

Audio environment

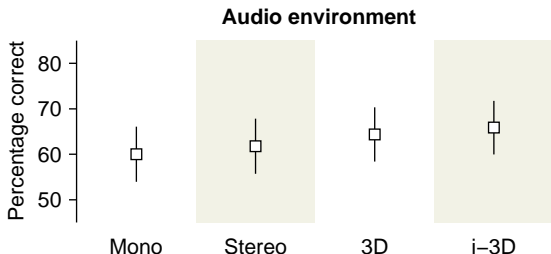


Figure: Fraction of correct answers to questions regarding the audio environment.

Multiple choice, three options, one correct

Example: "Which game was played at the end?"

A: Chess, Backgammon, Cards

Audio environment

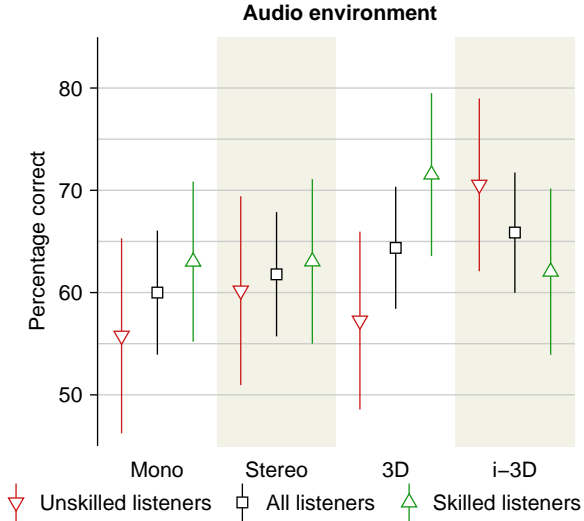


Figure: Fraction of correct answers to questions regarding the audio environment.

Conclusions

Hypothesis Spatial cues and interaction improves listeners' ability to discern sound sources leading to better attention to details.

Conclusion

- Concerning sounds in the **audio environment** (not narration), our results weakly confirm this hypothesis.
- Concerning **narration**, listeners performed better in the mono condition, perhaps indicating that their attention was more easily distracted by background sounds in 3D audio in accordance with our hypothesis.