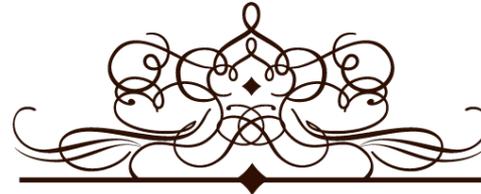




# Acustica degli ambienti reali e virtuali... in Unity



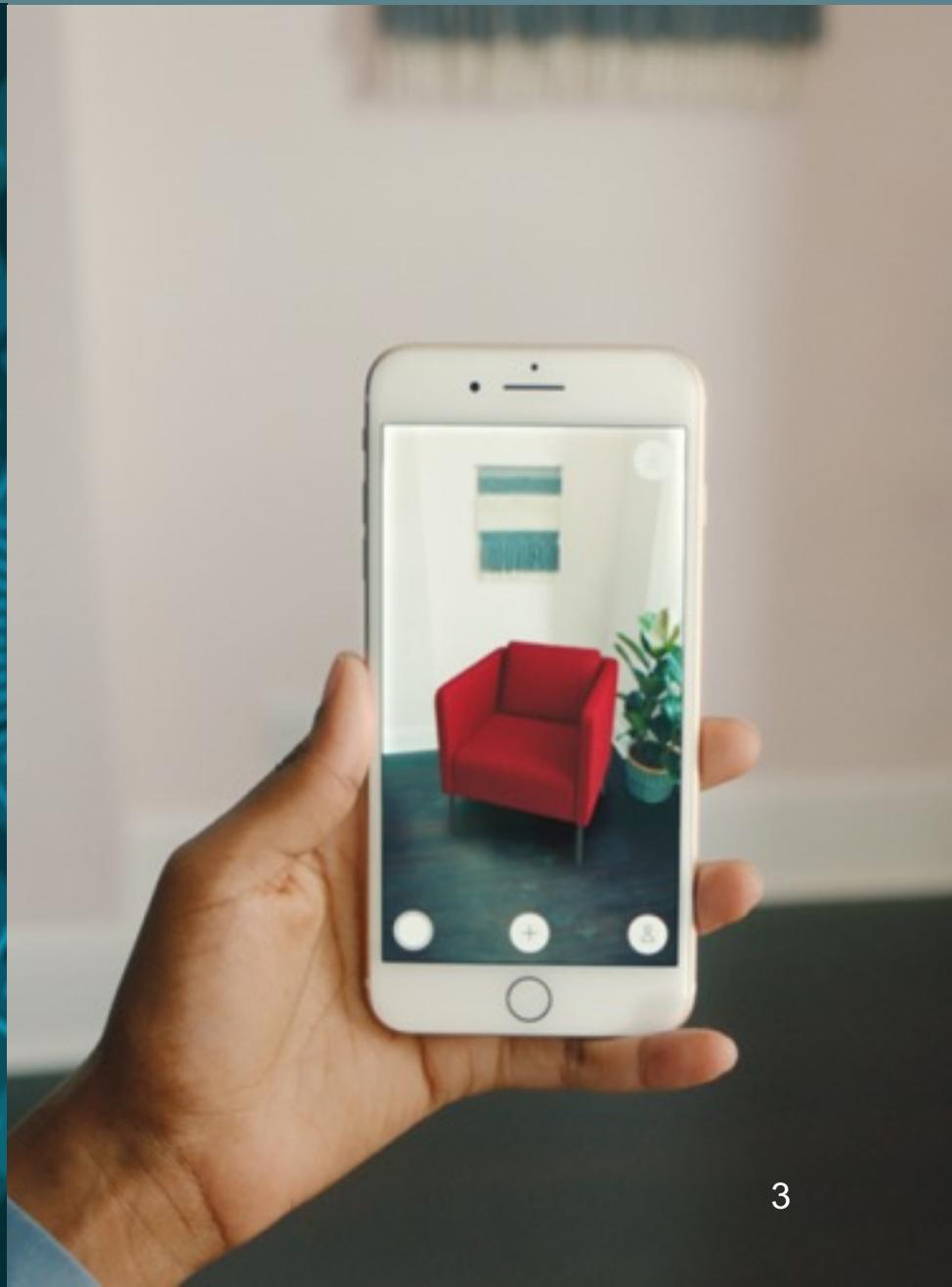
Alessandro  
Privitera

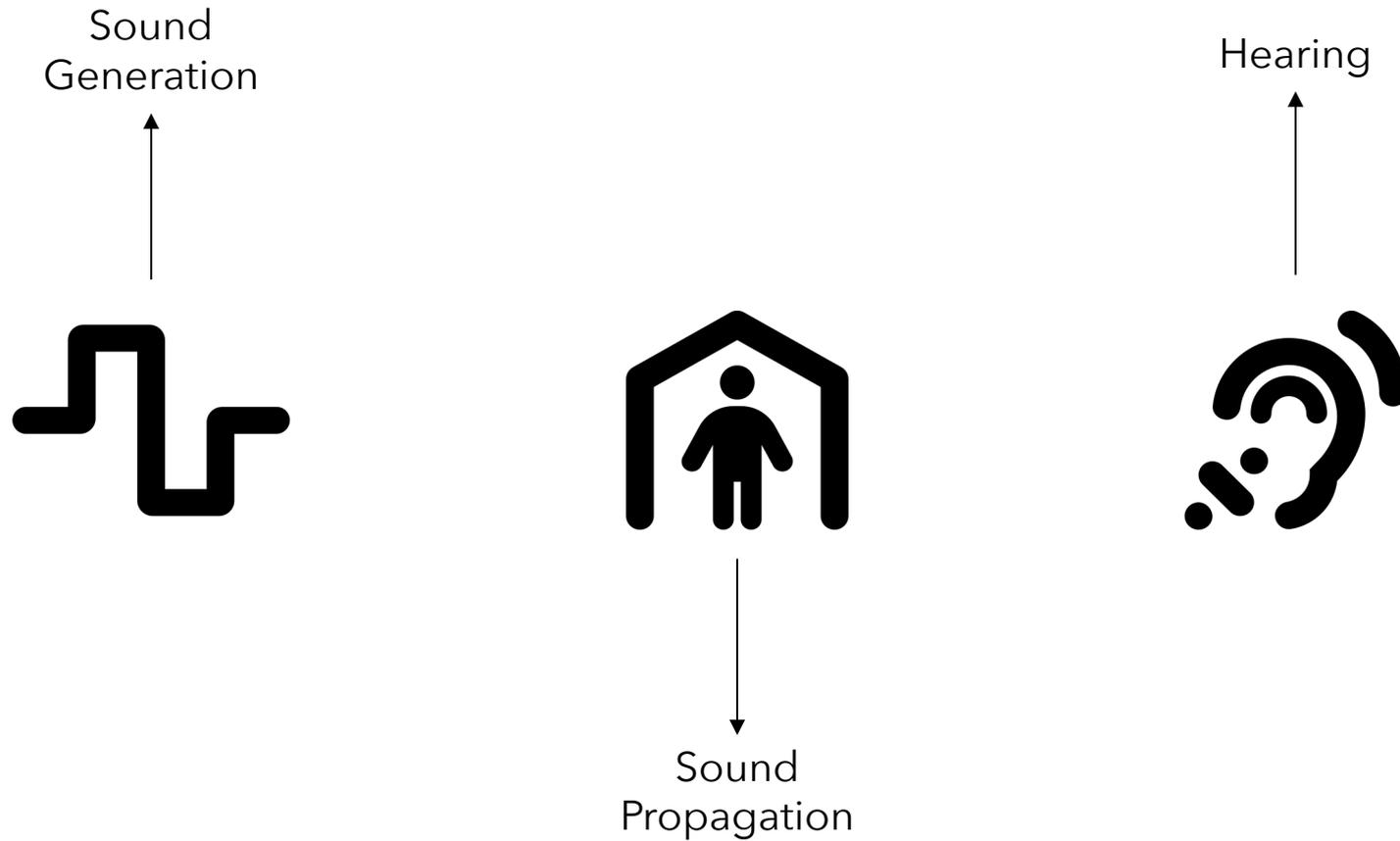


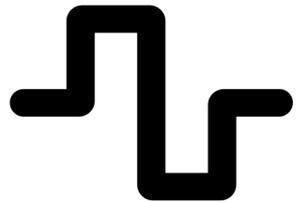
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# MENU

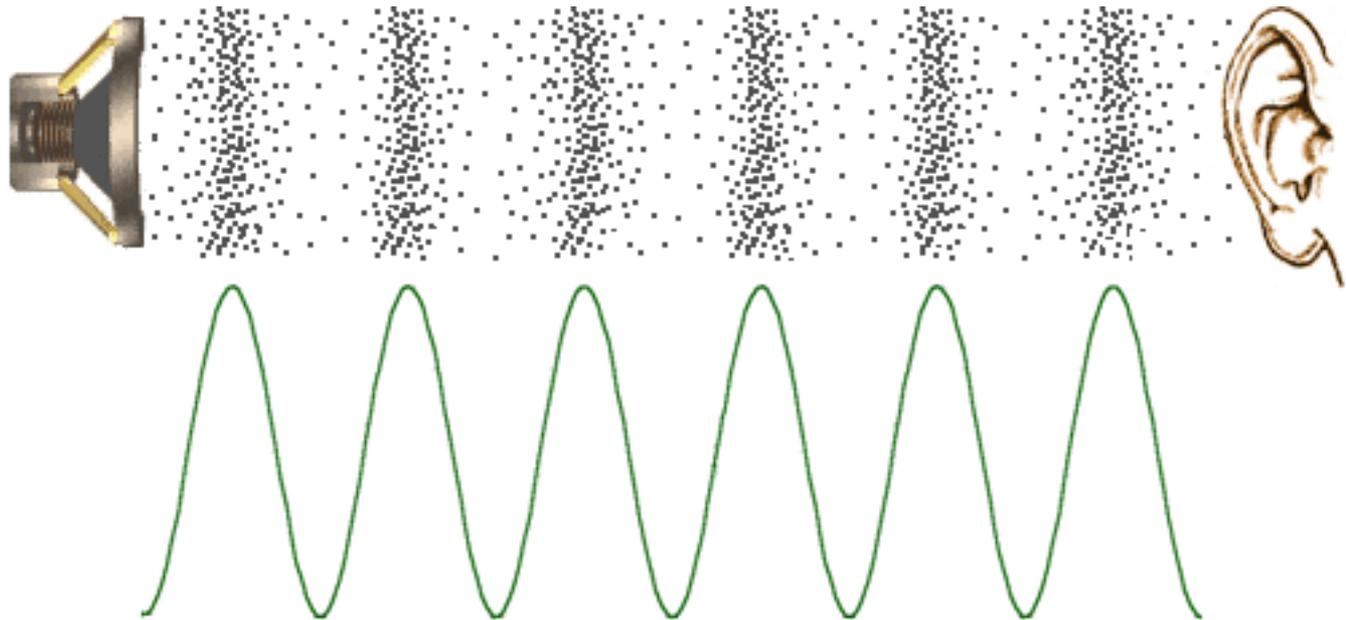
- 💡 AR vs VR
- 💡 Audio: generation, propagation, hearing
- 💡 Audio Design tips
- 💡 Unity Examples





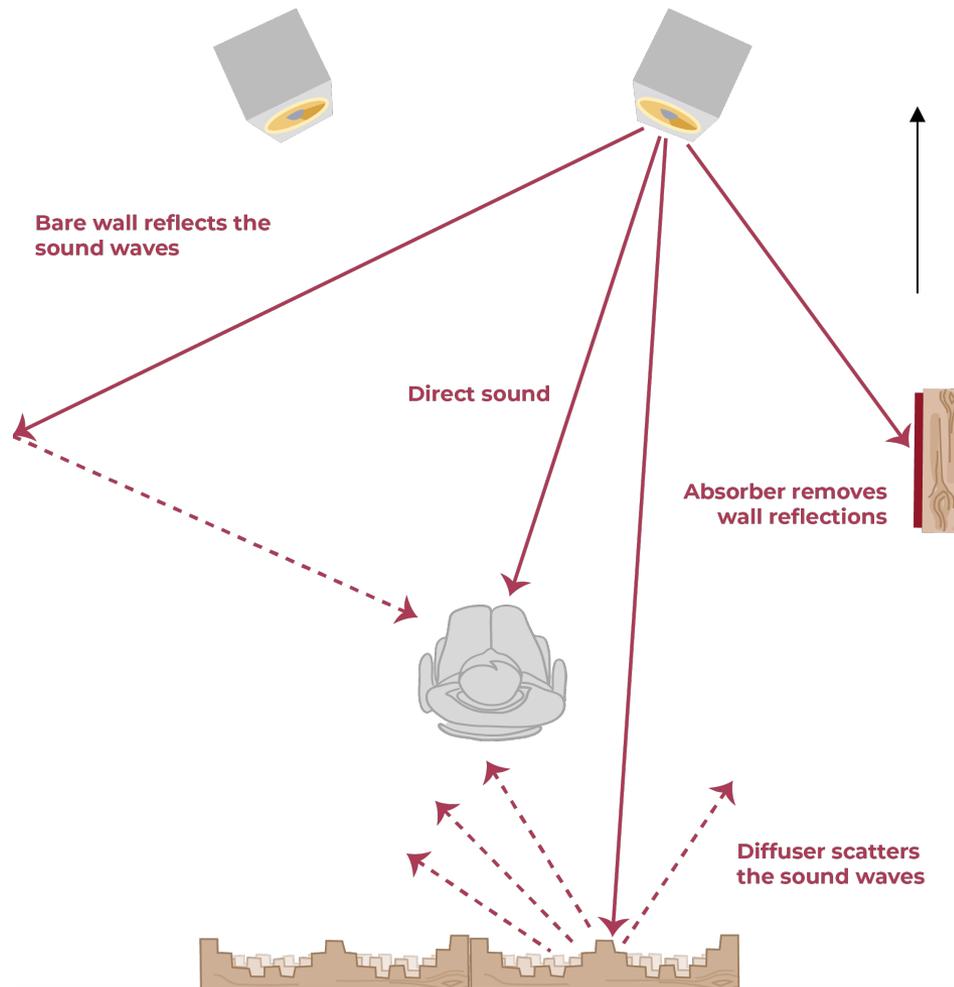


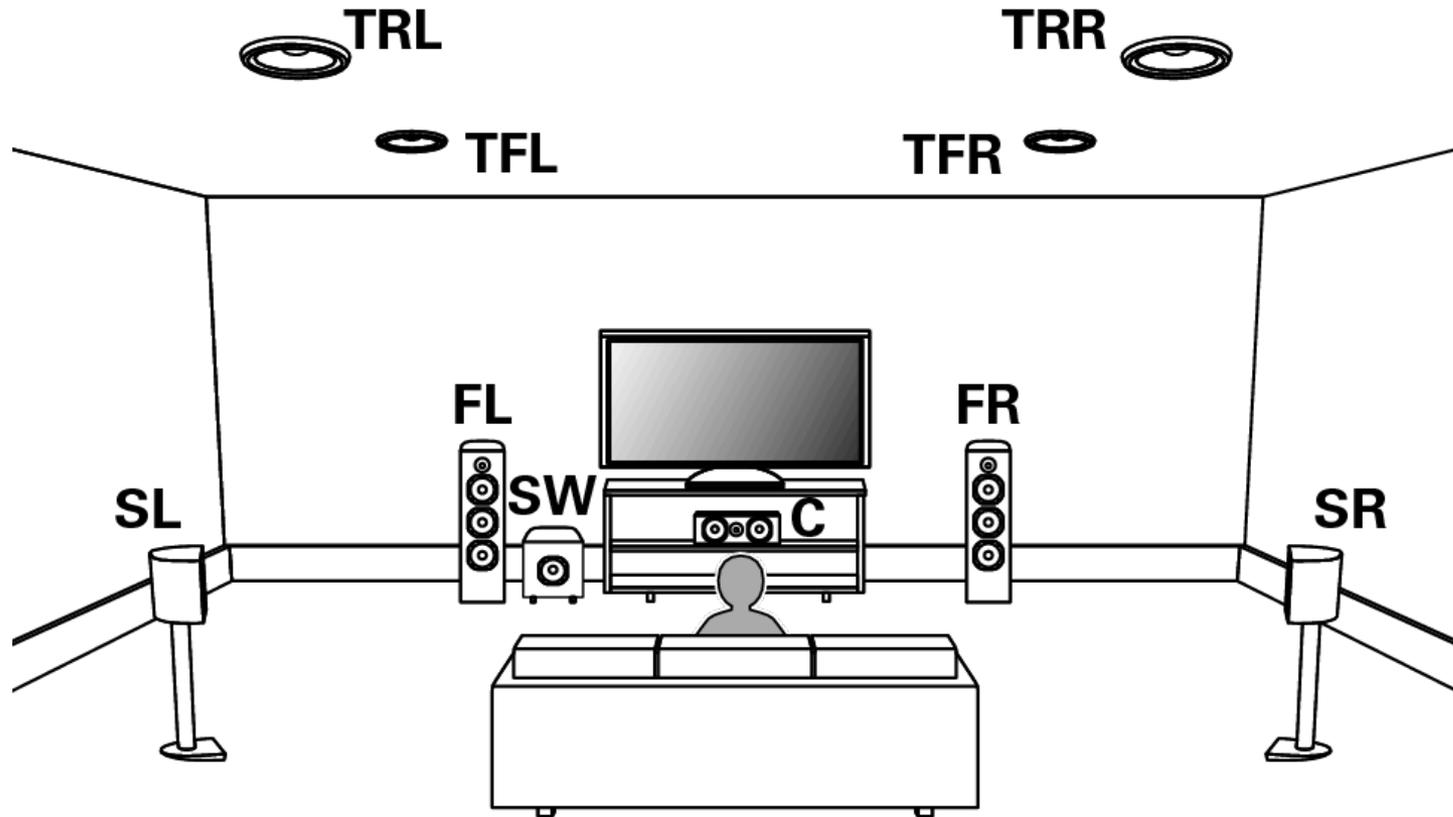
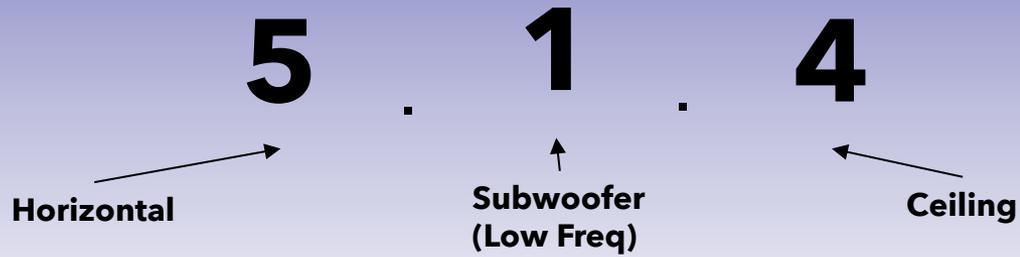
Sound  
Generation

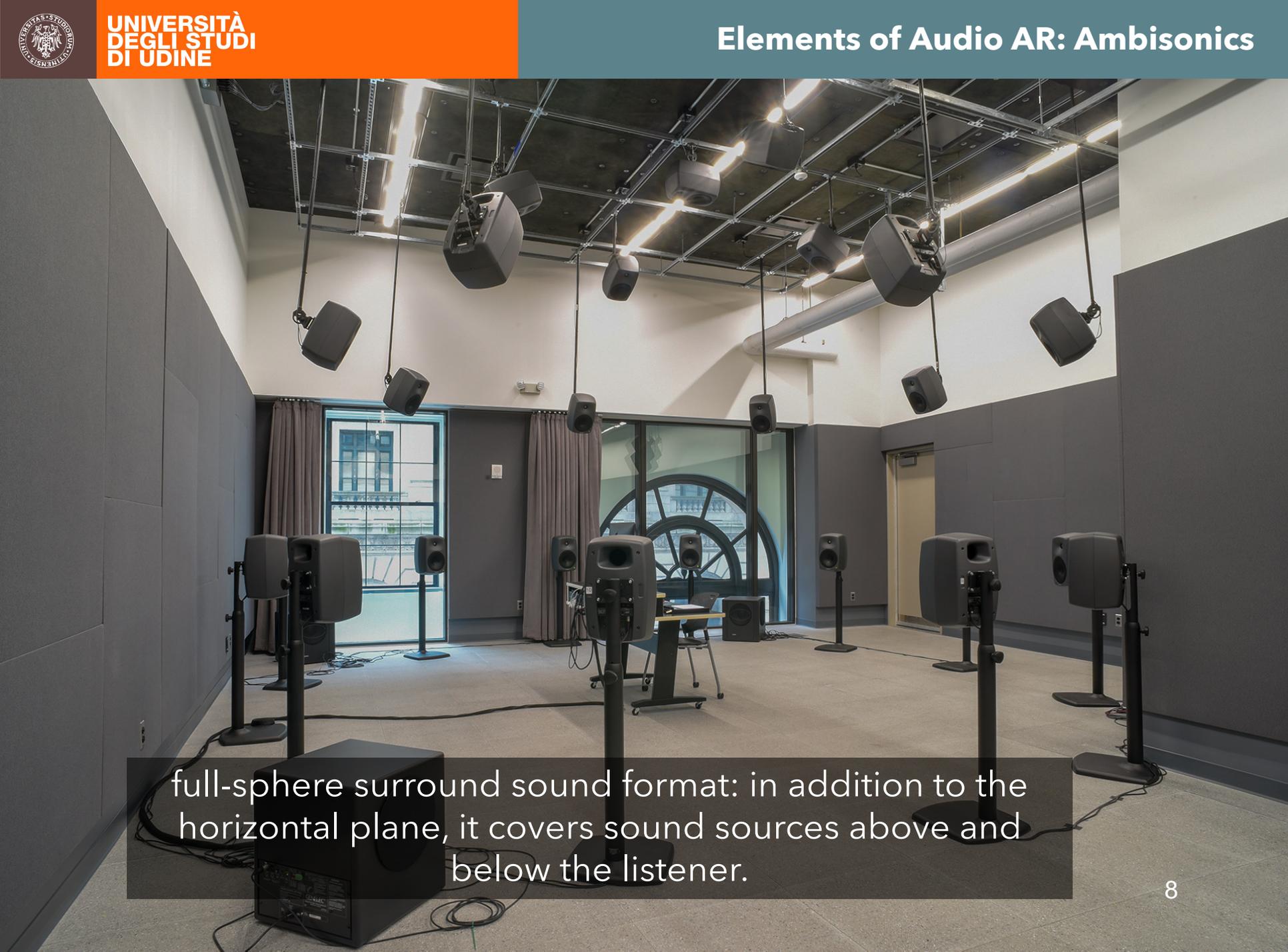




Sound  
Propagation

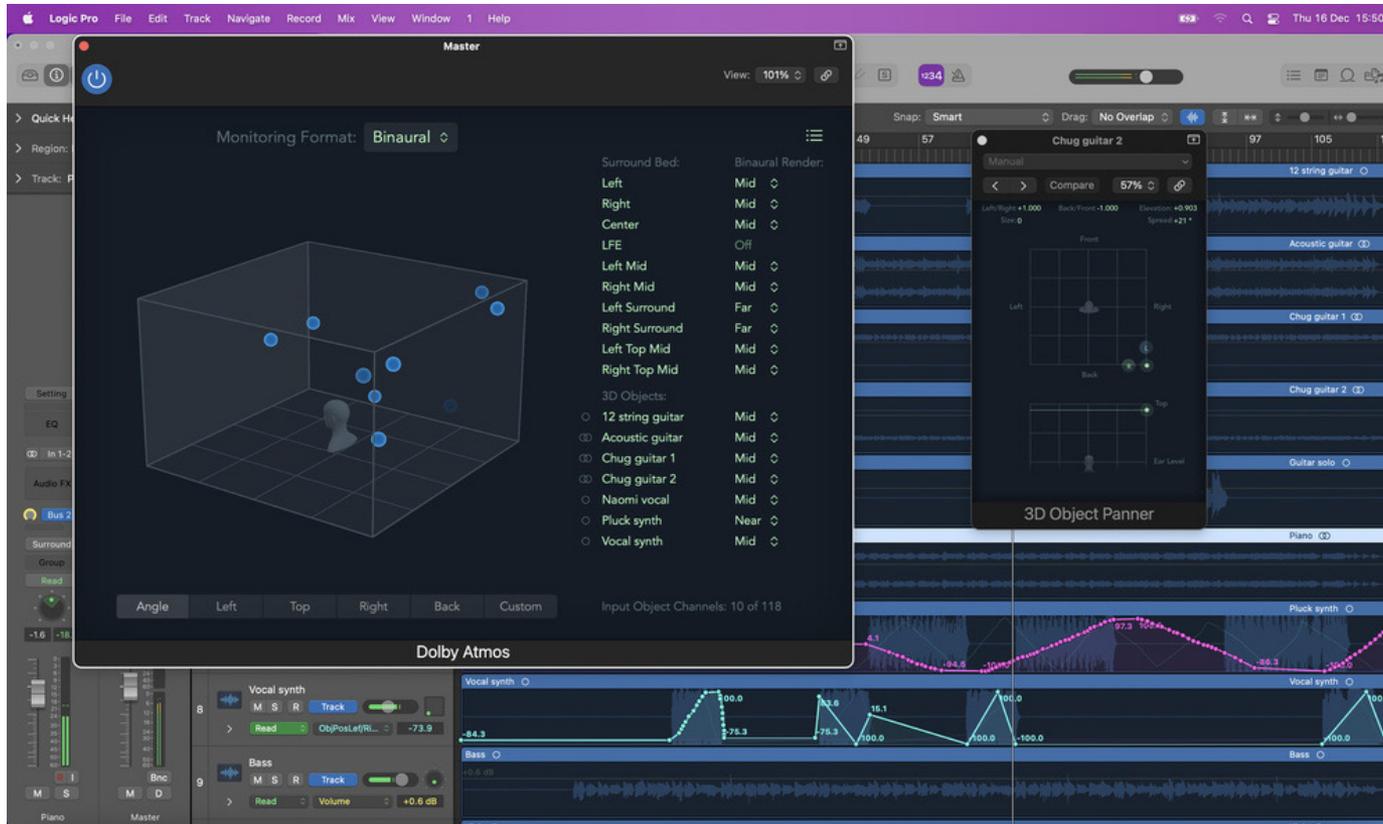




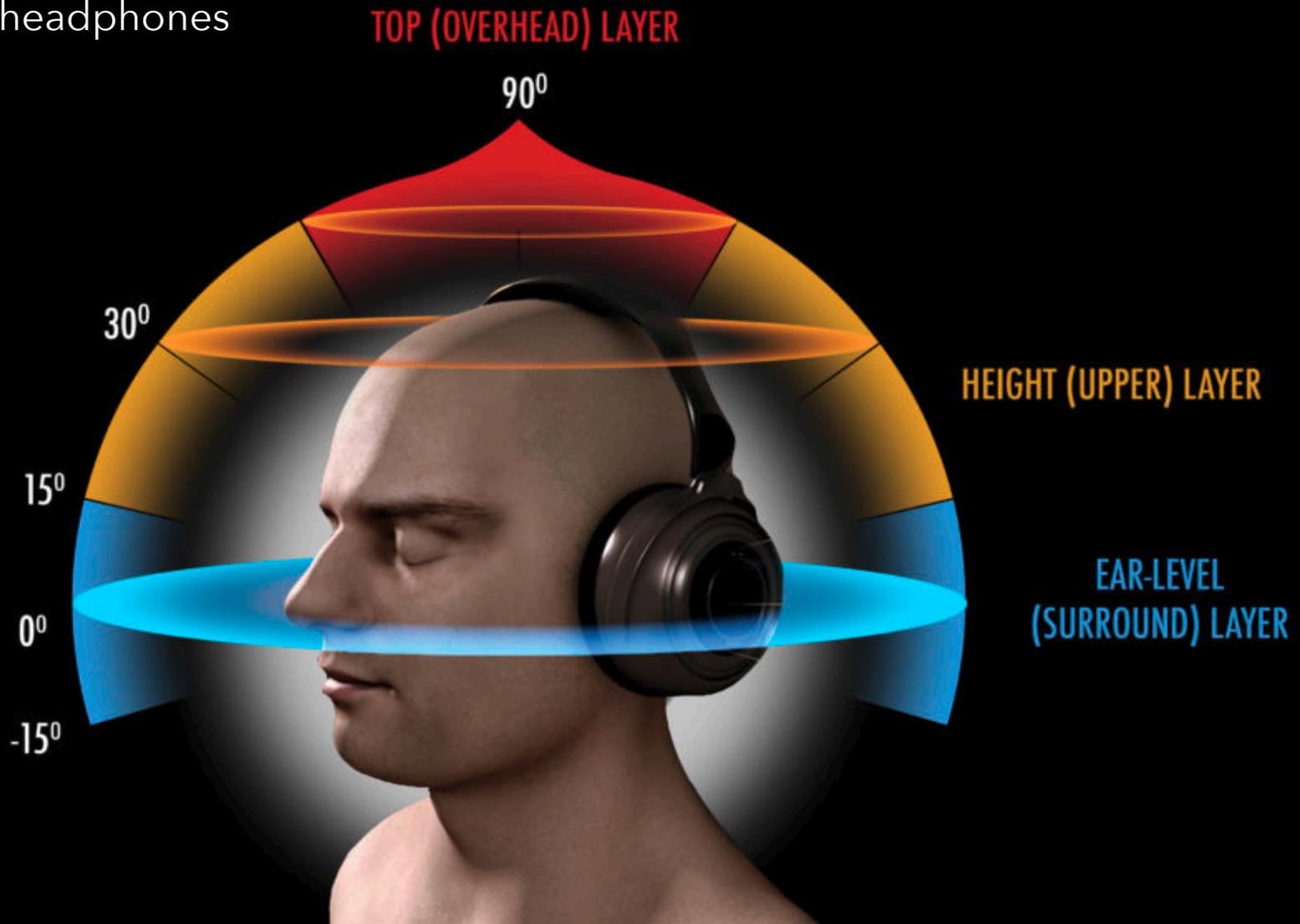


full-sphere surround sound format: in addition to the horizontal plane, it covers sound sources above and below the listener.

Up to 128 audio «objects» with associated spatial audio (location, pan, automation, etc.)



Technology for spatial audio listening using headphones

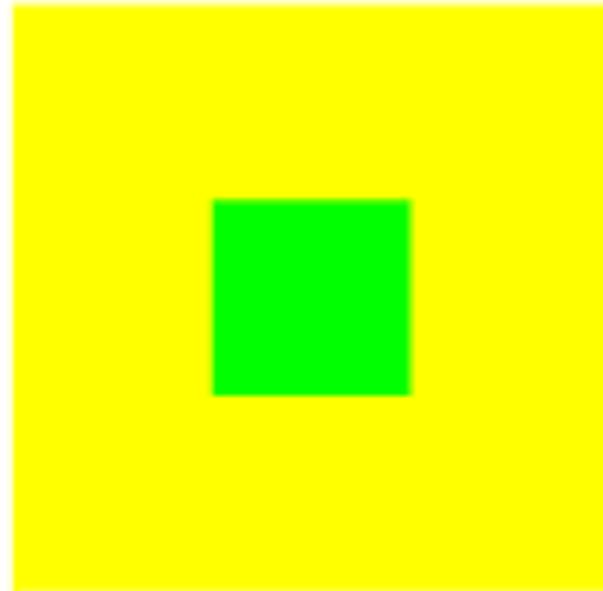
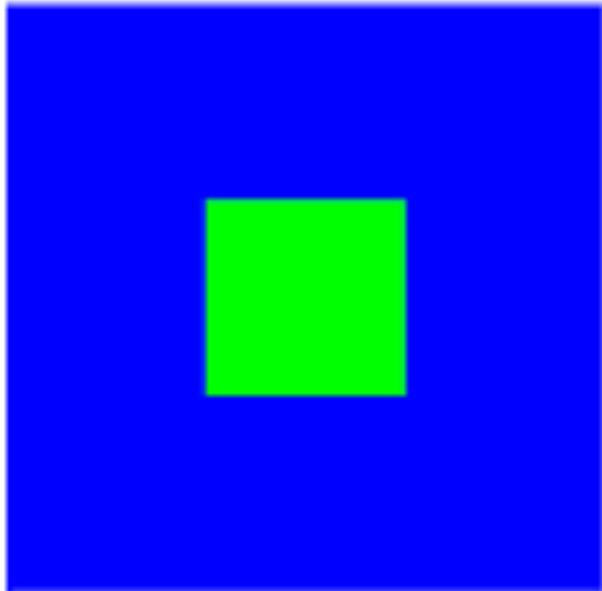


... .. JOHN ... ..



Hearing

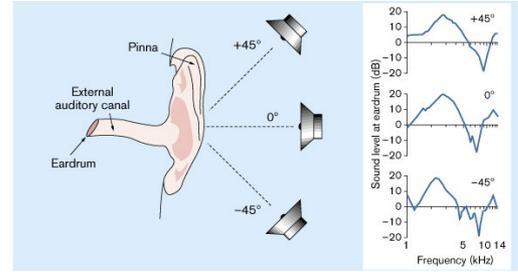




## Problems



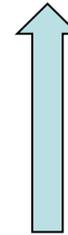
Front-back  
Confusion



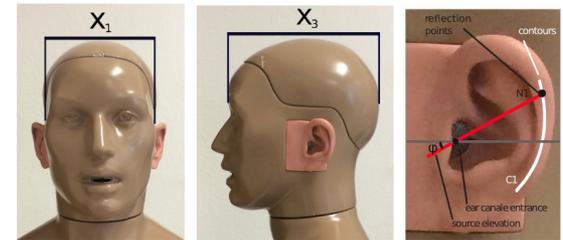
Sound Elevation  
Perception



Head tracking



Human experience  
is Multimodal

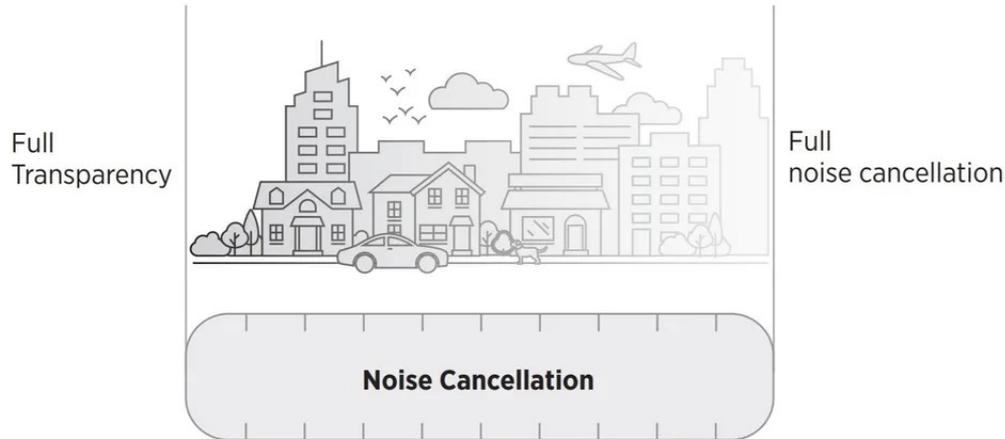


Head/Ear dimensions  
are not personalised

Experienced Audio AR users...

## Audio-Visual Mix





Environmental sounds are not modified by hearing devices (headphones, earphones, etc.)

Unfortunately,  
the state-of-the art...



Audio Engineering Society

## Convention Paper 10611

Presented at the 152nd Convention  
2022 May, In- Person and Online

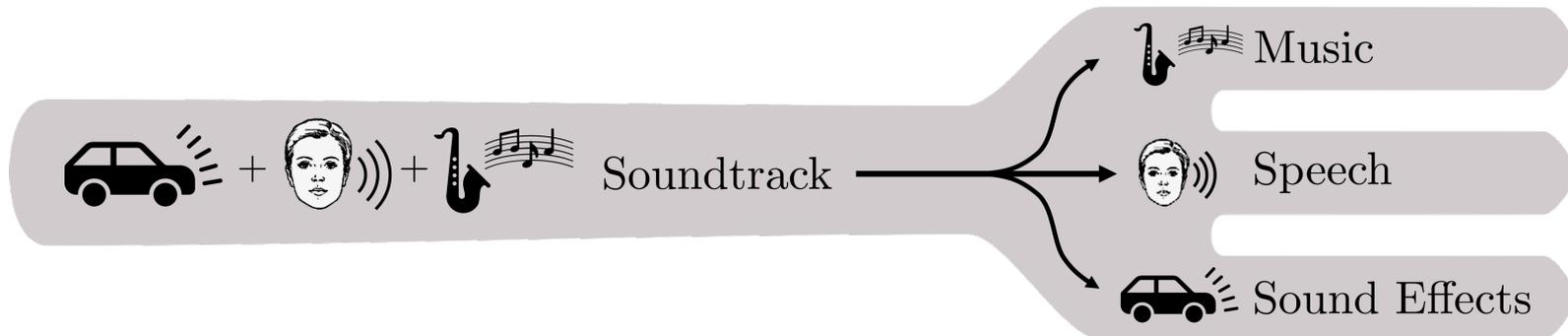
*This convention paper was selected based on a submitted abstract and 750-word precis that have been peer reviewed by at least two qualified anonymous reviewers. The complete manuscript was not peer reviewed. This convention paper has been reproduced from the author's advance manuscript without editing, corrections, or consideration by the Review Board. The AES takes no responsibility for the contents. This paper is available in the AES E-Library (<http://www.aes.org/e-lib>), all rights reserved. Reproduction of this paper, or any portion thereof, is not permitted without direct permission from the Journal of the Audio Engineering Society.*

### An open dataset of measured HRTFs perturbed by headphones

Roman Schlieper<sup>1</sup>, Stephan Preihs<sup>1</sup>, and Jürgen Peissig<sup>1</sup>

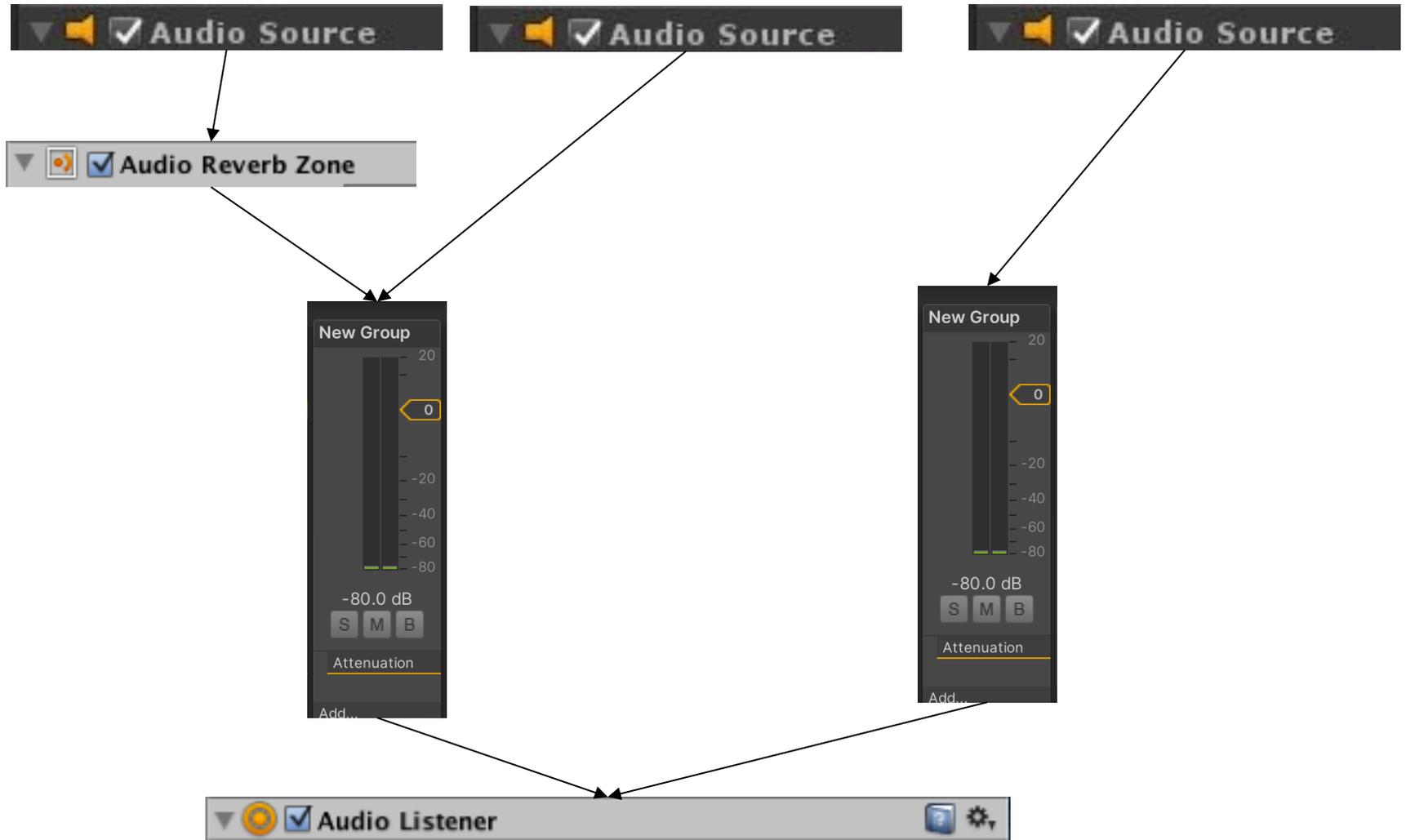
<sup>1</sup>Gottfried Wilhelm Leibniz Universität Hannover

Correspondence should be addressed to Roman Schlieper ([schlieper@ikt.uni-hannover.de](mailto:schlieper@ikt.uni-hannover.de))



Tips for an engaging game/XR audio:

- Less loops, adaptive music
- Less is more, avoid ear fatigue



Generates Spatial Audio

The screenshot shows the Unity Inspector window for an audio clip named 'pickupHealth'. The 'Import Settings' section is expanded, showing a 'Default' profile. The settings are as follows:

- Force To Mono:
- Normalize:
- Load In Background:
- Ambisonic:
- Load Type: Decompress On Load
- Preload Audio Data:
- Compression Format: Vorbis
- Quality: 100
- Sample Rate Setting: Preserve Sample Rate

Below the settings, a summary shows:

- Original Size: 202.6 KB
- Imported Size: 23.9 KB
- Ratio: 11.78%

The 'Imported Object' section shows the audio clip 'pickupHealth'. At the bottom, a waveform visualization is displayed with the text 'Vorbis, 44100 Hz, Mono, 00:02.351'.

→ Platform Optimisations



Audio Sources Goes Here



The screenshot shows an audio mixer interface. On the left is a sidebar with the following sections:

- Mixers**: + NewAudioMixer (Audio Listener) - Inactive
- Snapshots**: + Snapshot (with a star icon)
- Groups**: + Master (with a dropdown arrow), New Group, New Group, New Group
- Views**: + View

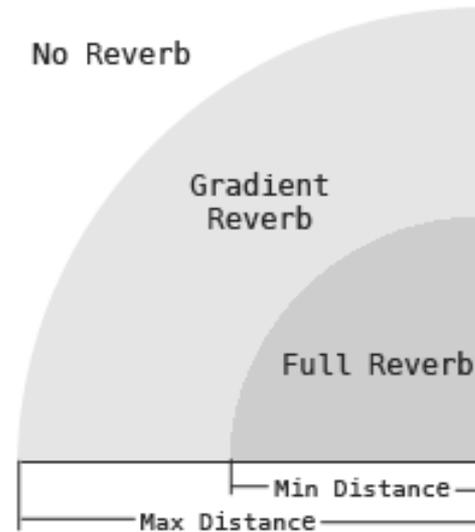
The main area contains four mixer channels:

- Master**: Attenuation slider at 0 dB, buttons S, M, B, and an Add... button.
- New Group**: Attenuation slider at 0 dB, buttons S, M, B, and an Add... button.
- New Group**: Attenuation slider at 0 dB, buttons S, M, B, and an Add... button.
- New Group**: Attenuation slider at 0 dB, buttons S, M, B, and an Add... button.

Each channel has a vertical scale from -80 to 20 dB. The current attenuation for all channels is -80.0 dB.

▼  Audio Reverb Zone

Min Distance	10
Max Distance	15
Reverb Preset	Generic
Room	-1000
Room HF	-100
Room LF	0
Decay Time	1.49
Decay HFRatio	0.83
Reflections	-2602
Reflections Delay	0.007
Reverb	200
Reverb Delay	0.011
HFRference	5000
LFRference	250
Room Rolloff Factor	0
Diffusion	100
Density	100



Reverb Zones take an Audio Clip and «distorts» it depending where the audio listener is located inside the reverb zone. They are used when you want to gradually change from a point where there is no ambient effect to a place where there is one, for example when you are entering a cavern.

Audio Source

AudioClip Lord of the Land

Output None (Audio Mixer Group)

Mute

Bypass Effects

Bypass Listener Effects

Bypass Reverb Zones

Play On Awake

Loop

Priority High Low 128

Volume 1

Pitch 1

Stereo Pan Left Right 0

Spatial Blend 1

Reverb Zone Mix 1

3D Sound Settings

Doppler Level 0

Spread 138

Volume Rolloff Custom Rolloff

Min Distance Controlled by curve

Max Distance 60

Listener

1.1

1.0

0.9

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.1

0.0

0 10 20 30 40 50 60

Volume Spatial Spread Reverb

To Audio Mixer

Loop File

Use spatial algorithm

Use Reverb Zone

More specific 3D settings



<https://bit.ly/priviteraUniud>

An alternative to standard Spatializer  
(With first reflections, occlusion and HRTF)



