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The Influences of Microphone System, Video, and Listening Position on the Perceived Quality of Surround Recording for Sport Content

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Research Question

- What technical factors significantly influence the perceived audio quality of 3D immersive sport content?

Independent Variables		Dependent Variables	
Microphone system	First-Order Ambisonics (FOA) vs. Equal Segment Mic Array (ESMA)	**Presence**	Sense of being there in the space.
Loudspeaker format	4-channel Quadraphonic vs. 8-channel double quad layers	**Listener Envelopment (LEV)**	Degree to which auditory scene is enveloping the listener.
Listening position	On-centre vs. Off-centre	**Robustness**	Degree to which the position of an auditory event changes with listener movements.
Content type	Indoor (squash) vs. outdoor (hockey)	**Depth**	Sense of perceived distance of in the auditory scene as a whole.
Video	With and without Video on TV	**Quality of Experience (QoE)**	The overall acceptability of the auditory experience as perceived subjectively.

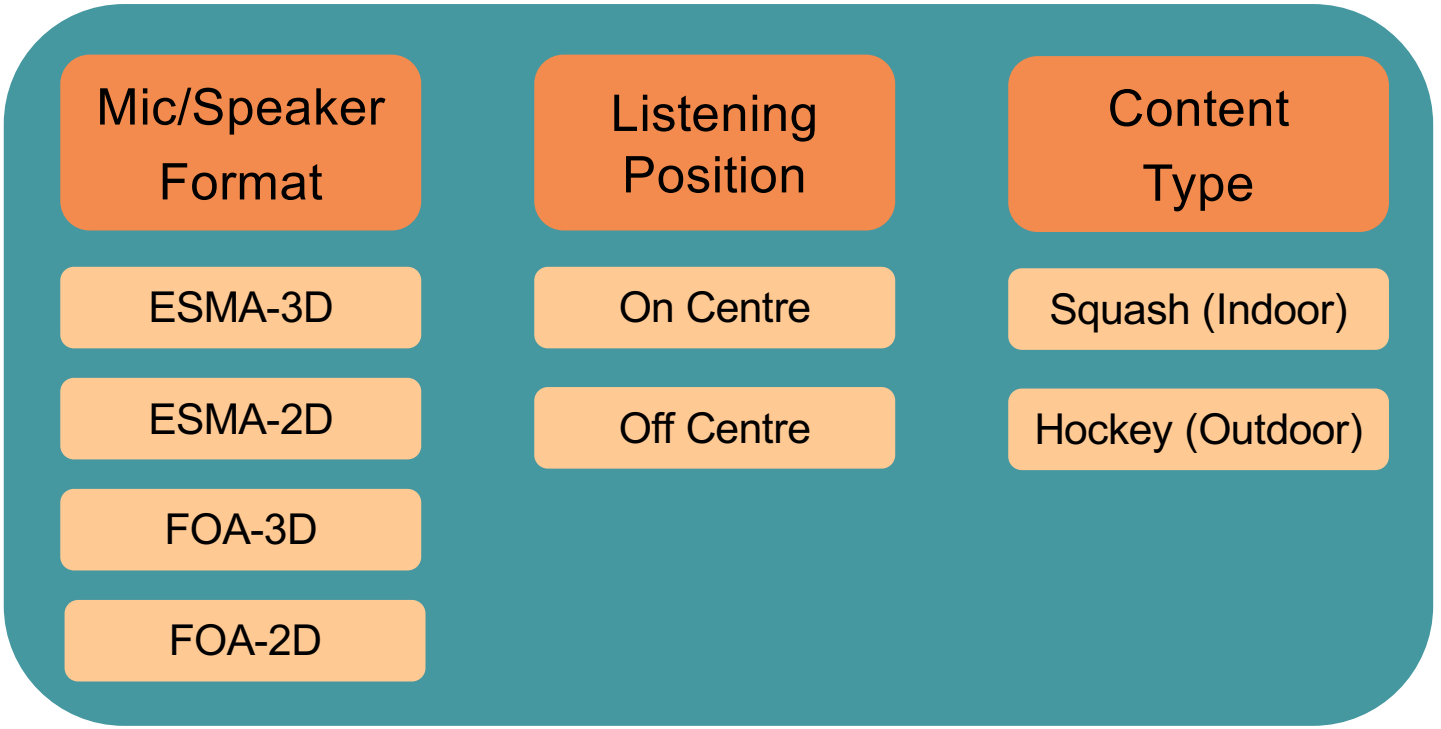
Experimental Design

- Mixed design
  - Between-Subject for Video (On/Off) - 2 subject groups
  - Within-Subject for Recording/Reproduction Format, Video and Listening Position.

Video On

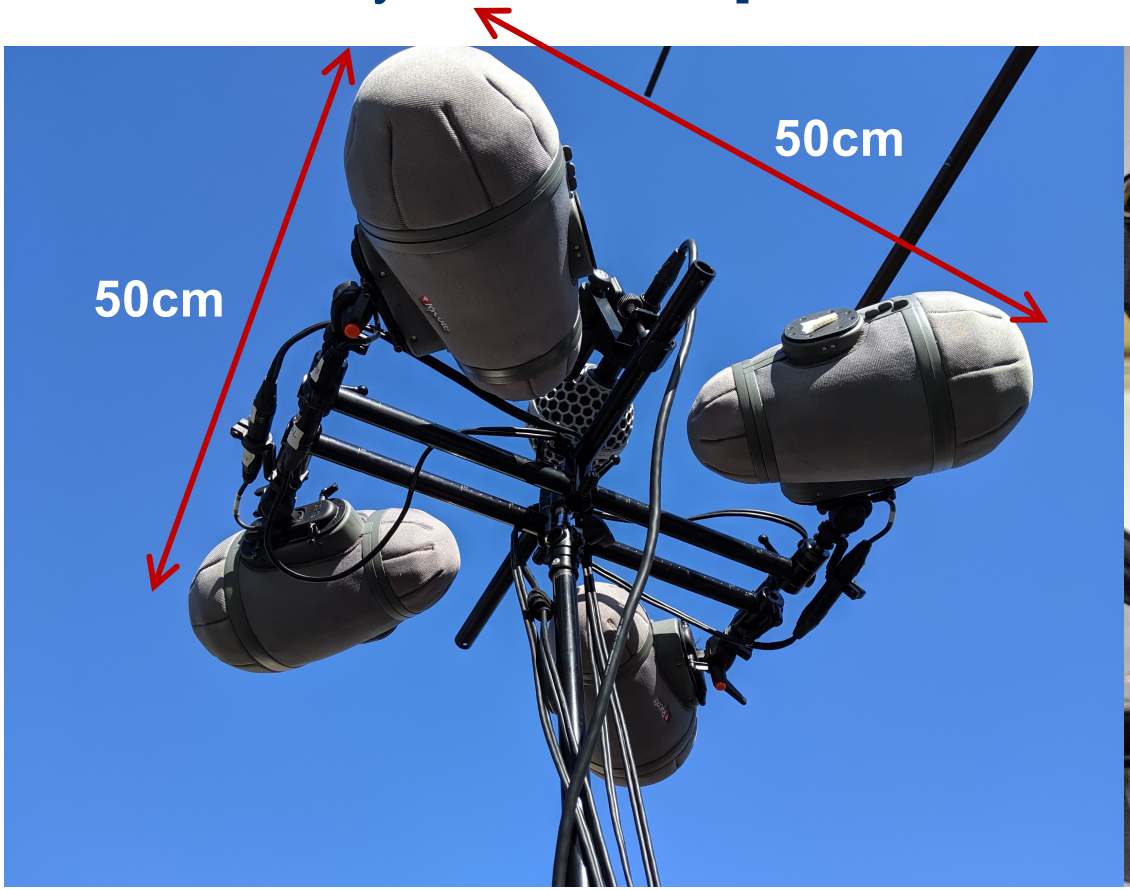
vs.

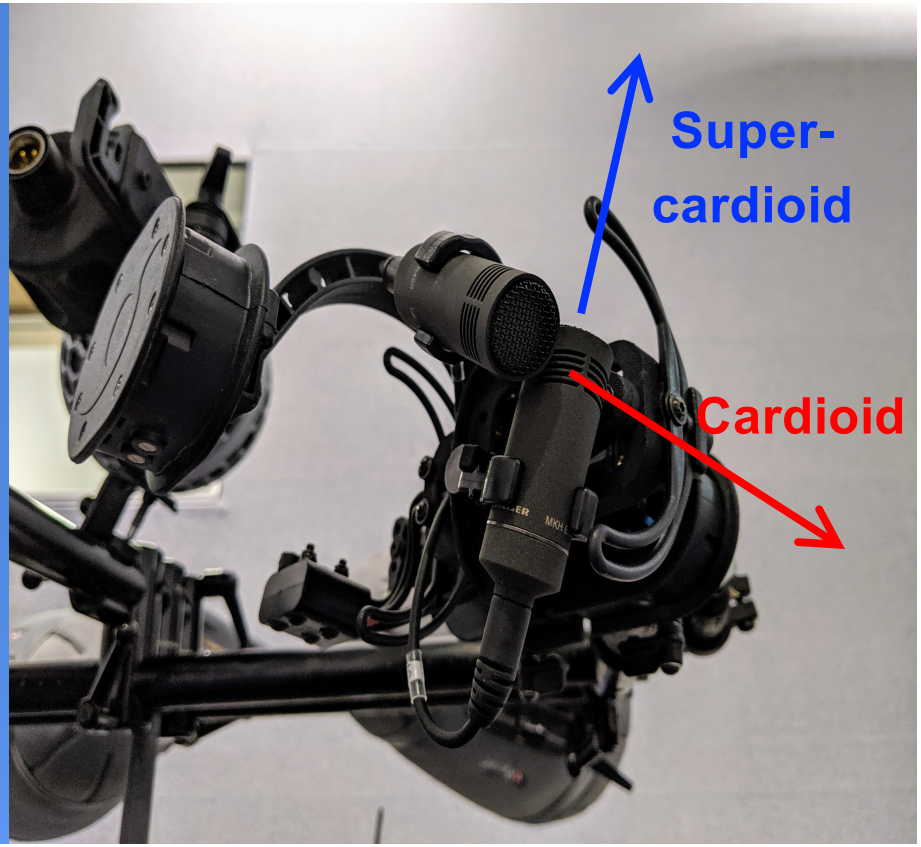
Video Off



ESMA-3D (Equal Segment Microphone Array 3D)

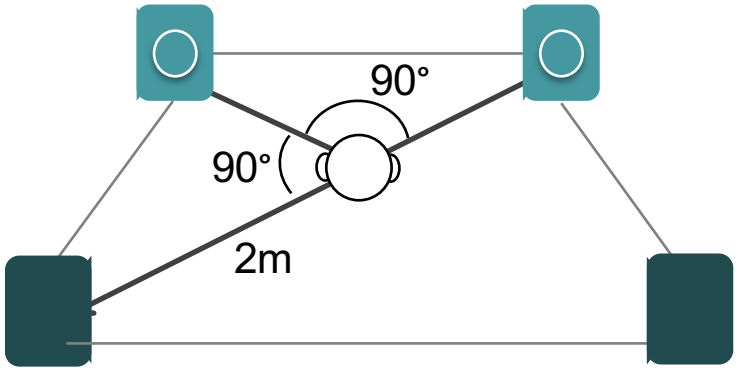
- A 50cm x 50cm square of 4 cardioids for the main layer and 4 supercardioids for the height layer [Lee 2018].
- Vertically Coincident [Lee and Gribben 2014].



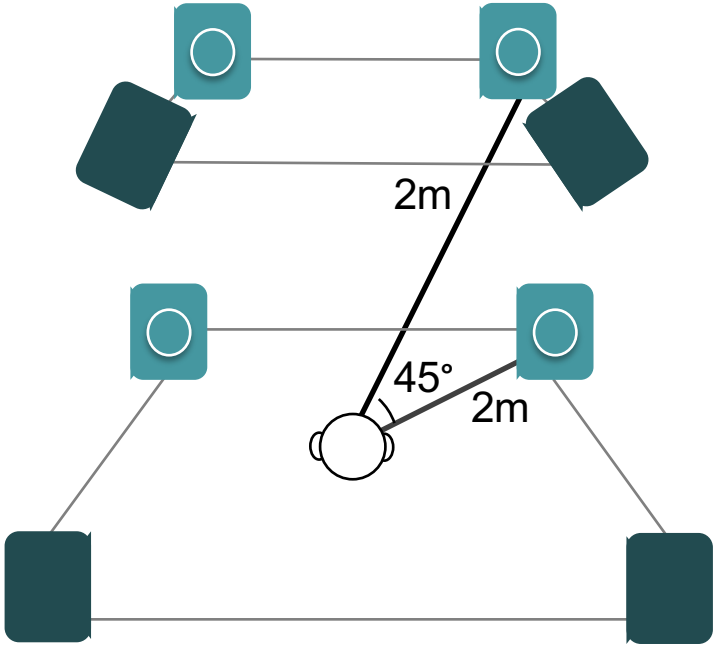


Reproduction Format

- 4ch quad (2D) vs. 8ch double quad layers (3D)



4-channel
Quadraphonic



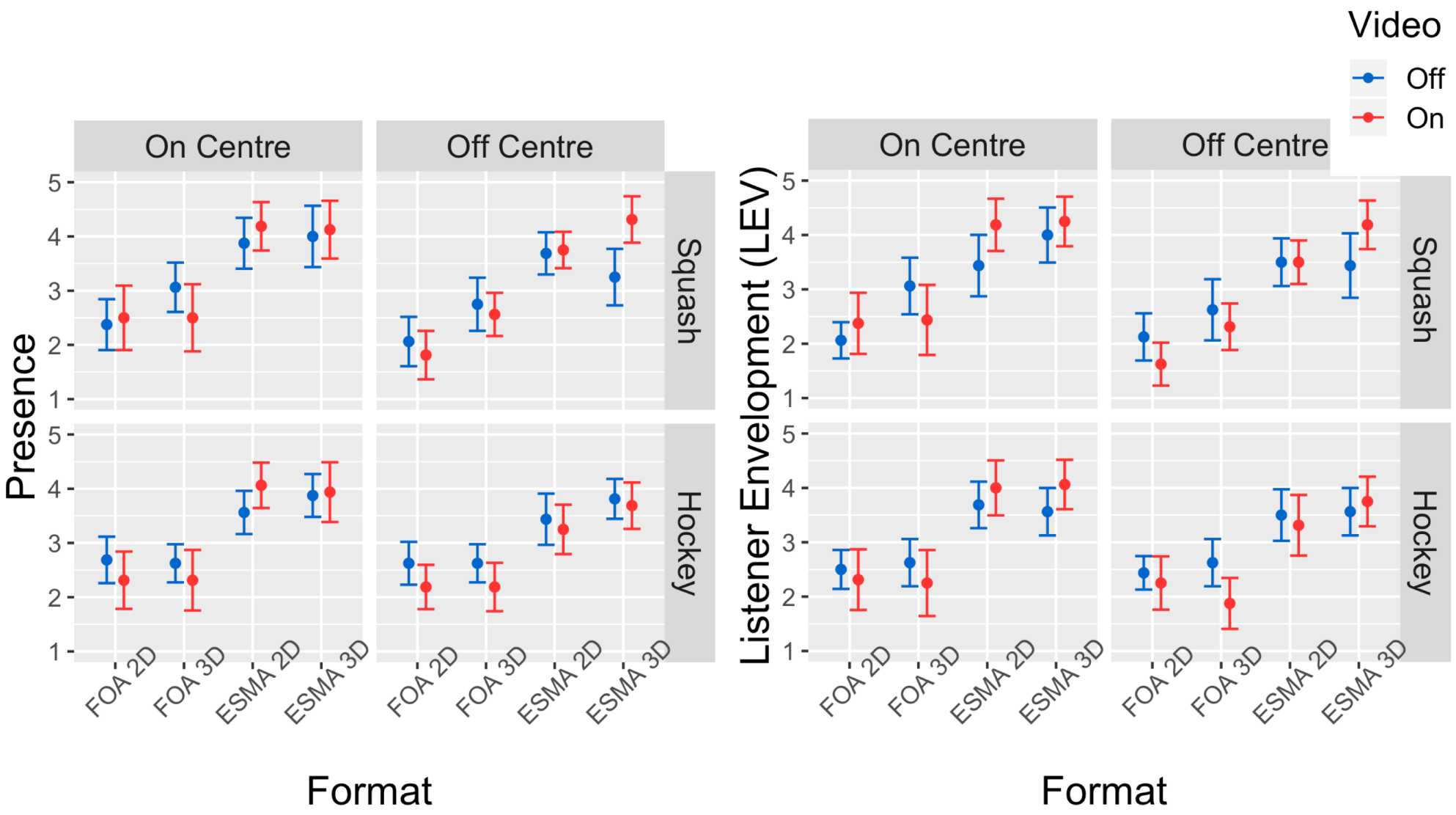
8-channel
Quad + Quad

Listening Test

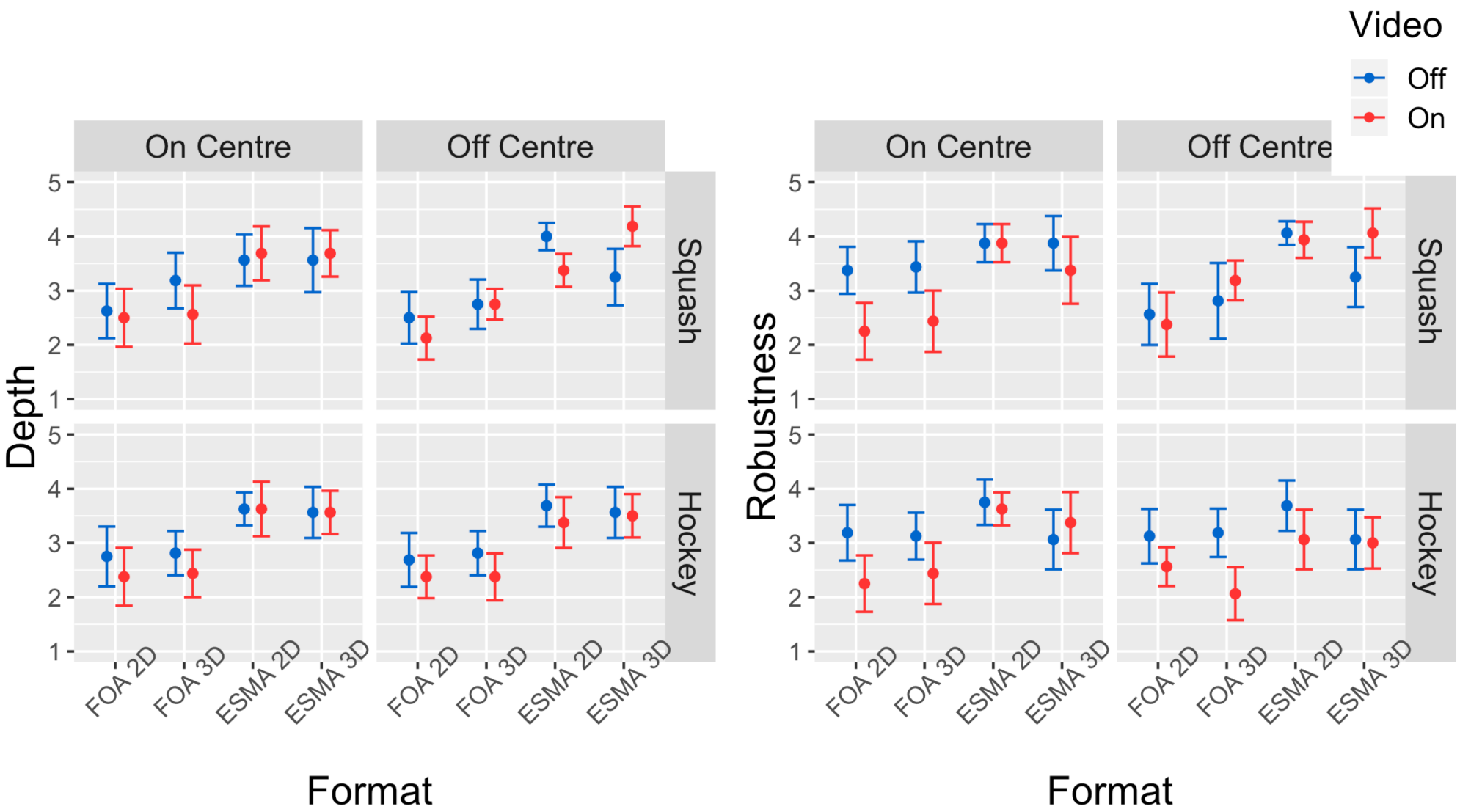
- Conducted in an ITU-R BS.1116-compliant listening room.
- 16 Subjects (2 repetitions for each condition)
  - 8 with Video on 50-inch TV
  - 8 without Video
- 16 stimuli for each group
- Single stimulus presentation in a randomised order.
- 5-point Absolute Categorical Rating (ACR)

  (5 = Excellent, 4 = Good, 3 = Fair, 2 = Poor, 1 = Bad)

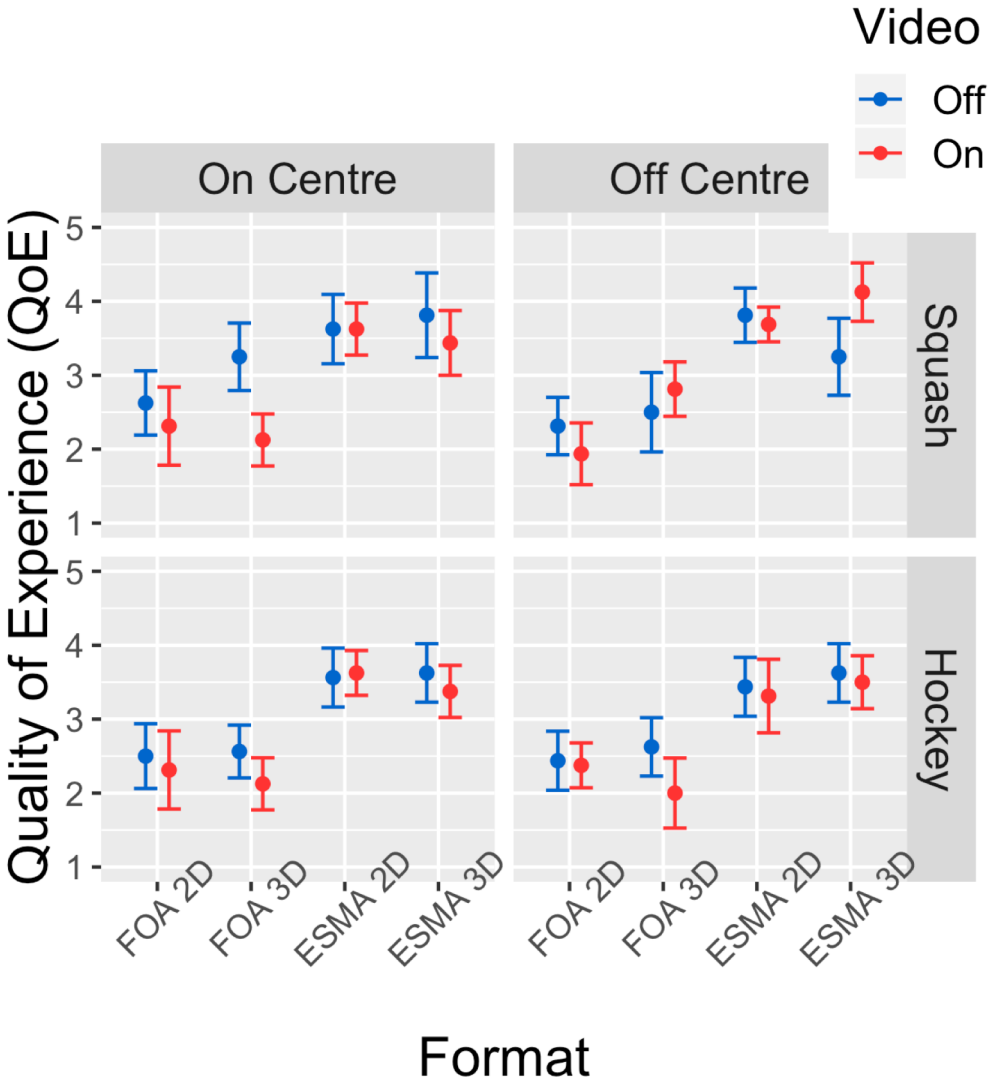
Results

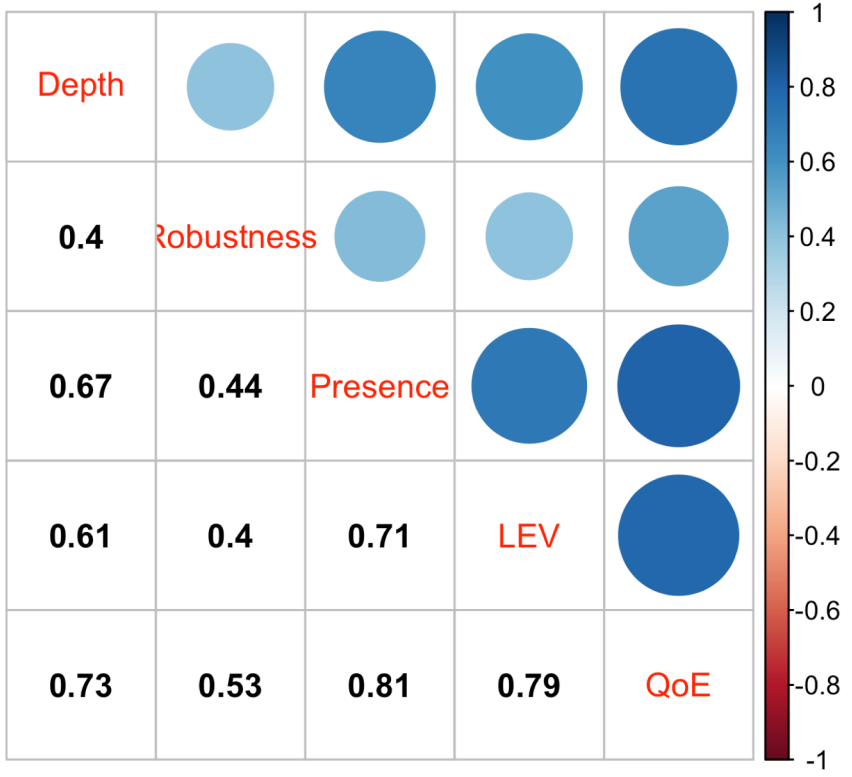

Video
Off
On
On Centre
Off Centre
Squash
Hockey
Presence
Listener Envelopment (LEV)
1
2
3
4
5
FOA 2D
FOA 3D
ESMA 2D
ESMA 3D
Format
Format

Results


Video
Off
On
On Centre
Off Centre
Squash
Hockey
Depth
Robustness
5
4
3
2
1
FOA 2D
FOA 3D
ESMA 2D
ESMA 3D
Format
Format

Results



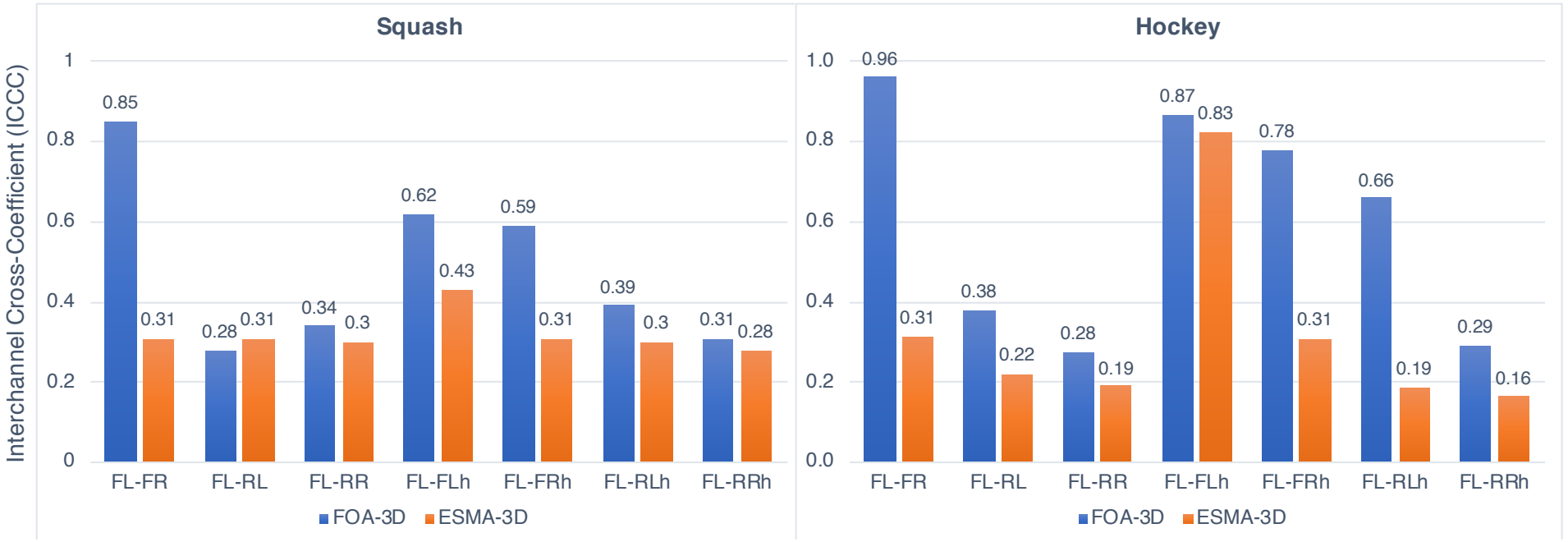


QoE is most correlated with Presence and LEV.

Discussion

- The results showed that ESMA was rated higher than FOA overall.
- 2D and 3D speaker formats did not have a significant difference.
- ESMA has lower interchannel correlation than FOA.

→ Greater LEV and Robustness → Better Presence and QoE



Discussion

- The video accompaniment mainly worked negatively on Robustness and QoE with the FOA, whereas it was a positive factor on Presence, Depth and QoE with the ESMA.

- For FOA, Video tends to degrade QoE at On-Centre but improve it at Off-Centre.

→ Discrepancy between audio and visual references due to the FOA's failure to physically reconstruct the sound field.

→ ESMA provides more plausible representation of the sound field.

References

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