

Really hear?

The effects of audio quality on presence

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Why study audio?

Sheridan (1992)
Extent of sensory info

Predominance of
visual modality in
presence research

Multichannel =
Increased accuracy/richness
in the spatial representation
of an environment

Advances in
audio technology

Audio affects visual

Aims

- **To explore the effects of multichannel audio on presence**

Can we replicate the findings of Hendrix & Barfield (1996) using a:

- (a) photorealistic video stimulus with synchronous audio?
- (b) more structured, empirically derived questionnaire (ITC-SOPI)?

- **To explore the effects of multichannel audio on audio/visual quality evaluations**

Audio Study A

- Design: 1 audio factor (3 levels: mono, stereo, 5.1) rep. meas. (c/balanced)
- Method: 18 students/staff (9M, 9F, 20-57yrs, 30.8 years)
- Stimulus: Rally car video stimulus viewed on 28" Philips 100Hz TV monitor housed in PiT. Viewing distance = 120cm (visual angle: 29 deg H; 17 deg V)



Volume matched (mono = stereo = 5.0 @ 70dB SPL)

For 5.1, bass elevated volume by further 10dB

Audio Study A

■ Measures:

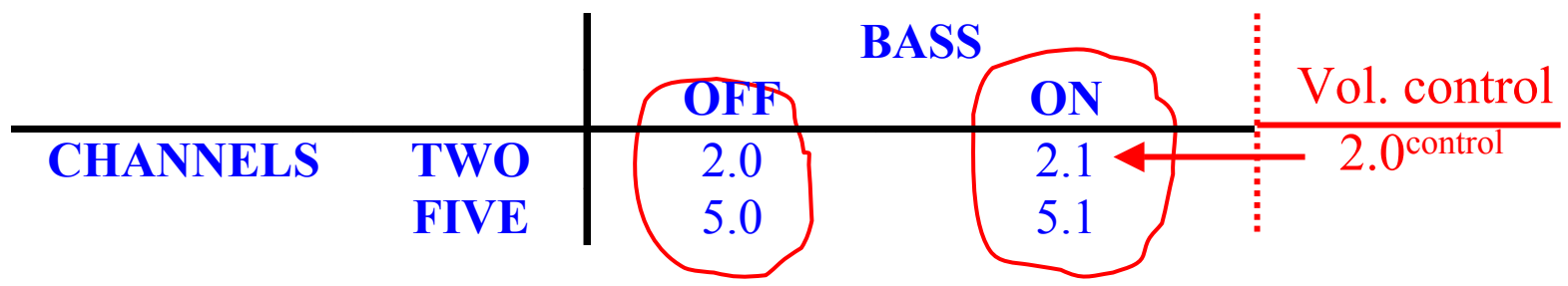
- ITC-Sense of Presence Inventory (ITC-SOPI: Lessiter et al., 2001)
 - 44 items each scored 1-5
 - Sense of Physical Space (19); Engagement (13); Ecological Validity (5); Negative Effects (6)
- Slater-Usoh-Steed 6-item presence rating scale (SUS6: e.g., Usoh et al., 2000)
 - 6 items each scored 1-7
- Audio Experience Questionnaire (AEQ: based on Gabrielsson & Lindstrom, 1985)
 - 11 items each scored 1-7
 - e.g., excitement, spaciousness/surrounding, full/complete, clarity, loudness, overall
- Preference rating
 - Nominate favourite trial

Audio Study A: Results

- ANOVAs revealed significant main effects of audio mix on:
 - ITC-SOPI: Engagement
 - SUS6 (same pattern for SUS3)
 - AEQ: Spaciousness/surrounding
 - Loudness
 - Volume-related discomfort
 - Enjoyment
 - Overall audio rating
- Planned contrasts for each significant main effect: **5.1 > stereo = mono**
- As predicted, 5.1 nominated significantly more frequently
- **BUT, results could be due to volume rather than number of channels**

Audio Study B

- Design: 2 factor (bass/channel) rep. measures (c/balanced random orders)



Volume matched:

2.1, 2.0^{control} and 5.1 (83/84dB SPL pink noise)

2.0 and 5.0 (70dB SPL)

- Method: 30 students/advert respondents (15M, 15F, 18-44yrs, 28 years)
- Stimulus: As before - rally car audio and visuals

Audio Study B

■ Measures:

- ITC-Sense of Presence Inventory (ITC-SOPI: Lessiter et al., 2001)
 - 44 items each scored 1-5
- Slater-Usoh-Steed 3-item presence rating scale (SUS3: e.g., Usoh et al., 2000)
 - 3 items each scored 1-7
- Media Experience Questionnaire (MEQ, extension of AEQ)
 - 18 audio and visual items each scored 1-7 (each item examined separately)
audio - excitement, spaciousness/surrounding, full/complete, clarity, loudness, overall
visual - uncomfortableness, depth/3-D, excitement, fidelity, enjoyable, overall
PLUS one overall audio/visual rating

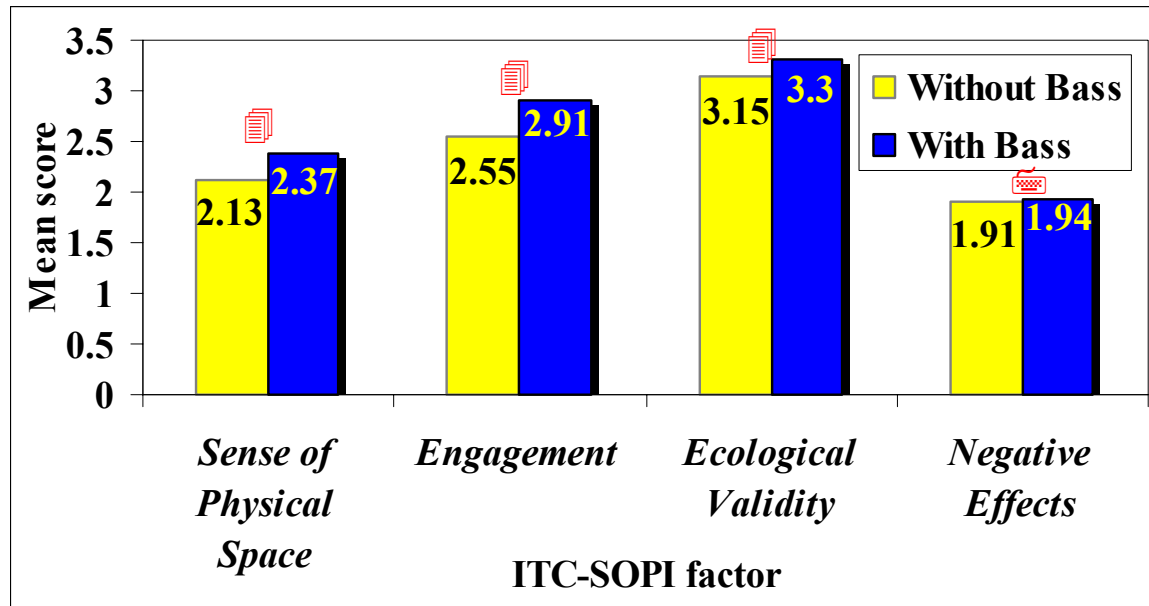
■ Analyses:

- Two factor (bass/channel) repeated measures ANOVAs
- Paired samples t-test to compare 2.1 with 2.0^{control}

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Audio Study B: ITC-SOPI Results

2 x 2 ANOVA results



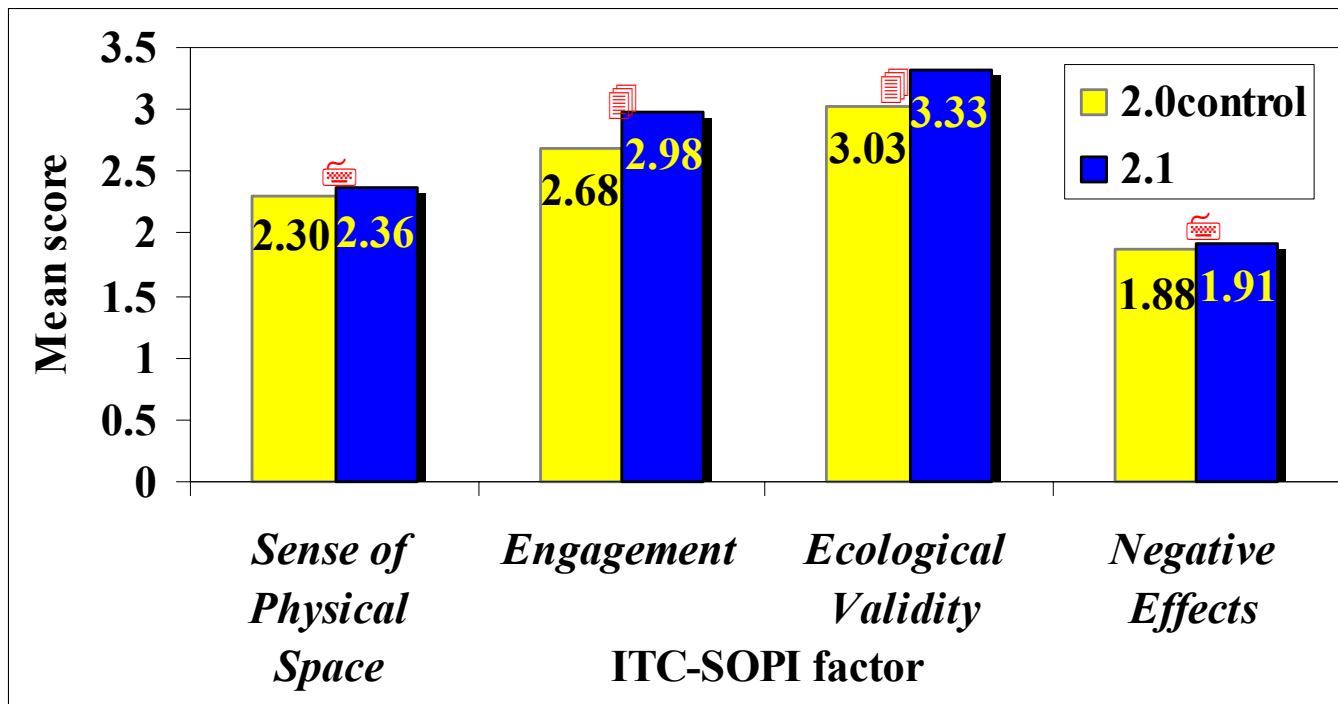
BASS: Sense of Physical Space, Engagement, Ecological Validity

CHANNEL: No significant main effects

BASS x CHANNEL: No significant interactions

Audio Study B: ITC-SOPI Results

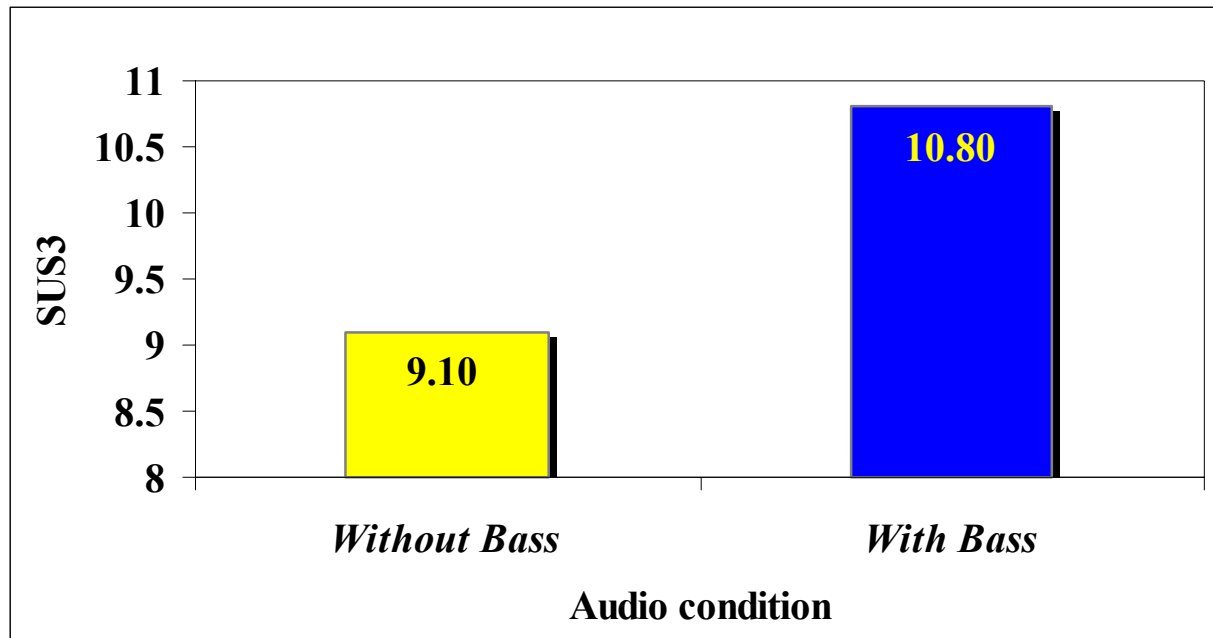
T-test (2.0^{control} vs. 2.1)



2.1 > 2.0^{control}: Engagement, Ecological Validity

Audio Study B: SUS3 Results

2 x 2 ANOVA result



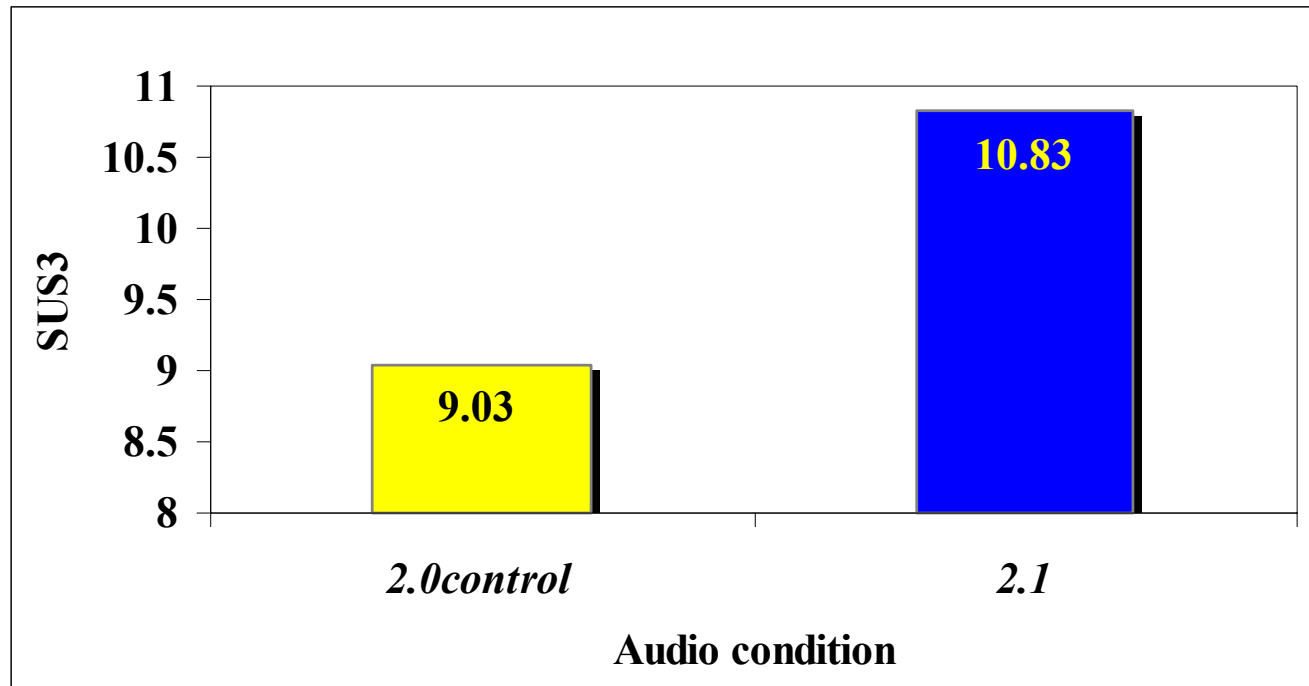
BASS: Significant main effect

CHANNEL: No significant main effect

BASS x CHANNEL: No significant interaction

Audio Study B: SUS3 Results

T-test result



2.1 > 2.0^{control} : Significant

Audio Study B: MEQ Results

•BASS Significant main effects for:

- 📄 Audio: excitement, spaciousness, fullness, clarity, loudness, volume-related discomfort, fidelity, enjoyment and overall audio
- 📄 Visual: a/v synchronicity, excitement, fidelity and enjoyment
- 📄 Overall Audio/Visual rating
- 🔊 Audio: audibility of extraneous sounds
- 🔊 Visual: uncomfortableness, depth/3-D, overall visual

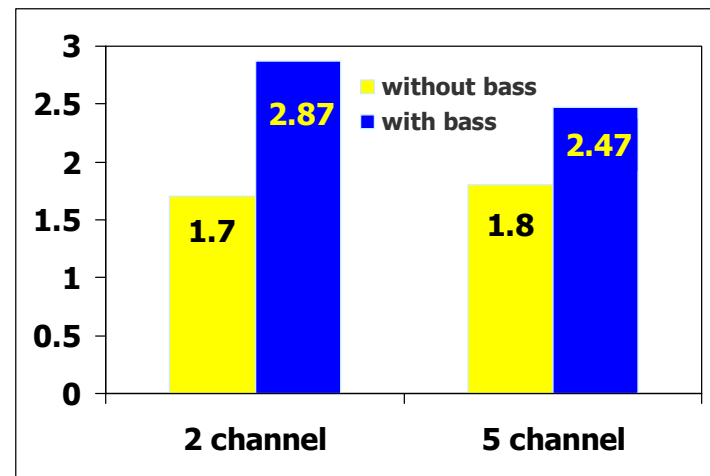
•CHANNEL Significant main effects for:

- 📄 Audio:enjoyment

•BASS x CHANNEL Significant interactions for:

- 📄 Audio:volume-related discomfort

•2.1 > 2.0^{control} No significant differences



Summary

- Study A revealed that 5.1 > mono or stereo for presence (Engagement and SUS6) and several audio quality ratings (enjoyment, spaciousness, overall audio). However, it was also rated as more loud and uncomfortable. Nevertheless, the 5.1 mix received more preference ratings. **BUT WHY?**
- Study B explored potential contributory factors - number of channels, bass and volume
- BASS resulted in higher presence ratings (Engagement, Ecological Validity and SUS3)
over and above increase caused by elevated volume
- VOLUME accounted for the increase in Sense of Physical Space and audio/visual quality ratings
- CONTRARY TO PREDICTION, 5 channel ~ 2 channel (except audio 'enjoyment')
 - **STIMULUS?**
 - **MIS-MATCH IN SIZE OR FIDELITY OF AUDIO AND VISUAL DISPLAYS?**

Conclusions

- Presentations with (rather than without) bass are more engaging and add to perceived naturalness and believability, but not to the sense of being a part of the displayed physical space
- No effect of surround sound on presence
 - Explore new stimuli for the effects of bass, channel and volume (content specific?)
- Are accurate phase differences essential?
- Differential sensitivity of ITC-SOPI scales to audio manipulations