1. BACKGROUND: DISTANCE PERCEPTION

For healthy sources (up to 1 m), in real anechoic space distance perception is:
- fairly accurate
- accurate for medial than lateral sources (Brunton, 1996)

Distance perception is better in reverberant space than anechoic, even for nearby sources (Sartelli, 2001)

HYPOTHESES

- reverberation will improve performance
- medial performance will be better than lateral (especially CORNER)

In rooms, there is a learning effect: distance performance improves with experience (Shinn-Cunningham, 2003)

Learning effects are present in different listeners locations in the same room (Kopco, 2003)

Examine learning effects on distance perception: is experience necessary for learning? Measure distance perception in simulated environments

1. EXPERIMENTAL PROCEDURES

- FIXED: environment is fixed throughout a run of 45 trials
- MIXED: room condition randomly selected from trial to trial
- nine distances presented randomly within run
- runs (45 trials) held direction (lateral / medial) fixed
- fixed河mixed河subjects
- room condition randomly selected from trial to trial
- two block types, differing in consistency of experience
- FIXED-MIXED group (there will be differences between subject groups)

Two subject groups
- MIXED (there will be differences between listener groups)
- fixed河mixed河 group

Three room conditions, differing in reverberation
Two sound source directions (medial and lateral)

2. CURRENT STUDY

Examine learning effects on distance perception: is experience necessary for learning?

Measure distance perception in simulated environments

Distance perception is better in FIXED block than MIXED block

- Reverberation improves distance perception: CENTER, CORNER better than ANECHOIC

HYPOTHESES

- FIXED results will be better than MIXED
- FIXED-MIXED group
- MIXED-FIXED group

Reverberation will improve performance
- Lateral performance is better than medial (especially without reverberation)

- Differences between the two eccentric conditions (CENTER, CORNER) is small
- performance is better in FIXED block than MIXED block
- mixed河fixed河 group

- transfer their experience (what cues are reliable?) even when simulated environments are intermingled
- reverberation improves distance judgements by an amount that will be larger than the corresponding difference in anechoic conditions
- learning in the FIXED block transfers to the MIXED block

3. METHODS

- median-eye experiment (30-40 cm)
- headphones presentations, simulating different source locations in the same room (Kopco, 2003)
- nine distances presented randomly within run
- runs (45 trials) held direction (lateral / medial) fixed
- six sessions
- subject indicated heard position on screen (Figure 1)
- subject河indicated河heard河position河on河screen河(Figure河1)

4. RESULTS - EFFECT OF ACOUSTIC ENVIRONMENT

Figure 2. Raw result: square of correlation coefficient between log of source and log of response distance. a) FIXED block

- difference is zero for MIXED-FIXED group
- difference is bigger for FIXED-MIXED than MIXED-FIXED group

- MIXED-FIXED subjects
- FIXED-MIXED subjects

- MIXED block
- MIXED block

- performance is better in FIXED block than MIXED block
- MIXED-FIXED group
- MIXED-FIXED group

- reverberation improves distance perception (CENTER, CORNER better than ANECHOIC)
- difference between the two eccentric conditions (CENTER, CORNER) is small

Figure 3. Effect of room consistency: difference in square of correlation coefficient (FIXED - MIXED)

- difference is positive (performance is better in FIXED block than MIXED block)
- difference is bigger for FIXED-MIXED than MIXED-FIXED group (order of blocks influenced results)

Figure 4. Effect of source direction: difference in square of correlation coefficient (lateral - medial)

- difference is zero for MIXED-FIXED group
- performance is sometimes better for lateral than medial sources
- reverberation improves distance judgements by an amount that will be larger than the corresponding difference in anechoic conditions
- learning in the FIXED block transfers to the MIXED block

5. RESULTS - EFFECT OF EXPERIENCE

LEARNING BETWEEN BLOCKS (REFER TO FIGURE 2)
- MIXED-FIXED group performs better than FIXED-FIXED group
- MIXED-FIXED group performs better than the MIXED-FIXED group
- + prior bad, inconsistent experience degrades performance when experience is consistent

WITHIN-BLOCK LEARNING
- no-measurable learning within MIXED block (changes too small to detect)
- + improvement measured in some FIXED block conditions

6. CONCLUSIONS

Consistent experience in a particular virtual environment allows listeners to:
- judge distance accurately in each environment
- improve performance slightly over time
- transfer their experience (what cues are reliable?) even when simulated environments are intermingled

Inconsistent experience (simulated environment change from trial to trial) causes:
- poor performance in all environments
- no improvements in performance with time
- listeners “give up” and do poorly even when experience is consistent later on

7. REFERENCES


