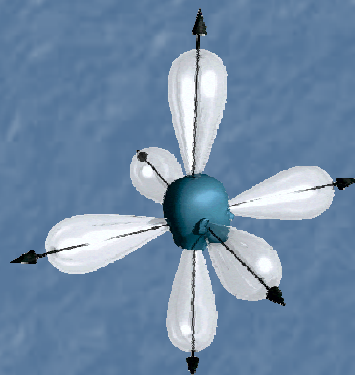# Spatial Perception and Expectations:

Factors in Acoustical Awareness for MOUT Training

Darin E. Hughes

Audio Producer – Research Associate

Institute for Simulation and Training – Media Convergence Lab

What I do

- Audio Producer:
  - Recording Engineer
  - Mixing Engineer
  - Mastering Engineer
  - Composer
  - Sound Designer
  - Audio for mixed reality
  - Freelance Engineer

- Research Associate:
  - Auditory Perception
  - Experiments in 3D audio
  - Pervasive sound systems
  - Science of sound design
  - Mixed reality audio

Why audio research is so important

- In combat, simulations, and training
  - 360 degrees
  - Hear through walls, around corners
  - Communication
  - Environmental recognition
  - Information carrying channels
  - Increased sense of presence

Artistic Research

- Crossing the boundary between art and science – by validating artistic technique

- How can sound design increase immersion and presence?

- Can we validate production techniques scientifically?
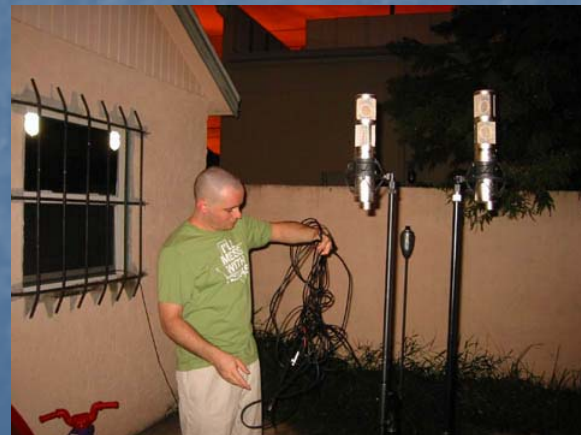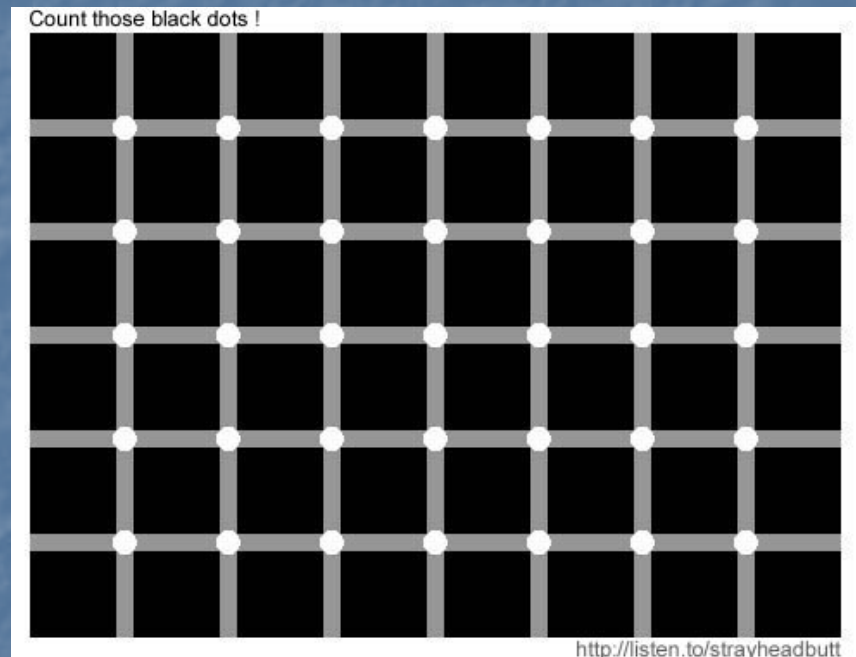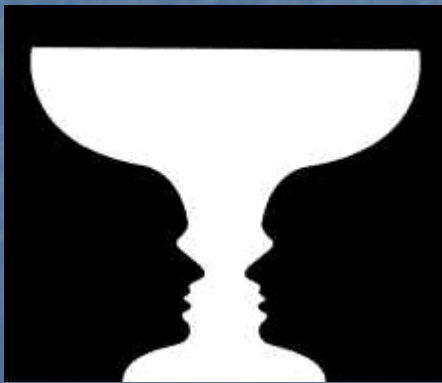
Expectations

- What factors contribute to our abilities to localize sounds?

- How much of localization depends upon emotional and psychological cues?

- Are you sure that airplane is above you?

Graphics and Perceptual Rendering

- Field of view
- Depth perception
- Color perception
- Direction of motion

Count those black dots !

http://listen.to/strayheadbutt

Purpose of Investigation

- Conduct initial study about expectations and spatial perceptions to:
  - Increase sense of presence
    - Improved sound design
  - Improve audio systems for simulation
  - Address efficiency and cost issues
  - Learn about biases that may impact combat situations (negatively or positively)

Method

- 21 students reporting normal hearing
- 10 sounds, 5 sec. clips, 80db
- Cakewalk Sonar for delivery
- 4.0 speaker arrangement, 5'7" high
- Speaker placement was masked

Method: Participant Evaluation Form

RESULTS

1 Airplane

H Start

4.80%	14.3	23.8
19	0	9.5
19	9.5	33.3

H Stop

66.6	14.3	4.8
9.5	0	0
14.3	4.8	0

V Start

80.9
14.3
4.8

V Stop

66.7
33.3
4.8

2 Pink Noise

52.4	47.6	14.3
9.5	0	0
9.5	19	0

47.6	42.9	9.5
9.5	0	0
9.5	19	0

61.9
38.1
4.8

57.1
38.1
4.8

3 Footsteps

47.6	9.5	0
38.1	0	0
42.9	0	0

38.1	9.5	0
33.3	0	0
23.8	9.5	0

42.9
33.3
23.8

28.6
52.4
19

4 Voice: "Hi"

23.8	33.3	14.3
14.3	23.8	0
9.5	0	0

14.3	23.8	19
4.8	23.8	0
4.8	0	0

71.4
28.6
0

71.4
28.6
0

5 Pink Noise

76.2	14.3	0
14.3	0	0
4.8	0	0

33.3	9.5	38.1
0	0	14.3
0	0	4.8

57.1
38.1
0

57.1
38.1
0

6 Helicopter

47.6	23.8	9.5
14.3	4.8	0
23.8	23.8	14.3

19	19	23.8
19	14.3	4.8
19	23.8	9.5

85.7
14.3
0

76.2
33.3
0

7 Car

4.8	4.8	19
0	4.8	52.4
0	9.5	47.6

0	4.8	42.9
0	4.8	42.9
0	14.3	28.6

19
76.2
9.5

19
76.2
9.5

8 Ocean

47.6	42.9	23.8
9.5	14.3	0
4.8	0	4.8

38.1	47.6	23.8
4.8	14.3	0
0	0	4.8

52.4
42.9
4.8

47.6
42.9
9.5

9 Dog

38.1	42.9	0
4.8	9.5	0
9.5	4.8	0

28.6	42.9	0
0	9.5	0
14.3	4.8	4.8

33.3
47.6
19

28.6
47.6
23.8

10 Thunder

95.2	0	0
19	0	0
9.5	0	0

95.2	0	0
9.5	0	0
9.5	4.8	0

61.9
33.3
9.5

| |
|---|
| 47.6 |
| 33.3 |
| 14.3 |

Conclusions

- Confounds:
  - Acoustic quality of room
  - Extraneous noise
  - Small number of subjects and sounds
- Nonetheless,
  - The results present good initial evidence that expectations do play a crucial role in our perception.

Current and Future Work

- Continuation of expectation studies:
  - More subjects
  - More sounds
  - Specific classifications of sounds
- Validating production techniques:
  - Surround Capture
  - Ambience techniques
- Audio engines and high-level interfaces
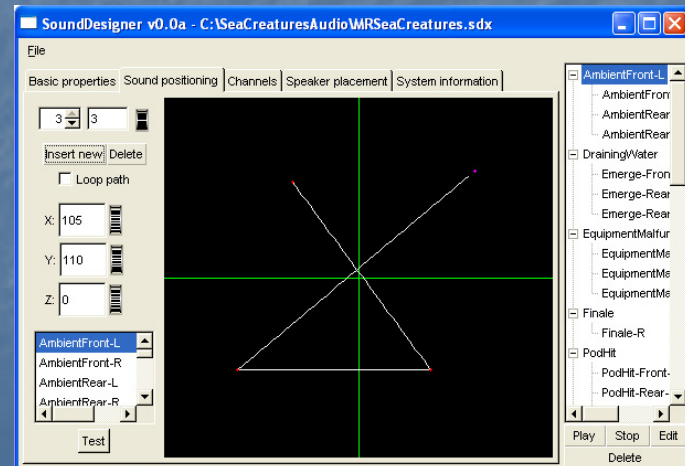
Thanks to

- RAVES (research in Augmented and Virtual Environments) – ONR/NRL
- US Army STO Embedded Training for Dismounted Soldier – RDECOM
- ARI, Orlando (Sc. & Tech. Training Ctr.)
- Canon MRL

Questions