Sound Locatability Tests

Comparative Locatability Tests of Warning Signals

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Sound Locatability Tests

- 4 Sounds:
  - BB   Broadband
  - MT   Multi-tone; 200 Hz intervals
  - TT   Triple-tone; 500 Hz, 1kHz & 2kHz
  - ST   Single-tone; 1kHz

Sound Locatability Tests

- 4 Sounds

- City of London Freeman's School

- In doors – simulate acoustic reflective

Sound Locatability Tests

- 4 Sounds

- City of London Freeman's School

- In doors

- Subjects
  - Age groups
    - 10 minors
    - 10 adults
  - 2 with known hearing loss

Age Group	#
Under 10	1
11 to 20	9
21-30	0
31-40	1
41-50	4
51-60	3
61+	2
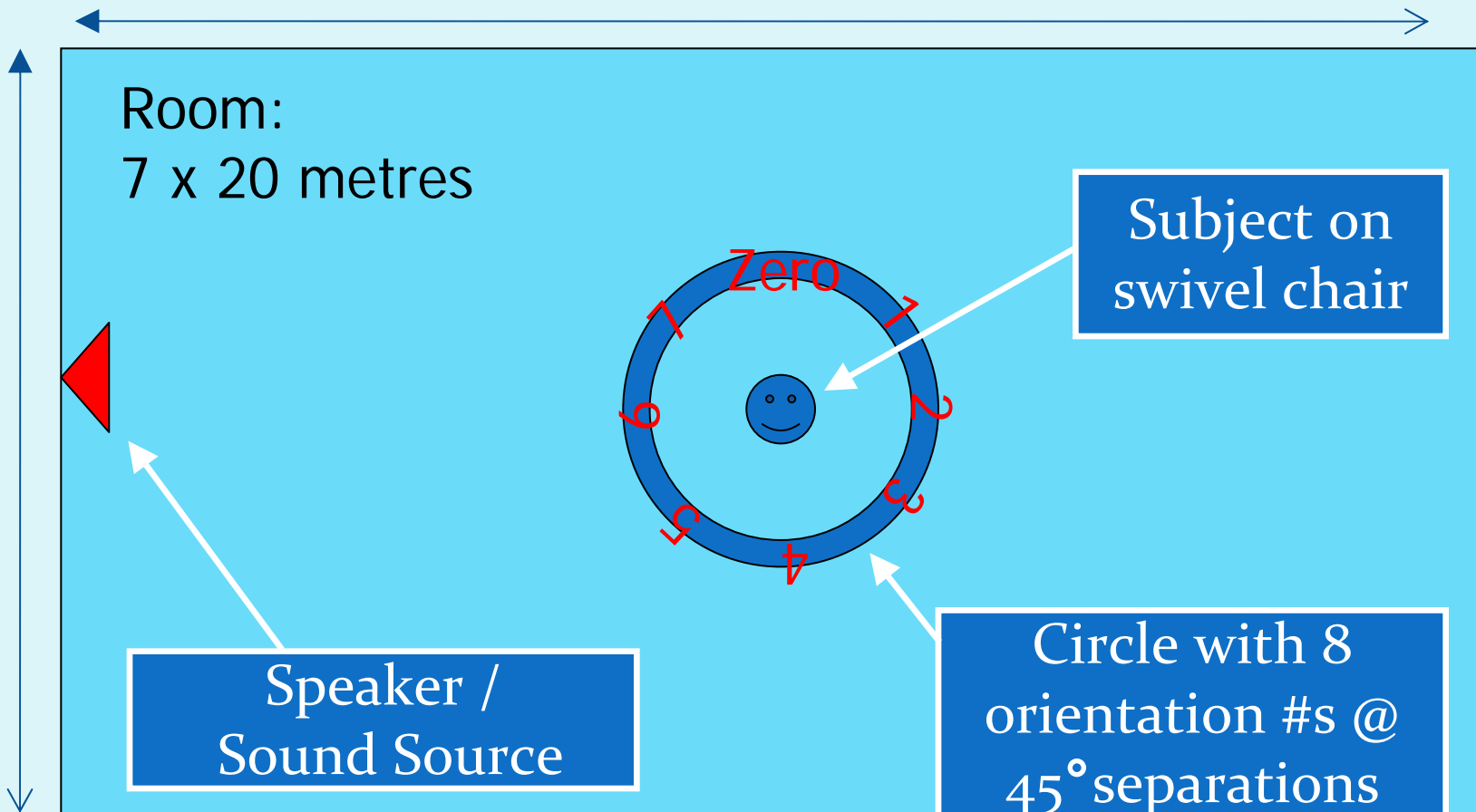
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Performance Factors

Room:
7 x 20 metres

Zero

Subject on swivel chair

Speaker / Sound Source

Circle with 8 orientation #s @ 45° separations

Performance Factors

- ## Ambient Noise:
  - ### Noisier ambient reduces response rate
  - ### Headphones:
    - #### subjects wore out-of-ear headphones:

    Does not block normal hearing
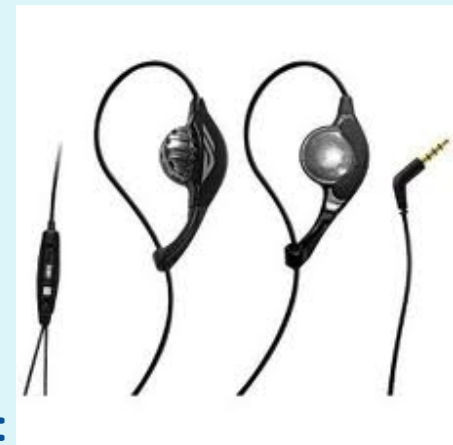

Type used:
AirDrives - Ambient Awareness

Performance Factors

- **Ambient Noise**
  - **Noisier ambient reduces response rate**
  - **Headphones**
    - **subjects wore out-of-ear headphones**
    - played high street sounds
    - SPL set at 60 dBA at the ear to simulate busy high street

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Performance Factors

- **Ambient Noise**
- **Random Results:**
  - In poor acoustic environment e.g.:
    - High ambient noise to signal ration
    - Ambient noise with sounds similar to signal
    - Acoustic reflective surfaces
  - Signal too quiet (low signal to noise ratio)
  - Poor locatable signal
  - Subject hearing impairment
  - Lack of attention / distraction; talking, on phone, sending SMS, listening to music

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Performance Factors

- **Ambient Noise**

- **Random Results (continued)**
  - Subject unable to locate the sound is likely to point in any direction or not at all; i.e.
    - 8 segments; if random each scores equally
    - 160 results for each sound
    - Maximum Random per sound = 160/8 = 20
  - "True Positive"; from results deduct:
    - 20 if high risk of random response
    - 0 if low risk of random response

Performance Factors

- **Ambient Noise**

- **Random** Results

- **Test Space**:

    - Different spaces give different results

    - Indoor tests:

        - Reflective surfaces

        - Likely poorer locatability results than outdoor "free field"

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Equipment

- 32 cards, each with unique combination:
  - an orientation #; zero to 7 (x 8) and
  - sound type (x 4)

    (Total = orientation # x sound type = 8 x 4 = 32)
- Speaker and lap top with 4 sound files –
  - Each sound file 1 second duration
- Swivel chair
- Blindfold
- Out-of-ear headphones with MP3 player

Set-Up

- Subject:
  - Blindfolded
  - wears headphones with MP3 player playing natural street sound at pre-set volume
  - sat on swivel chair
- Staff:
  - Controller (supervisor)
  - Assistant (plays sound files)
  - Recorder (records results)
  - Minder (manages subject)

Procedure

1. Controller selects card at random; shows minder, sound operator & assistant
2. Assistant records; orientation & sound type
3. Subject raises feet & minder turns chair in one, then other direction to disorientate subject
4. Minder stops subject facing orientation #, if minder between speaker and subject he/she moves to side
5. Sound played; 1 second
6. Subject immediately points at what is believe to be sound source
7. Minder calls closest direction # to direction subject points
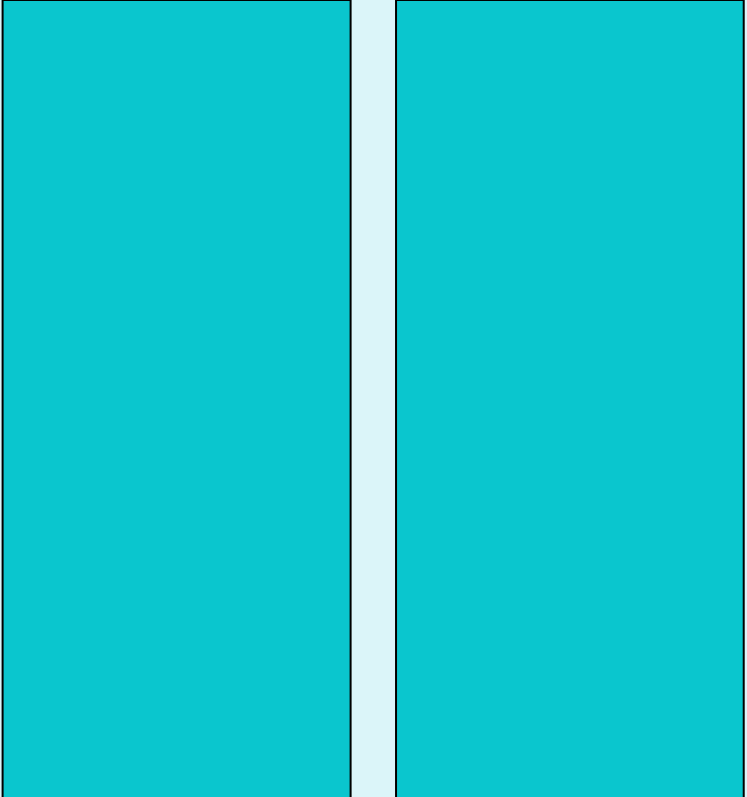8. Assistant recorders direction #

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Notes

- If subject is slow or cannot locate sound source scorer marks "- 2":
  - "-" to indicate no/poor response
  - "2" is 180 degree wrong direction
  - 2 x recorded in the 640 tests; 1 failure & 1 slow
- Test run:
  - Minder told to swivel subject and select at random orientation direction
  - Sound operator selects at random a sound
  - Result not recorded

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Sound Locatability Test

Sound	Total "on target"		
Broadband	83		
Multi-tone	73		
Triple-Tone	51		
Single Tone	48		

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Sound Locatability Test

Sound	Total "on target"
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Locatability

No Random Adjustment

% Better Than

14%	**MT**
63%	**TT**
73%	**ST**

Bar chart values: BB = 83, MT = 73, TT = 51, ST = 48

Sound Locatability Tests

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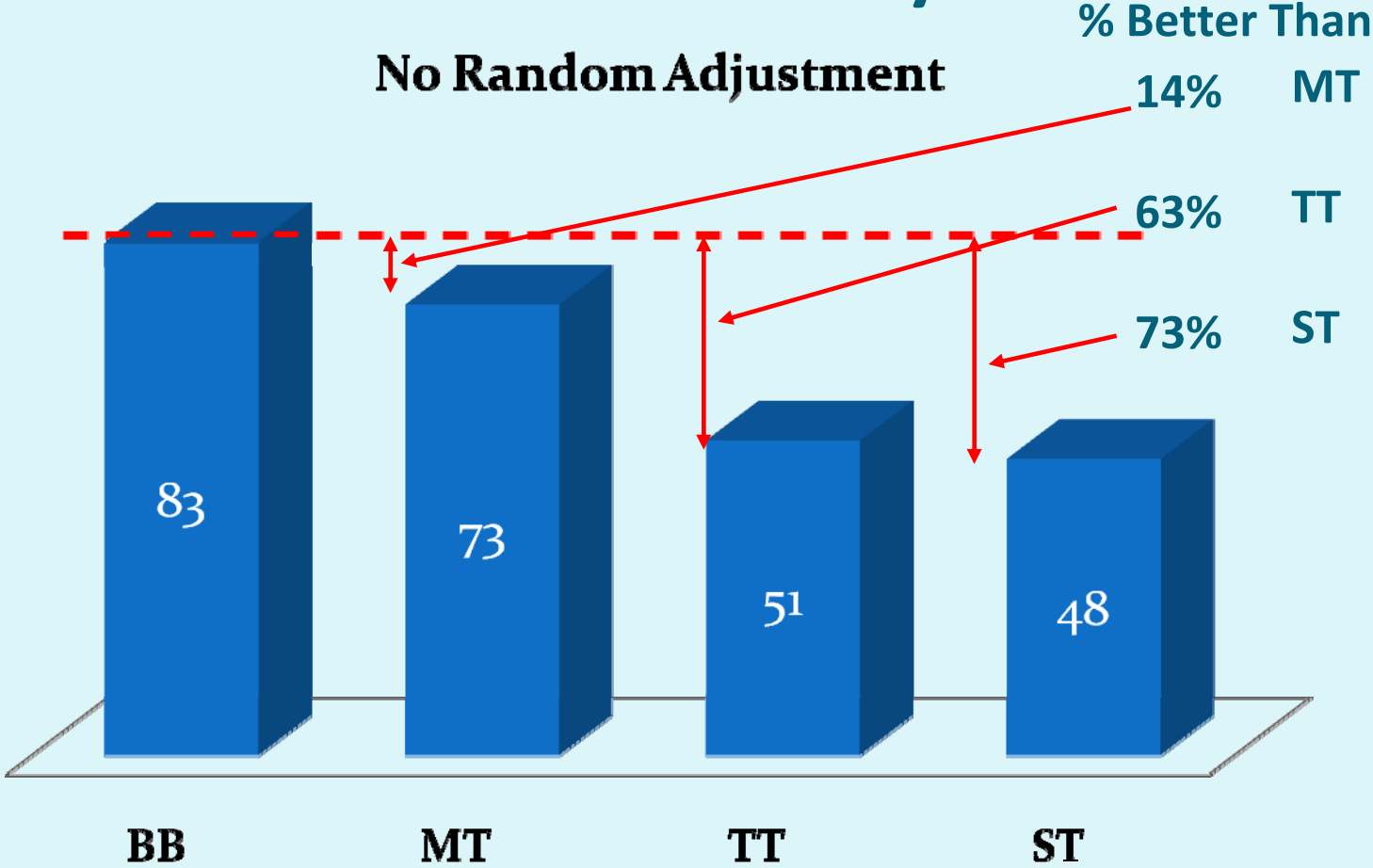
Locatability

Fixed Random

■ Random ■ Positive

63	53	31	28
20	20	20	20
BB	MT	TT	ST

% Better Than

19% **MT**

103% **TT**

124% **ST**

Sound Locatability Tests

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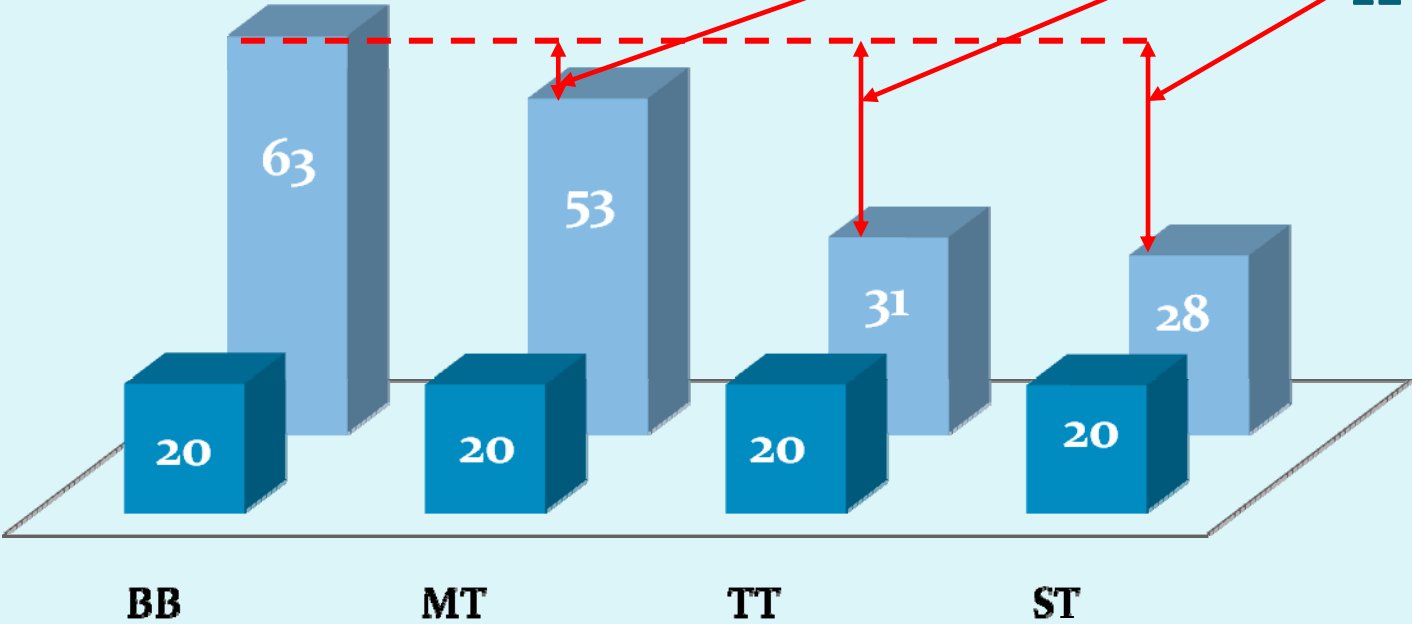
Locatability

Variable Random

■ Random ■ Positive

% Better Than

22% MT

102% TT

118% ST

83

68

41

38

0   5   10   10

BB   MT   TT   ST

Sound Locatability Tests
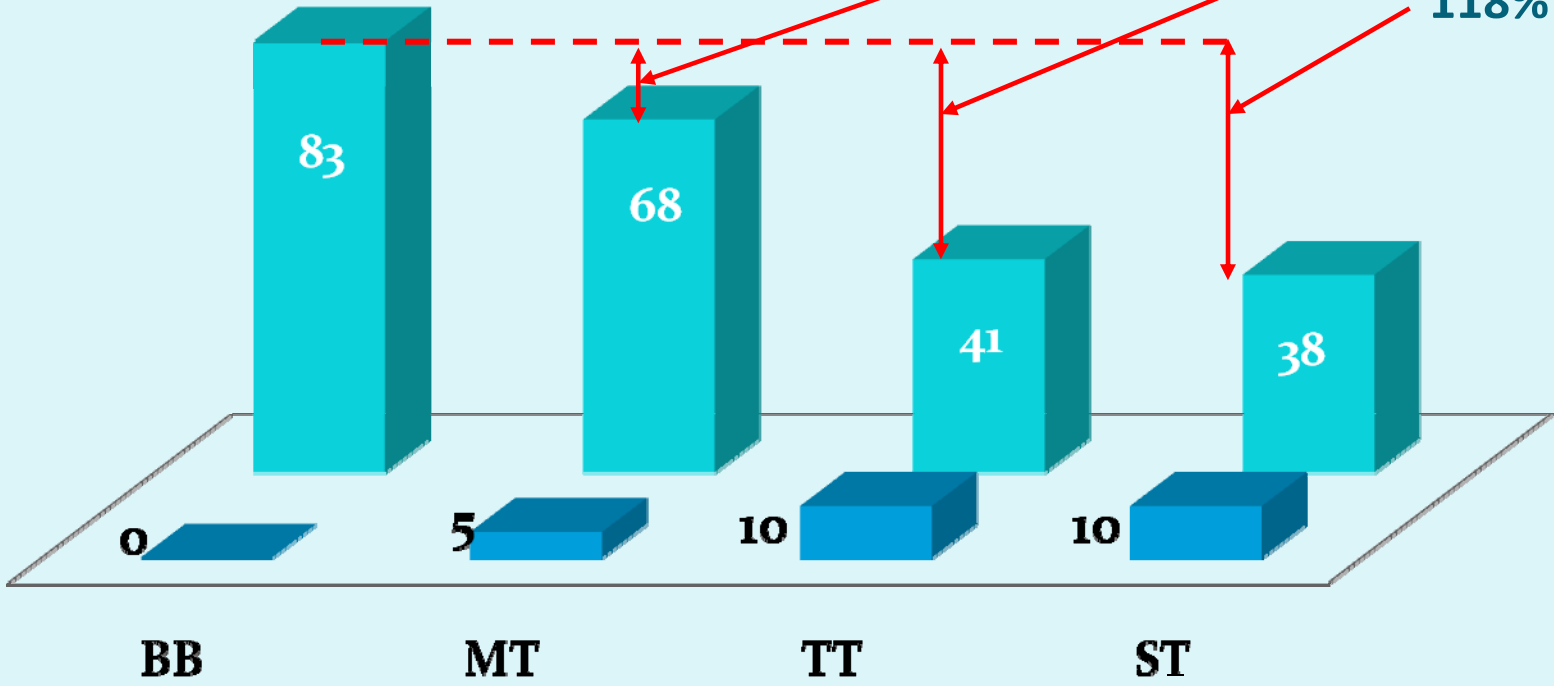
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Notes

- At Berlin meeting CLEPA undertook to also carry out tests on:
  - Attenuation
  - Directivity
  - Annoyance
- Unfortunately the extreme weather conditions at the end of last year prevented us from undertaking these.

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CLEPA is grateful to the City of London's Freemans School for their support and work with the sound locatability tests.

Any Questions?

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Multiple tone sound

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