Effects of learning on somatosensory and auditory decision-making and experiences: Implications for medically unexplained symptoms

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Have you ever thought someone was calling your name only to find that no-one was there?

felt a vibration and thought you received a text when you didn’t?

FALSE ALARMS!
Somatosensory signal detection task (SSDT)

Reference:
Correlate with symptom reporting\textsuperscript{2, 3}

Stable over time\textsuperscript{1}

Experimental analogue of MUS\textsuperscript{4}

MUS = Medically unexplained symptoms

References:
Persistent

Defy medical explanations

Debilitating

MUS

Cardiovascular symptoms

Bodily pain

Pseudoneurological problems

Gastrointestinal problems

Reference:
Prevalence rate of MUS:

- Survey in two general hospitals in southeast London: 52% (1)

Treatment cost:

- £3 billion in 2008-2009 (10% of total NHS expenditure; 2)
- Total: Over £14 billion

References:
Background:

Training → Reduces somatosensory false alarms → Decrease symptom reporting (1)

Perceptual learning

Transferred within the same modality (2, 4)
Transferred across different modality (2, 3)
Cross-modal transfer did not occur (4, 5)

References:
Research questions:

1. Can people be trained to make more false alarms on the SSDT?
2. Can the tendency to false alarm on the SSDT be reduced?
3. Will training-induced change in false alarm rate persist over time?
4. Will changes in false alarm rate affect similar perceptual experiences such as spontaneous sensations in the body and voice hearing?
Previous research findings:

- McKenzie et al. (2012) used associative learning paradigm to train participants but failed to increase the false alarm rate on the SSDT.
- An alternative approach would be to use operant conditioning principles.

Reference:
Conditioning Procedure:

To increase FAs:
• Reward hits
• Punish misses

To decrease FAs:
• Reward correct rejections
• Punish false alarms
Spontaneous sensation test:

- Be relaxed; focus all over your body; try to identify if you feel any automatic sensation.
- Duration of a trial: 20 seconds
Voice Detection Task:

- Nonsense Voices appeared randomly against a continuous background white noise.
- Amplitude: both threshold and suprathreshold (based on a pilot study).
- Participants pressed the spacebar every time they thought they heard a voice.
Study 1 & 2: Design and Procedure

**CONTROL condition** (both studies)

1. Baseline voice detection task
2. Baseline Spontaneous Sensation Test
3. Baseline SSDT (2 x 80 trials)

**EXPERIMENTAL condition**
Identification of high and low false alarmers

4. Sham SSDT training (4 x 80 trials; pseudo winning and losing of points)
5. Follow-up voice detection task
6. Follow up Spontaneous Sensation Test
7. Follow-up SSDT (2 x 80 trials)

**STUDY 1** (False alarm increasing study)
Baseline false alarm rate < .15

4. Manipulation SSDT (4 x 80 trials)
   - Won 5 points for hits
   - Lost 5 points for misses

**STUDY 2** (False alarm decreasing study)
Baseline false alarm rate ≥ .15

4. Manipulation SSDT (4 x 80 trials)
   - Won 5 points for correct rejections
   - Lost 5 points for false alarms

**Study 1:** n = 75 (41 control participants)
**Study 2:** n = 76 (37 control participants)
SSDT Findings of Study 1 (Training to Increase False Alarms):

\[ F(1.54,112.17) = 18.21, \ p < .0001, \ \eta^2_p = .20 \]

\[ F(1.84,134.38) = .386, \ p = .663, \ \eta^2_p = .005 \]
SSDT findings of Study 2 (Training to decrease false alarms):

Log transformed false alarm rate

$F(1.78, 131.56) = 32.62, \ p < .0001, \ \eta^2_p = .306$

Square root transformed sensitivity

$F(1.72, 127.60) = 2.00, \ p = .146, \ \eta^2_p = .03$
Voice detection task:

Study 1
(False alarm increasing study)

Study 2
(False alarm decreasing study)

- There was no effects of the training on the spontaneous sensation task performance.
Correlational Analyses:

<table>
<thead>
<tr>
<th>Variables</th>
<th>SSDT baseline FA in light present condition</th>
<th>SSDT baseline FA in light absent condition</th>
<th>Total voice</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSDT baseline FA in light absent condition</td>
<td>.651****</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total voice</td>
<td>.164*</td>
<td>.262***</td>
<td></td>
</tr>
<tr>
<td>Voice FAs</td>
<td>.171*</td>
<td>.214**</td>
<td>.514****</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01, *** p < .005, **** p < .001.

- The spontaneous sensation task did not correlate significantly with the SSDT or voice detection task.
Conclusion:

- Somatosensory misperception can be changed with training.
- Sensory modalities seem to share common perceptual decision-making processes.
- The findings that perceptual distortions and decision-making processes underlying cross-modal perception could be changed with training might have important implications for the management of medically unexplained symptoms.
Thank You