AUTONOMIC RESPONSE AND AUDITORY SENSITIVITY IN RELATION TO COMMONLY REPORTED MISOPHONIC TRIGGER SOUNDS

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Overview

- What is Misophonia?
  - Introduction
  - Recent Studies
- Hypotheses
- Methods and Materials
- Procedure
- ECG Recordings
- Results
- Conclusion
Introduction-What is Misophonia?

- “Hatred of Sound”
- Jastreboff and Jastreboff 2001
  - noticed patients labeled as phonophobic were not actually afraid of sounds, but displayed decreased sound tolerance and an aversion or dislike, of certain, quiet, sounds.
- Edelstein, Brang, Rouw, & Ramachandran 2013
  - Chronic condition in which every day, quiet, repetitive sounds, provoke strong autonomic arousal and emotional responses.
- Few studies have tried to define misophonia and its causes.
  - no broadly used scale or criteria to formally diagnosis
Misophonia Triggers

- Quiet, everyday repetitive sounds
  - *Chewing, Sighing, Breathing, Clicking, etc.*
- Not just sounds
  - *visual stimuli as long as the image is directly related to the trigger sound.*
- Varying levels of severity
- Avoidance of situations
Introduction

- Dozier (2015)
  - Classical Conditioning Theory
Introduction - Neuro Condition?

  - *Physiological response of participants to certain auditory stimuli*

- Skin Conductance Response (SCR)
  - *participants were exposed to aversive stimuli (auditory, visual, and combined) to show presence of emotional reactions.*
  - *Misophonic participants showed increased SCR responses to only auditory triggers*
  - *Suggests and supports the theory of misophonia being a neurological disorder involving the auditory and autonomic pathways.*
Table 1 | Summary of qualitative data gathered from interviews of the 11 misophonic subjects (4 males and 7 females, mean age = 35.82; range = 19–65) in Experiment 1, broken down into 18 of the most salient diagnostic categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
</table>
| Age of onset                    | 8–10 years old (3)–27%  
As long as can remember (3)–27%  
Childhood (3)–27%  
17 (1)–9%  
Early teenage years (1)–9%       |
| Worst trigger sounds            | Eating/chewing/crunching sounds (11)  
Lip smacking (2)  
Pen clicking (2)  
Clock ticking (2)   |
| Other trigger sounds            | Low frequency bass sounds (8)  
Pen clicking (4)  
Footsteps (3)  
Finger tapping (3)  
Whistling sounds (3)  
Typing (3)  
Lip smacking (2)  
Clock ticking (1)  
Plastic bags (1)  
Repetitive barking (1)  
Finger tapping (1)  
Sniffing (1) |
Autonomic Nervous System

- Involuntary mediation
  - *Internal organs and blood vessels*

- Sympathetic vs. Parasympathetic
  - **“speed up” for danger**
    - Constricting blood vessels, Increase BMP, Relax airways
  - **“slow down” for vegetative activities**
    - Slow BPM, Constrict airways, Constrict pupils

- Relation of Misophonia?
  - *Increased heart rate*
  - *Skin temperature change?*
Auditory Pathway

- **Sound**
  - *Audible pressure changes in the air*
  - *Frequency 20 Hz- 20,000 Hz*
  - *Intensity*

- **Outer Ear**
  - *Pinna*
  - *Canal*

- **Middle Ear**
  - *Ossicles*
  - *Oval Window*

- **Inner Ear**
  - *Cochlea*
  - *Auditory Vestibular Nerve*

Diagram:

1. Auditory Receptors in Cochlea
2. Brain Stem Neurons
3. MGN
4. Auditory Cortex
Purpose and Hypothesis

- To try and identify an underlying cause of misophonia through comparison of audio sensitivity, autonomic system responses, and survey measurements.
  - Goal is to identify a potential link of misophonia to an auditory system abnormality or a relation to the neurological processes of regulating the autonomic responses.

- H1: Participants who score higher on the misophonic scales will have a decreased skin temperature, increased BPM, and increased audio sensitivity.

- H2: Participants who demonstrate misophonic tendencies will have more items indicated as frustrating on the sound survey, a higher Misophonia Activation Scale score, and will have an overall decreased mood (increased negativity/decreased positivity).
  - Trait vs. State
Methods

- Participants
  - N=21

- Equipment
  - ECG recordings with LabChart
  - Skin Temperature with LabChart
  - Stimuli sounds presented with SuperLab 4

- Stimuli
  - Common trigger sounds
  - Free recordings from YouTube.com
Trigger Sounds Stimuli

- 4 sets
  - *Calm: 18.5 s brown noise*
    - Silence breaks included

- 3 sets
  - *3 triggers in each of the 3 sets*
    - Totaled 70s (300ms breaks)

<table>
<thead>
<tr>
<th>Set 1</th>
<th>Set 2</th>
<th>Set 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chip Crunching</td>
<td>Pen Clicking</td>
<td>Eating/Smacking</td>
</tr>
<tr>
<td>Heavy Breathing</td>
<td>Wrapper Crinkling</td>
<td>Coughing</td>
</tr>
<tr>
<td>Finger Nail Clipping</td>
<td>Drinking/Gulping</td>
<td>High Heel Clicking</td>
</tr>
</tbody>
</table>
Trigger Stimuli Examples

Brown Noise

Eating Trigger

Pen Click Trigger
Questionnaires

- Demographics
  - Age, gender, race, class, major, hearing disorder

- NPMS-SF
  - 17 moods
  - Current mood
  - Pre and post

- Sound Survey
  - Specific to sounds

- A-MISO-S
  - Adapted
  - Activation score for misophonia
A-MISO-S

1. How much of your time is occupied by **sounds that irritate you?** (How frequently do the thoughts about irritating sounds occur?) Circle your rating.

| None | 0 |
| Mild, Less than 1hr/day (occasional thoughts about sounds; no more than 5 times a day.) | 1 |
| Moderate, 1 to 3 hrs/day (frequent thoughts about sounds; more than 5 to 8 times a day.) | 2 |
| Severe, greater than 3 hrs/day up to 8hrs/day (very frequent thoughts about sounds.) | 3 |
| Extreme, greater than 8hrs/day (near constant thoughts about sounds.) | 4 |

2. How much do irritating sounds interfere with your social or work functioning? (Do sounds prevent you from normal functioning/ impair your performance?)

| None | 0 |
| Mild, slight interference (with social or occupational activities, but overall performance not impaired.) | 1 |
| Moderate, definite interference (but still manageable.) | 2 |
| Severe (substantial impairment in social or occupational performance.) | 3 |
| Extreme (incapacitating.) | 4 |

- Adaptation to take away “misophonic sounds”
- Clarification for student level
Procedure

- Audio Sensitivity
  - 20Hz- 20kHz
  - 4 spacebar indication
  - Averaged

- Break/explanation

- ECG recording with stimulus presentation
  - ECG electrode placement
  - Temperature measure

- End surveys and debrief if needed
ECG Recording-Ideal

- Participant #515

Skin Temperature

Trigger Set

Calm Set

Smoothed BPM

BPM

°C
ECG Recording-Typical Patterned Response

- Participant #506
ECG Recording-No Response

- Participant #505
Analysis and Results

- LabChart Reader, Excel, and SPSS

- Physiological Measures:
  1. Skin Temperature (rate of change and difference between sets)
     - Rate of Change: change of temperature over time in the different sets
  2. Heartrate (average BPM and difference between sets)
  3. Audio Sensitivity (average high and low ranges)

- Qualitative Measures:
  1. Activation Scale Scores
  2. Current Mood State (negativity and positivity subset changes)
  3. Sound Survey Items (# items rated “3” or above)
<table>
<thead>
<tr>
<th></th>
<th>Diff_Temp</th>
<th>Set_rate</th>
<th>Avg_low_audio</th>
<th>Avg_high_audio</th>
<th>Sound_3_and_above</th>
<th>Activation_Score</th>
<th>Change_in_Neg</th>
<th>Change_in_positive</th>
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<tbody>
<tr>
<td>Diff_Temp</td>
<td>Pearson Correlation</td>
<td>0</td>
<td>0.403</td>
<td>-0.242</td>
<td>-0.457*</td>
<td>-0.13</td>
<td>-0.148</td>
<td>0.162</td>
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<tr>
<td>Set_rate</td>
<td>Pearson Correlation</td>
<td>0.403</td>
<td>0</td>
<td>0.091</td>
<td>-0.374</td>
<td>0.257</td>
<td>0.101</td>
<td>0.335</td>
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<td>-0.242</td>
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<td>0</td>
<td>-0.192</td>
<td>0.481*</td>
<td>0.217</td>
<td>-0.439*</td>
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<td>Avg_high_audio</td>
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<td>-0.457*</td>
<td>-0.374</td>
<td>-0.192</td>
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<td>-0.238</td>
<td>-0.08</td>
<td>0.078</td>
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<td>Pearson Correlation</td>
<td>-0.13</td>
<td>0.257</td>
<td>0.481*</td>
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<td>0.335</td>
<td>-0.439*</td>
<td>0.078</td>
<td>-0.026</td>
<td>0.075</td>
<td>0</td>
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<tr>
<td>Change_in_positive</td>
<td>Pearson Correlation</td>
<td>0.349</td>
<td>-0.134</td>
<td>0.09</td>
<td>-0.149</td>
<td>0.192</td>
<td>-0.598**</td>
<td>-0.263</td>
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</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).
- Diff.Temp + Avg.High.Audio  -0.457 - Variable

- Activation.Score + Change.in.positive -0.598 - Increase score = decrease positivity

- Sound.3_and_above + Avg.Low.Audio 0.481 - Increase in items = increasing sensitivity

- Avg.Low.Audio + Change.in.neg -0.439 - Decrease in low sensitivity = increase in negativity change
### Paired Samples Statistics

<table>
<thead>
<tr>
<th>Pair</th>
<th>Metric</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
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</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td>Calm_rate</td>
<td>0.2998</td>
<td>21</td>
<td>0.40231</td>
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<td>0.39365</td>
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<td>Pair 2</td>
<td>Calm_BPM</td>
<td>81.8848</td>
<td>21</td>
<td>12.15112</td>
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### Paired Samples

<table>
<thead>
<tr>
<th>Pair</th>
<th>Metric</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
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</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td>Calm_rate - Set_rate</td>
<td>-0.09608</td>
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<td>0.018</td>
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<td>Calm_BPM - Set_BPM</td>
<td>-0.01286</td>
<td>-1.03724</td>
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<td>20</td>
<td>0.979</td>
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<td>Pair 3</td>
<td>Avg_Calm - Avg_Set</td>
<td>0.04476</td>
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<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Std. Error Mean</td>
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<tr>
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<td>----------------</td>
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<td></td>
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<tr>
<td>Change_in_Neg</td>
<td>21</td>
<td>-0.0952</td>
<td>3.57638</td>
<td>0.78043</td>
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<td>Change_in_positive</td>
<td>21</td>
<td>-1.4762</td>
<td>2.71328</td>
<td>0.59209</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
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</thead>
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<tr>
<td>Change_in_Neg</td>
<td>-0.122</td>
<td>20</td>
<td>0.904</td>
<td>-0.09524</td>
<td>-1.7232 - 1.5327</td>
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<td>Change_in_positive</td>
<td>-2.493</td>
<td>20</td>
<td><strong>0.022</strong></td>
<td>-1.47619</td>
<td>-2.7113 - -0.2411</td>
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</table>
Conclusions

- The t-tests do prove that the stimuli are working and causing at least a few physiological changes.
  - *Temperature Change Pattern indicates that the misophonic trigger sounds did influence the participants on a physiological level.*
  - *Rise in temperature due to stress mechanism and not simple heart fluctuations.*

- Emotionality Changes from Triggers
  - *Positive subset significant change*

- Perhaps not all correlations are directly related to misophonia
  - *Average Low Audio may be distinct from misophonia*
  - *Sound and Activation not measuring same thing (short term vs. long term)*

- Some Correlations do fit with the theory and help support the hypotheses and direction of current misophonia research.

- Perhaps the physiological measures relate to other processing mechanisms as well
  - *How fast a person takes to “ramp up” and calm down*
Acknowledgement

- I would like to thank the Roanoke College Department of Psychology for providing support, equipment and facilities for this project. Thanks is also extended to Dr. David Nichols for advising the empirical portion of this study and providing resources and knowledge. Thank you to Dr. Angela Allen for advising me in the literature review independent study and to Caitlin Morse for acting as a researcher and providing assistance.
References


Questions?