Etiology and Research on Misophonia: How it Develops and Expands

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Misophonia Association Convention
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Brief History of Misophonia

- 1997, Audiologist Marsha Johnson (tinnitus treatment clinic)
  - Soft Sound Sensitivity Syndrome or Selective Sound Sensitivity Syndrome (4S)
  - Inability to tolerate specific soft sounds
- 2001/2002, Pawel and Margaret Jastreboff (tinnitus experts)
  - Misophonia
    - Miso – hate or dislike
    - Phonia – sound
- Viewed as an auditory phenomenon – treatment domain of audiologists
- 2011, New York Times Article, “When a Chomp or a Slurp is a Trigger for Outrage”
- 2013, Schröder et al., Misophonia: Diagnostic Criteria for a New Psychiatric Disorder
- 2013, Edelstein et al., Misophonia: Physiological Investigations and Case Descriptions
Misophonia – Genetics vs. Experience

• Genetic factors – YES
  – Emotional sensitivity
  – Sensory sensitivities
  – Anxiety
  – Strong-willed
  – It runs in my family (genetics)

• Experience factors – YES
  – Trauma (some “yes”, most “no”)
  – Stress in family life (some “yes”, some “no”)
  – It runs in my family (experience)
  – Personal stories report specific experiences (few “yes”, most “no”)
    • Most don’t remember
We are all alike. It must be genetic.

- Trigger sounds: mouth and nose sounds
- Onset: late childhood or early teens
- Emotions: anger, rage, and disgust
We are all alike. It must be genetic.

- Trigger sounds: mouth and nose sounds
- Onset: late childhood or early teens
- Emotions: anger, rage, and disgust
Auditory Triggers

• 1,000+ solicited from online misophonia groups
  – 96% - Mouth sounds, such as chewing, crunching food, lip smacking, slurping, tongue clicking, or throat clearing
  – 83% - Breathing sounds, such as gasping, wheezing, sniffing, or other loud mouth sounds
  – 67% - Mechanical sounds made by hand, such as keyboard clicking, pen clicking, pencil tapping, crinkling paper, or nail clipping
  – 59% - Foot sounds, such as tapping, stomping, shuffling, or squeaking shoes
  – 59% - Hand sounds, such as finger snapping, tapping, or rubbing
  – 38% - Mechanical sounds without people involved, such as clock ticking, copy machine noise, or phone ringing
  – 37% - Joint sounds, such as knuckle cracking
  – 31% - Speech sounds, such as consonant sounds (s, k, p, etc.) or mispronunciation of words
  – 28% - Other sounds
Visual Triggers

- 1,000+ solicited from online misophonia groups
  - 78% - Open mouth chewing
  - 47% - Leg jiggling
  - 41% - Jaw movement
  - 37% - Repetitive hand movement such as twiddling thumbs
  - 23% - Single hand movement such as touching face or pointing
  - 17% - Hair twirling

- 92% reported visual triggers
Other Triggers

- Other
  - Feeling vibration, such as bumping a desk
  - Odors (wintergreen gum, toothpaste, perfume)
  - Touch from another person
  - Vibration from bass

- Virtually any repeating sight, sound, or sensation can be a trigger for someone

  - Repetitive tapping was same rate as eating sounds
We are all alike. It must be genetic.

- Trigger sounds: mouth and nose sounds
- Onset: late childhood or early teens
- Emotions: anger, rage, and disgust
Survey of individuals with misophonia
- n = 1061
- Recruited online
- Age 18 and older
- 82% female
- No significant difference in male vs. female

Rate of Onset of Misophonic Population

- Rate of onset per year calculated as #-onset-[age] / #-participants-[age]-or-older
- Plot is average of yearly onset rates for each age range.
We are all alike. It must be genetic.

- Trigger sounds: mouth and nose sounds
- Onset: late childhood or early teens
- Emotions: anger, rage, and disgust
Emotions of Misophonia

- Anger
- Anxiety
- Desire to escape
- Rage
- Hate the person
- Disgust
- Fear
- Sadness

- Despair or hopelessness
- Guilt
- Resentment
- Offended
- Revenge
- Verbal aggression
- Physical aggression
- Physical harm
Emotions were grouped
- Anger = aggravation, irritation, annoyance, frustration, anger, or rage

Most emotions were mild
- Irritation, mild disgust, annoyance

100% reported an emotional response to at least 1 trigger.

<table>
<thead>
<tr>
<th>Emotional Response</th>
<th>Number of People (n=26)</th>
<th>% of People</th>
<th>Number of Tests (n=76)</th>
<th>% of Trigger Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td>24</td>
<td>92.3%</td>
<td>57</td>
<td>75.0%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>24</td>
<td>92.3%</td>
<td>32</td>
<td>42.1%</td>
</tr>
<tr>
<td>Desire for Escape</td>
<td>14</td>
<td>53.8%</td>
<td>23</td>
<td>30.3%</td>
</tr>
<tr>
<td>Disgust</td>
<td>12</td>
<td>46.2%</td>
<td>17</td>
<td>22.4%</td>
</tr>
<tr>
<td>Fear</td>
<td>6</td>
<td>23.1%</td>
<td>9</td>
<td>11.8%</td>
</tr>
<tr>
<td>Sadness</td>
<td>4</td>
<td>15.4%</td>
<td>5</td>
<td>6.6%</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>34.6%</td>
<td>9</td>
<td>11.8%</td>
</tr>
<tr>
<td>None</td>
<td>8</td>
<td>30.8%</td>
<td>15</td>
<td>19.7%</td>
</tr>
</tbody>
</table>

Emotional Responses to Weak Triggers (Dozier & Morrison, 2017)
In the News: April 17, 2015 (ABC, CNN, and Fox News)

**Woman booted from flight for stabbing seatmate with pen**

Lenny Mordarski, 68, attacked by 64-yr-old woman.
Misophonia is...

- A form of Sensory Processing Disorder (SPD, sensory over-responsivity)?
- A form of Obsessive Compulsive Disorder (OCD)?
- A symptom of autism spectrum disorder (ASD)?
<table>
<thead>
<tr>
<th>Comorbid Disorder</th>
<th>Lifetime Formal Diagnosis (N=1101)</th>
<th>Perceived Present Condition (N=1118)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mood disorder (depression, clinical depression, bipolar disorder)</td>
<td>45.0%</td>
<td>34.9%</td>
</tr>
<tr>
<td>Anxiety disorder (panic disorder, phobia, other anxiety disorder)</td>
<td>34.2%</td>
<td>36.9%</td>
</tr>
<tr>
<td>Obsessive-Compulsive disorder</td>
<td>12.2%</td>
<td>17.4%</td>
</tr>
<tr>
<td>Tinnitus (ringing in the ears)</td>
<td>11.4%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Post traumatic stress disorder (PTSD)</td>
<td>10.8%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Attention deficit hyperactivity disorder (ADHD)</td>
<td>10.6%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Sensory processing disorder or sensory over-responsivity (SPD)</td>
<td>5.1%</td>
<td>16.3%</td>
</tr>
<tr>
<td>Excoriation (compulsive skin picking)</td>
<td>2.6%</td>
<td>8.2%</td>
</tr>
<tr>
<td>Body Dysmorphic disorder</td>
<td>2.5%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Autism spectrum disorder (including Asperger's and PDD)</td>
<td>2.5%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Trichotillomania (compulsive hair pulling)</td>
<td>1.5%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Tourette's disorder</td>
<td>1.2%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Other</td>
<td>4.7%</td>
<td>3.2%</td>
</tr>
<tr>
<td>None (except misophonia)</td>
<td>38.2%</td>
<td>27.5%</td>
</tr>
</tbody>
</table>
Misophonia is...

- A rare disorder?
Prevalence of Misophonia

- Dozier 2013 Survey Monkey sample vs FB group sample: 15.1%
- Jastreboffs 2014: 3.2% (based on tinnitus prevalence and clinic patients)
- Wu et al. 2014: 19.9% of undergraduate psychology students reported “clinically significant misophonia”
  - No gender difference
- Cash dissertation 2015: 18.4% (undergraduates); 13.5% (community)
  - No gender difference for prevalence
  - Women reported greater severity
- 23andMe.com 2015: “Does the sound of others chewing fill you with rage?”
  - Yes = 19%
  - No = 77%
  - Not sure = 4%
- Zhou, Wu, & Storch 2017: Survey of Chinese undergraduate students. 16.6% reported “clinically significant misophonia”
Misophonia Is Like an Avalanche

- Watch video https://www.youtube.com/watch?v=BpNxRsIoN58
  - The snowboarder survived.

- Flood of emotions, fight-or-flight, distress, horrible physical feelings, overwhelming
Misophonia Is Like an Avalanche

- Where did it start?
Misophonia Is Like an Avalanche

- Where does avalanche start?
  - Invisible, small slip of snow
- Start is minor compared to avalanche
- We focus on the snow crashing down the hill
- Misophonia: We focus on the experience
  - All after the initial events
What is wrong with me? What can I do?

- I feel horrible
- I have a high fever
- I have a headache
- I am weak
- I am tired
- I don’t want to eat
What is wrong with me? What can I do?

- I feel horrible
- I have a high fever
- I have a headache
- I am weak
- I am tired
- I don’t want to eat
- Treatment Options
  - Antibiotics prescribed by doctor
  - Acetaminophen and ibuprofen and get lots of rest
What is wrong with me? What can I do?

- I feel horrible
- I have a high fever
- I have a headache
- I am weak
- I am tired
- I don’t want to eat

Treatment Options
- Typhoid (bacterial)
  - Antibiotics prescribed by doctor
- Flu (viral)
  - Acetaminophen and ibuprofen and get lots of rest
Neuroplasticity

“Neurons that fire together wire together.”
Donald Hebb, neuropsychologist

(Experience becomes integrated with outcomes.)
Example - Infants

- Holding/cuddling – relaxes infant
- Rocking – relaxes infant
- Touch – relaxes infant
- Mother talks to baby

- Baby fusses – mother talks – baby relaxes
- Happens the 1st day!
Example – Tom (me)

- 4 distinct unpleasant, varied events with dogs
- Age 21, I reached to pet dog’s head – bite – heart races
- Reach to pet dog’s head – heart races
Misophonic Emotions – Kumar

- Sukhbinder Kumar (2015) conference presentation
  - fMRI study

- vmPFC (ventromedial prefrontal cortex)
  - Known to be involved in regulation of emotions
  - Acts as gas pedal or breaks for emotions

- vmPFC – associative learning emotions
  - neutral stimulus→positive, neutral stimulus→negative
  - Conditioned Emotional Response (CER)
Misophonic Emotions – Kumar

- Anterior insular cortex (AIC)
  - Integrates internal and external stimuli
    - Interoceptive (internal states/stimuli)
    - Exteroceptive (taste, touch, hearing, smell and sight) senses
  - Subjective feeling of emotions

- High activity
  - Anterior insular ↔ hippocampus
  - Anterior insular ↔ amygdala
Connection of vmPFC and Anterior Insula

- For non-misophonic individuals
  - vmPFC puts breaks on emotions
- For misophonic individuals
  - vmPFC boosts emotions

Source: Kumar et al. (2017). The Brain Basis for Misophonia. *Current Biology*
Conclusions – Kumar

- “In misophonic subjects... the connectivity between vmPFC and anterior insula is positive, indicating that vmPFC, rather than regulating, is boosting the activity of anterior insula.”
- “Given the role of vmPFC in learning associations, our data is consistent with the view that aberrant associations represented in vmPFC drive areas involved in emotion processing.”

Plain English
- Misophonia emotions are Conditioned Emotional Responses
- They develop through experience with the triggers
- Emotions are an involuntary response
Edelstein, Brang, Rouw, Ramachandran (2013)

- Response (SCR) to a variety of stimuli (misophonic, neutral, positive)
  - 6 participants, 5 controls
- SCR response validated the report of extreme emotional responses
Presenting Condition

- Viewed as an emotional response disorder

- More accurately
Personal Examples

- Remembering developing their first trigger
  - Girl classmate sniffing
  - Bill and mockingbirds
  - John (teenager) and brother breathing

- Behavior when developing their trigger matched their reflex
  - Karen (age 48) and asthma
  - Carla (age 10) and brother at
  - Connor (age 24), Marine in Afghanistan
Dozier & Morrison, 2017
26 people
Weak triggers
2 auditory triggers and 1 visual trigger
Wide variety of responses
100% has a physical response to 1 or more triggers
30% physical but no emotion
15% emotion but no physical
Reflex is invisible to others!

<table>
<thead>
<tr>
<th>Initial Physical Response</th>
<th>People (n=26)</th>
<th>% of People</th>
<th>Trigger Tests (n=76)</th>
<th>% of Trigger Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulders</td>
<td>13</td>
<td>50.0%</td>
<td>26</td>
<td>34.2%</td>
</tr>
<tr>
<td>Arms/Hands</td>
<td>11</td>
<td>42.3%</td>
<td>24</td>
<td>31.6%</td>
</tr>
<tr>
<td>Neck</td>
<td>9</td>
<td>34.6%</td>
<td>17</td>
<td>22.4%</td>
</tr>
<tr>
<td>Chest</td>
<td>5</td>
<td>19.2%</td>
<td>8</td>
<td>10.5%</td>
</tr>
<tr>
<td>Back</td>
<td>5</td>
<td>19.2%</td>
<td>8</td>
<td>10.5%</td>
</tr>
<tr>
<td>Abdomen</td>
<td>4</td>
<td>15.4%</td>
<td>8</td>
<td>10.5%</td>
</tr>
<tr>
<td>Jaw</td>
<td>3</td>
<td>11.5%</td>
<td>5</td>
<td>6.6%</td>
</tr>
<tr>
<td>Thighs</td>
<td>2</td>
<td>7.7%</td>
<td>4</td>
<td>5.3%</td>
</tr>
<tr>
<td>General tensing</td>
<td>2</td>
<td>7.7%</td>
<td>3</td>
<td>3.9%</td>
</tr>
<tr>
<td>Sexual</td>
<td>2</td>
<td>7.7%</td>
<td>2</td>
<td>2.6%</td>
</tr>
<tr>
<td>Warmth</td>
<td>2</td>
<td>7.7%</td>
<td>5</td>
<td>6.6%</td>
</tr>
<tr>
<td>Toes</td>
<td>2</td>
<td>7.7%</td>
<td>3</td>
<td>3.9%</td>
</tr>
<tr>
<td>Stomach/Nausea</td>
<td>2</td>
<td>7.7%</td>
<td>2</td>
<td>2.6%</td>
</tr>
<tr>
<td>Breath</td>
<td>2</td>
<td>7.7%</td>
<td>2</td>
<td>2.6%</td>
</tr>
<tr>
<td>Torso</td>
<td>2</td>
<td>7.7%</td>
<td>3</td>
<td>3.9%</td>
</tr>
<tr>
<td>Head</td>
<td>2</td>
<td>7.7%</td>
<td>2</td>
<td>2.6%</td>
</tr>
<tr>
<td>Face</td>
<td>1</td>
<td>3.8%</td>
<td>1</td>
<td>1.3%</td>
</tr>
<tr>
<td>Numb sensation</td>
<td>1</td>
<td>3.8%</td>
<td>1</td>
<td>1.3%</td>
</tr>
<tr>
<td>Various</td>
<td>8</td>
<td>30.8%</td>
<td>10</td>
<td>13.2%</td>
</tr>
</tbody>
</table>
Validation of Reported Initial Physical Response

• Misophonia: Evidence for an Elicited Initial Physical Response
  – Tom Dozier, Leighton Grampp, Michelle Lopez

• Research objective:
  – To validate an elicited muscle flinch using direct observation in individuals with misophonia

• General Methodology:
  – Expose person to recorded neutral and misophonic stimuli
  – Visual observation of response on person’s body
  – Electromyography recording of muscles (3 channels)
Results – Bonnie, auditory stimulus
Results – Bonnie, visual stimulus
Theory of How Misophonia Develops (etiology)

- A stimulus occurs (99% of time a sound)
- An emotions occurs in response to sound
- A physical response occurs (usually tensing a muscle)
- Experience (sound) becomes integrated with outcome (muscle tenses)
  - Sound → Annoyance → Muscle flinch
  - Sound → Annoyance → Muscle flinch
  - Trigger → Muscle flinch → Annoyance
  - Trigger → Muscle flinch → Annoyance
  - Trigger → Muscle flinch → Anger
  - Trigger → Muscle flinch → Anger
  - **Trigger → Muscle flinch → Rage**
Examples of Acquired Muscle Reflexes

- Dr. Eugene Lipov, M.D.
  - Trauma center surgeon with pager
- Doctors with pagers survey
  - “Did you develop a unique, distinct physical response to your pager such as a muscle flinch or tingling? (Did you have a physical sensation when the pager went off?)”
  - 6 yes, 4 no
- Professional with stressful phone calls (chest muscles, leg)
- Friend on 3-yr overseas assignment and phone
- Julie Theobald and chemotherapy
Misophonia Emotions

- Pain Induced Aggression
- Sprague-Dawley rats (docile)
- Rats shocked through floor of cage
- Rats immediately attacked each other (brief, <1s)

How Misophonia Strengthens and Expands

- Gets worse when triggered repeatedly (and miso-distress)
- Triggered -> phy & emo reflexes -> stronger phy & emo resp.
- Tense when there may be triggers -> stronger miso-response
- New triggers – stimuli paired with triggers
  - Crinkle – crunch (crinkle becomes a trigger)
How Misophonia Strengthens and Expands

- Stimulus (similar to a trigger) → new trigger or new source (person)
- Stimulus → some emotions/flinch → new trigger (40%)

- Neurons that fire together wire together.
- Experience becomes integrated with outcomes.
- Brain plasticity at its worst
How Misophonia Declines

- Break the miso-strengthen cycle
- Effective treatment
- Relax when entering a trigger situation $\rightarrow$ reduced responses
- Triggered (relaxed) $\rightarrow$ weaker phy & emo reflexes $\rightarrow$ weaker phy & emo responses
How Misophonia Declines

- Relax initial physical reflex muscle before a trigger → reduced future response
  - Session tomorrow on Progressive Muscle Relaxation

- Neurons that fire together wire together.
- Experience becomes integrated with outcomes.
- Brain plasticity at its best
Conclusion

- Misophonia is a condition that develops through experience
  - Brain plasticity
- Enabled, enhanced, and complicated by genetic factors
- Specific triggers and physical reflex for each person
- Spreads to other sounds, sights, and sources
Conclusion

- Results from a normal neurological process (same as the baby)
- Sensory experience becomes integrated with outcomes.
- Can develop at any age
- Can develop again even if all triggers are eliminated
- Learn to relax when stressed -> reduces risk of developing misophonia again
- Relaxing before and through triggers -> reduces misophonia severity
  - Muscle relaxation training tomorrow at 11:15am
Thank you!

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